BRITISH ANTARCTIC ("TERRA NOVA") EXPEDITION, 1910.

NATURAL HISTORY REPORTS.

ZOOLOGY. VOL. I.

VERTEBRATA

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PREFACE

THE "Terra Nova" Expedition (1910–13), under the command of the late Captain R. F. Scott, R.N., C.V.O., will ever be remembered for the journey to the South Pole which ended in the death of the leader and his four brave companions. But, in spite of this disaster, the expedition accomplished all that it set out to do. It was thoroughly equipped for scientific purposes, in both men and material, and the programme of scientific work was carried out in full.

The biologist in charge of operations on the ship was Mr. D. G. Lillie, M.A., to whose skill and energy the large and valuable marine collections are mainly due. On the outward and homeward voyages from England to New Zealand fine-meshed tow-nets were put overboard whenever possible, and seventy plankton samples were obtained; in addition two hauls were made with the trawl, one near the Falklands, at a depth of 125 fathoms, and one off Rio de Janeiro, at a depth of 40 fathoms. The winter cruise (July 10th to October 10th, 1911) round the Three Kings Islands and to the north of New Zealand produced biological results of great importance; eighty plankton samples were obtained, and the seven hauls made with trawl and dredge at depths of 15 to 300 fathoms revealed a bottom-fauna of extraordinary variety, including a great number of forms new to science. Between New Zealand and McMurdo Sound one hundred and thirty-five samples of plankton and fifty of muds and oozes were obtained; in the Ross Sea and in McMurdo Sound fifteen rich hauls with the trawl, at depths of 40 to 300 fathoms, produced a collection which has added greatly to our knowledge of the Antarctic marine fauna.

In this work on the ship several officers helped. Mr. Lillie also wishes to acknowledge the assistance in trawling and in winding up plankton nets given, often out of working hours, by Seamen A. S. Bailey, A. Balson, W. L. Heald, J. Leese, M. McCarthy, T. F. McLeod, and T. S. Williamson. Seaman McLeod also mended nets; others who should be mentioned are Boatswain A. Cheetham, who helped with the trawl and supplied tackle, Carpenter F. E. C. Davies, who made frames for nets, and Chief Engineer W. Williams, who repaired trawl frames and other iron gear.

In addition to the trawling and tow-netting Mr. Lillie paid special attention to whales, recording all those seen from the ship. In October 1911 he visited the Whaling Station at Whangamumu, near the Bay of Islands, and in 1912 he spent four months (July to October) in the same region on two floating factories belonging to the New Zealand Whaling Company. He is the author of the Report on the Cetacea (Zoology, Vol. I, No. 3).

That accomplished naturalist and skilful artist, the late Dr. E. A. Wilson, was the chief biologist of the shore party; he was mainly responsible for the collection of Birds, the report on which will include many reproductions of the sketches he made. Dr. Wilson, with the late Lieutenant H. R. Bowers and Mr. A. Cherry-Garrard, undertook a most arduous and hazardous winter journey to the Emperor Penguin Rookery at Cape Crozier, to secure eggs with a series of early embryos, material that is now in the hands of Professor J. Cossar Ewart, F.R.S. Staff-Surgeon G. Murray-Levick, R.N., made numerous observations on the habits of the Adélie Penguin, and has written a report on this subject (Zoology, Vol. I, No. 2) illustrated by photographs that he took. Surgeon-Captain E. L. Atkinson, R.N., parasitologist to the expedition, collected and studied numerous parasites, the Antarctic material being taken chiefly from seals and fishes during the winter of 1911. The results of his work appear in the Report on Parasitic Worms (Zoology, Vol. II, No. 3) prepared by him in conjunction with Dr. R. T. Leiper, F.R.S.

PREFACE

Further details of the scientific work done by the expedition will be found in "Scott's Last Voyage" (Smith, Elder & Co., 1913).

When the collections reached England arrangements for working out many of the groups were made, and it was decided to issue the Zoological Reports from time to time, as they were ready for publication. The subject-matter was distributed provisionally among as many volumes as seemed likely to be required, the first to include the Vertebrates, the second the Molluscs and Worms, and the third the Arthropods. These three volumes have now been closed, and the outstanding reports on these groups will appear in other volumes of the series.

C. TATE REGAN,
Keeper of Zoology.

19*th January* 1924.

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BRITISH MUSEUM (NATURAL HISTORY).

BRITISH ANTARCTIC ("TERRA NOVA") EXPEDITION, 1910.

NATURAL HISTORY REPORT.

ZOOLOGY.

THE Trustees of the British Museum have undertaken the publication of the Natural History results of the British Antarctic Expedition, 1910, conducted by the s.s. "Terra Nova," under the command of the late Capt. R. F. Scott, R.N., C.V.O. Arrangements for working out most of the groups collected have already been made.

Mr. C. Tate Regan's Memoir on Fishes is the part which is ready for publication first. It may be useful to explain that it is proposed to issue the Zoological Reports, from time to time, as they are ready for publication. By adopting this method the delay which results from waiting until a volume is completed may be avoided; but, on the other hand, a natural sequence of subjects can hardly be maintained.

The plan that will be adopted will be to distribute the subject-matter provisionally among as many volumes as seem likely to be required. No attempt will be made to complete a volume before commencing the publication of its successor; and two or more volumes may accordingly be in process of publication concurrently. When a volume has reached a convenient size it will be completed by the issue of a title-page and table of contents.

SIDNEY F. HARMER,
Keeper of Zoology.

BRITISH MUSEUM (NATURAL HISTORY),
LONDON, S.W.
June 27, 1914.

FISHES.

BY C. TATE REGAN, M.A.

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I.—SYSTEMATIC PART.

1. THE ANTARCTIC FISHES.

THE collection includes examples of twenty-five species, twelve of which have been described as new to science in a preliminary note (Ann. Mag. Nat. Hist. (8) XIII, 1914, pp. 11–14), four of these being new generic types. This large proportion of new forms is doubtless due to the fact that the bulk of the collection was dredged at depths varying from about 50 to 250 fathoms. All but three of the species belong to the group Nototheniiformes, and the additions to our knowledge of the genus *Trematomus*, the Harpagiferinae and the Chaenichthyidae, are of considerable importance. A new genus of the Bathydraconidae resembles the northern Cottid *Icelus* in its armature of spinate bony plates, and the first Antarctic species of *Paraliparis* is of interest.

MYCTOPHIDAE.

1. *Myctophum antarcticum*, Günth.

55° 6′ S., 120° 3′ W., surface.

MURAENOLEPIDAE.

2. *Muraenolepis microps*, Lönnb. (Pl. II, fig. 2).

Muraenolepis marmoratus microps, Lönnberg, Swedish S. Polar Exped. Fish., p. 43 (1905).

Depth of body 6 in the length, length of head 4½. Length of snout 3, diameter of eye 5 in length of head, equal to or a little less than interocular width, much greater than interorbital width. Barbel $\frac{1}{5}$ or $\frac{1}{6}$ length of head. Maxillary extending to below anterior part or middle of eye. Dorsal filament (absent in one specimen) longer than diameter of eye, inserted a little behind base of pectoral. Anal origin only a little in advance of middle of length of fish. Pectoral $\frac{1}{2}$ to $\frac{3}{5}$, pelvics $\frac{3}{4}$ length of head. Greyish.

Here described from two specimens, 130 and 140 mm. in total length, from off new land south of the Balleny Islands; depth 200 fathoms.

These seem to belong to the same species as a small fish (55 mm.) from the South Sandwich Islands, which is doubtless identical with Lönnberg's *M. microps* from South Georgia. *M. marmoratus*, Günth., from Kerguelen, has a somewhat deeper body and shorter head, larger eye, shorter barbel and dorsal filament. *M. orangiensis*, Vaill., from Magellan, seems to be more slender and to have a smaller head and longer barbel than either of the other species, from which it differs also in the much longer tail, more than $1\frac{1}{2}$ as long as the rest of the fish.

NOTOTHENIIDAE.

Nototheniinae.

Trematomus, Bouleng.

The known species of this genus number fourteen (or thirteen if *T. dubius* be the young of *T. vicarius*), from the coasts of the Antarctic Continent and South Georgia. In addition to three new species the "Terra Nova" obtained examples of two formerly placed in *Notothenia*, enabling me to examine the pectoral arch and to assign them to their correct position.

Synopsis of the Species.

I. Upper surface of head naked.

A. Cheeks and opercles fully scaled.

Interorbital width $3\frac{1}{3}$ to 5 in length of head. D. VI–VIII, 32–38. A. 32–36 . . *newnesii.*

Interorbital width 8 or 9 in length of head. D. IV, 37. A. 32–33 . . . . *nicolai.*

B. Cheeks and opercles scaly above, naked below.

D. V–VI, 34–37. A. 31–33 . . . . *borchgrevinkii.*

D. IV–V, 30–33. A. 29–30 . . . . *brachysoma.*

II. Occiput scaly; cheeks and opercles fully scaled.

A. Interorbital region naked, or incompletely scaled. D. IV-VI, 33–38. A. 31–35.

Interorbital region naked, or with a single median series of scales; diameter of eye 3 (young) to $4\frac{1}{3}$ (adult) in length of head; 60 to 75 scales in a longitudinal series *bernacchii.*

Interorbital region with two or three series of scales in the middle; diameter of eye $4\frac{2}{3}$ (adult) in length of head; 56 to 59 scales in a longitudinal series . . . . . *vicarius.*

Interorbital region naked; diameter of eye $3\frac{2}{3}$ (young) in length of head; 55 scales in a longitudinal series . . . . *dubius.*

B. Interorbital region fully scaled; praeorbital naked.

1. 60 to 75 scales in a longitudinal series, 34 to 46 in upper lateral line.

D. VI–VII, 36–41. A. 33–36 . . . . *hansoni.*

D. V–VII, 31–35. A. 31–35 . . . . *loennbergii.*

2. 52 to 56 scales in a longitudinal series, 30 to 36 in upper lateral line. D. v–vi, 32–35. A. 29–32.
   - Dorsal spines flexible . . . . *pennellii.*
   - Dorsal spines pungent . . . . *centronotus.*

C. Interorbital region fully scaled; praeorbital scaly.
   - Snout and lower jaw naked. D. iv–vi, 31–34. A. 29–32. 46 to 54 scales in a longitudinal series . . . . *scotti.*
   - Snout and lower jaw scaly. D. vi–vii, 31–33. A. 34–36. 70 to 80 scales in a longitudinal series . . . . *lepidorhinus.*
   - Snout and lower jaw scaly. D. vi, 35–36. A. 33–34. 70 scales in a longitudinal series . . . . *eulepidotus.*

3. *Trematomus brachysoma*, Pappenh. (Pl. ii, fig. 3).

A specimen of 170 mm. in total length, stranded on an ice floe in 67° 24′ S., 177° 34′ W. A water-colour sketch made by Mr. Lillie shows the body purplish gray, and the fins blue, with the dark spots of the same tint as the colour of the body.

4. *Trematomus bernacchii*, Bouleng. (Pl. i, fig. 1).

Cape Evans and off Cape Adare, 45 to 50 fathoms; bottom shingle.

5. *Trematomus hansoni*, Bouleng. (Pl. i, fig. 2).

A large number of examples of this and the preceding species were caught in 1911 at the winter quarters, Cape Evans, by means of a fish trap made of wire netting stiffened by iron hoops and bars, which was lowered through holes in the ice. It was noted that when a new hole was tried one or two good catches would result, and then no more at all, perhaps because the attention of Weddell Seals had been attracted. The fish were eaten and had a distinctly sweetish taste.

Three water-colour sketches were made by Dr. Wilson to show the natural coloration; two of these are reproduced on Plate I.

6. *Trematomus loennbergii*, Regan.

Trematomus loennbergii, Regan, Trans. R. Soc. Edinburgh, xlix, 1913, p. 263, pl. viii, f. 4.

Depth of body 4 to 5 in the length, length of head 3 to $3\frac{3}{4}$. Diameter of eye 3 to $3\frac{1}{2}$ in length of head, interorbital width 6 to 10. Maxillary extending to below anterior $\frac{1}{4}$ or $\frac{1}{3}$ of eye; upper surface of head to nostrils, cheeks and opercles scaly. 10 to 13 gill-rakers on lower part of anterior arch. Dorsal v–vii, 31–35. Anal 31–35. Pectoral nearly as long as head; pelvics reaching anal. Caudal rounded or subtruncate. Caudal peduncle as long as or longer than deep. 60 to 75 scales in a longitudinal series, 34 to 46 in upper lateral line; lower lateral line, when developed, sometimes with as many as 15 tubules. Body with irregular dark cross-bars.

Several examples up to 190 mm. in total length, from off new land south of the Balleny Islands, at a depth of 200 fathoms, from near Inaccessible Island, 222 to 241 fathoms, and from the entrance to McMurdo Sound, 77° 13′ S., 164° 18′ W., 207 fathoms.

7. *Trematomus pennellii*, Regan (Pl. III, fig. 2).

Trematomus pennellii, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, p. 12.

Depth of body $4\frac{1}{2}$ to 5 in the length, length of head $3\frac{1}{3}$ to $3\frac{1}{2}$. Diameter of eye $3\frac{1}{4}$ to $3\frac{1}{2}$ in length of head, interorbital width 8 to 10. Maxillary extending to below anterior $\frac{1}{4}$ of eye; occiput, interorbital region, cheeks and opercles scaly. 13 to 16 gill-rakers on lower part of anterior arch. Dorsal V–VI, 32–34; spines flexible. Anal 30. Pectoral $\frac{3}{4}$ or $\frac{4}{5}$ length of head; pelvics extending to origin of anal. Caudal subtruncate. Caudal peduncle as long as deep. 52 to 56 scales in a longitudinal series from above base of pectoral fin to caudal, 32 to 36 in upper lateral line; lower lateral line without tubules. Olivaceous, with two or three series of large dark spots which may unite to form irregular cross-bars.

Off Cape Adare; 45 to 50 fathoms; bottom shingle. Five specimens, 100 to 140 mm. in total length.

This species is named after Commander H. L. L. Pennell, R.N.

8. *Trematomus centronotus*, Regan (Pl. III, fig. 1).

Trematomus centronotus, Regan, Ann. Mag. Nat. Hist. (8), XIII, 1914, p. 12.

Depth of body 4 in the length, length of head $3\frac{1}{3}$ to $3\frac{3}{5}$. Diameter of eye $3\frac{1}{4}$ in the length of head, interorbital width 10. Maxillary extending to below anterior $\frac{1}{4}$ or $\frac{1}{5}$ of eye; occiput, interorbital region, cheeks and opercles scaly. 14 gill-rakers on lower part of anterior arch. Dorsal V–VI, 32–35; spines stiff, pungent. Anal 29–32. Pectoral $\frac{3}{5}$ or $\frac{2}{3}$ length of head; pelvics extending to origin of anal. Caudal peduncle as long as deep. 52 to 56 scales in a longitudinal series from above base of pectoral fin to caudal, 30 to 36 in upper lateral line; lower lateral line without tubules. Large dark spots uniting to form irregular cross-bars.

Two specimens, 175 and 210 mm. in total length, from McMurdo Sound, 100 to 200 fathoms.

The pungent dorsal spines distinguish this species from all others of the genus, but it so closely resembles *T. pennellii* in other characters, scarcely differing except in the larger eye, that it is undesirable to place it in another genus.

9. *Trematomus scotti*, Bouleng. (Pl. IV, fig. 2).

Notothenia scotti, Bouleng. Nat. Antarct. Exped. Nat. Hist. II, Fish, p. 2, pl. I, f. 1 (1907); Regan, Trans. R. Soc. Edinb. XLIX, 1913, p. 271.

Depth of body 4 to $5\frac{1}{2}$ in the length, length of head 3 to $3\frac{3}{4}$. Diameter of eye $2\frac{4}{5}$ to $3\frac{1}{3}$ in length of head, interorbital width about 12. Maxillary extending to below anterior $\frac{1}{4}$ of eye; occiput, interorbital region, praeorbitals, cheeks and opercles scaly. 10 to 13 gill-rakers on lower part of anterior arch. Dorsal IV–VI, 31–34. Anal 29–32. Pectoral $\frac{3}{5}$ to $\frac{3}{4}$ length of head; pelvics reaching vent or anal fin. Caudal rounded. Caudal peduncle about as long as deep. 46 to 54 scales in a longitudinal series from above base of pectoral fin to caudal, 11 to 23 in upper lateral line; lower

Compared with examples of *T. lepidorhinus* of nearly the same size this species has a shorter snout, more oblique mouth and broader interorbital region. The tail is shorter, as the vent is nearly equidistant from tip of snout and end of anal fin, whereas it is much nearer the snout in *T. lepidorhinus*. The much shorter lower lateral line and the more numerous dorsal rays are further important differences.

12. *Pleuragramma antarcticum*, Bouleng.

Ross Sea, 158 fathoms. Cape Evans, frozen on an iceberg.

Harpagiferinae.

The subfamily Harpagiferinae includes Nototheniids with the body naked, the gill-membranes broadly united to the isthmus and not forming a fold across it, the operculum hooked so that its upper edge is deeply concave, and the upper lateral line with tubules, the lower reduced to a series of pores.

The genera with a mental barbel were previously represented in the British Museum only by an example of *Dolloidraco longipinnis* recently received from Professor Roule, but the "Terra Nova" collection includes a large series of fishes of this group, representing six species.

Synopsis of the Genera of Harpagiferinae.

I. A mental barbel; opercles not spinate.

A. Post-temporal not prominent; head not or scarcely broader than deep; interorbital region narrow.

Spinous dorsal fin above base of pectoral . . . . . *Artedidraco*, Loennb.

Spinous dorsal fin above operculum . . . . *Dolloidraco*, Roule.

B. Upper limb of post-temporal projecting as a prominent curved ridge; spinous dorsal above operculum.

Head longer than broad, scarcely broader than deep; interorbital region narrow . . . . *Histiodraco*, gen. nov.

Head as long as broad, much broader than deep; interorbital region wide . . . . *Pogonophryne*, Regan.

II. No barbel; operculum and suboperculum each forming a prominent spine . *Harpagifer*, Richards.

Artedidraco, Lönnberg.

Artedidraco, Lönnberg, Swedish South Polar Exped. Fish. p. 39 (1905).

Head without ridges or tubercles, covered with loose, smooth skin, longer than broad, not or scarcely broader than deep; interorbital region narrow. Post-temporal not prominent. Opercles not spinate. A mental barbel. Body compressed. Spinous dorsal fin above base of pectoral.

Synopsis of the Species.

I. Barbel club-shaped, with papillose terminal knob.

Depth of body 5 to $5\frac{1}{2}$ in the length, length of head $2\frac{5}{6}$ to 3. D. III–IV, 25. A. 17–18. Anterior rays of soft dorsal longest . . . . *orianae.*

Depth of body 4 in the length, length of head $2\frac{2}{3}$. D. III, 23–24. A. 17. Middle rays of soft dorsal longest . . . . *mirus.*

II. Barbel without distal expansion, either smooth, finely papillose or slightly fringed.
 A. Caudal rounded or subtruncate.
  D. II–IV, 24–26. A. 17–20 . . . . *skottsbergii.*
  D. IV–V, 27–28. A. 19–20 . . . . *shackletoni.*
 B. Caudal slightly emarginate. D. II–III, 26–28. A. 18–21 . . . . . *loennbergii.*

13. *Artedidraco orianae*, Regan (Pl. VI, fig. 2).

Artedidraco orianae, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, p. 12.

Depth of body 5 to $5\frac{1}{2}$ in the length, length of head $2\frac{5}{6}$ to 3. Diameter of eye $3\frac{1}{2}$ in the length of head, interorbital width 10. Maxillary extending to below anterior $\frac{1}{4}$ of eye. Barbel $\frac{1}{4}$ length of head, club-shaped, with papillose distal expansion. Seven short gill-rakers on lower part of anterior arch. Dorsal III–IV, 25; rays of soft dorsal decreasing from third or fourth; last adnate to caudal peduncle. Anal 17–18, separated by an interspace from caudal fin. Pectoral 17-rayed, $\frac{5}{7}$ or $\frac{3}{4}$ length of head, extending to third or fourth ray of anal; pelvics as long, extending to vent or origin of anal. Caudal subtruncate. Five dark bars across back, extending upwards on the dorsal fins, the first at base of spinous dorsal, the second and fourth stronger than the rest; a spot on praeorbital, another on cheek; lower part of body irregularly spotted; fins with series of spots.

Two specimens, 80 mm. in total length, from off Cape Adare; depth 45 to 50 fathoms; bottom shingle.

The species is named in honour of Mrs. E. A. Wilson.

A. mirus, from South Georgia, described and figured by Lönnberg (Swedish South Polar Exped. Fish. p. 40, pl. IV, f. 14), from a specimen of 114 mm., appears to differ from *A. orianae* in the deeper body (depth 4 in the length), larger head ($2\frac{2}{3}$ in the length), longer barbel ($\frac{1}{3}$ the length of head), shorter paired fins (pectoral $\frac{2}{3}$, pelvics $\frac{1}{2}$ to $\frac{3}{5}$ length of head), higher soft dorsal with the middle rays longest and the last joined to the caudal fin, and in the absence of an interspace between anal and caudal.

14. *Artedidraco skottsbergii*, Lönnberg (Pl. V, fig. 1).

Artedidraco skottsbergii, Lönnberg, Swedish South Polar Exped. Fish. p. 48, pl. IV, f. 15 (1905); Vaillant, Expéd. Antarct. Française, Poiss. p. 46 (1906).

Depth of body $4\frac{1}{2}$ to $5\frac{1}{2}$ in the length, length of head 3 to $3\frac{1}{2}$. Diameter of eye 3 to $3\frac{3}{5}$ in the length of head, interorbital width about 14 to 20. Maxillary extending to below anterior $\frac{1}{4}$ of eye. Barbel simple, smooth or finely papillose, less than $\frac{1}{2}$ diameter of eye. Seven gill-rakers on lower part of anterior arch. Dorsal II–IV, 24–26. Anal 17–20. Pectoral with 15–17 rays, $\frac{3}{5}$ to $\frac{4}{5}$ length of head, extending to vent or origin of anal; pelvics shorter, barely reaching vent in young, not in adult. Caudal rounded or subtruncate. Body with numerous irregular dark spots; a series of blotches at base of dorsal fin sometimes continued on sides as bars; vertical fins with series of spots on the rays, those on posterior part of dorsal and anal and near upper and lower edges of caudal deep black; pectorals barred. Vertebrae 15 + 23.

Here described from 18 examples, up to 120 mm. in total length, from the entrance to McMurdo Sound, 76° 56′ S., 164° 12′ E., 160 fathoms; 77° 13′ S., 164° 18′ E., 207 fathoms; and off Granite Harbour, 50 fathoms. The species was known previously from Graham Land.

15. *Artedidraco shackletoni*, Waite.

Artedidraco shackletoni, Waite, Brit. Antarctic Exped. Fish. p. 15, pl. II (1911).

Depth of body 4 in the length, length of head $2\frac{3}{4}$ to $2\frac{4}{5}$. Diameter of eye $3\frac{1}{2}$ to $3\frac{3}{4}$ in length of head, interorbital width about 14. Maxillary extending to below middle of eye. Barbel smooth, tapering, $\frac{1}{5}$ to $\frac{2}{9}$ ($\frac{1}{4}$) length of head. Seven gill-rakers on lower part of anterior arch. Dorsal IV (V) 27–28; middle soft rays longest. Anal 19 (20). Pectoral with (15) 16–17 rays, $\frac{3}{5}$ length of head, extending to vent or origin of anal; pelvics shorter, not reaching vent. Caudal subtruncate. Uniform or finely speckled; caudal and pectorals spotted.

Here described from two examples, 132 and 142 mm. in total length, from the entrance to McMurdo Sound, 77° 13′ S., 164° 18′ E., 207 fathoms, and 76° 56′ S., 164° 12′ E., 160 fathoms. The type, 146 mm. in total length, from off Cape Royds at a depth of 30 to 80 fathoms, had V, 27 dorsal and 20 anal rays. It had the barbel a little longer (slightly more than $\frac{1}{4}$ the length of head), the spinous dorsal less, and the soft dorsal somewhat more elevated than in the specimens here described, but these differences are well within the limit of variation as shown by other species.

16. *Artedidraco lönnbergii*, Roule (Pl. V, fig. 2).

Artedidraco mirus (part) Lönnberg, Swedish South Polar Exped. Fish. p. 40, pl. I, f. 4 (1905).
Artedidraco loennbergii, Roule, Deuxième Expéd. Antarct. Franç. Poiss. p. 13, pl. IV, f. 4 (1913).

Depth of body 5 to 6 in the length, length of head $2\frac{3}{4}$ to $3\frac{1}{4}$. Diameter of eye 3 to $3\frac{1}{2}$ in length of head; interorbital space very narrow. Maxillary extending to below anterior $\frac{1}{4}$ of eye. Barbel simple, or slightly fringed distally, $\frac{1}{7}$ to $\frac{1}{4}$ length of head. Six or seven gill-rakers on lower part of anterior arch. Dorsal II–III, 26–28. Anal 18–21. Soft dorsal and anal usually highest posteriorly. Pectoral with 14 to 16 rays, $\frac{3}{5}$ to $\frac{2}{3}$ length of head, reaching anal in young, but not in adult; pelvics reaching vent in young, but not in adult. Caudal slightly emarginate. A series of dark blotches at base of dorsal fin and sometimes at base of anal; a dark lateral band, made up of irregular spots, from eye to caudal fin; pale bands above and below it are continued along the upper and lower margins of the caudal fin; dorsal and middle of caudal with spots on the rays; pectorals usually barred.

Previously known from South Georgia and from Graham Land; here described from twenty-two examples measuring up to 110 mm. in total length from:—Ross Sea, 74° 25′ S., 179° 3′ E., 158 fathoms; off new land south of the Balleny Islands, 200 fathoms; McMurdo Sound, entrance, 76° 56′ S., 164° 12′ E., 160 fathoms and 77° 13′ S., 164° 18′ E., 207 fathoms, and near Inaccessible Island, 222 to 241 fathoms.

Histiodraco, gen. nov.

Differs from *Dolloidraco* in that the upper limb of the post-temporal projects as a prominent curved ridge, as in *Pogonophryne*.

17. *Histiodraco velifer*, Regan (Pl. v, fig. 3).

Dolloidraco velifer, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, p. 12.

Depth of body 4 in the length, length of head $2\frac{2}{5}$. Diameter of eye $3\frac{1}{2}$ in the length of head, interorbital width 12. Maxillary extending to below middle of eye, or beyond. Barbel fringed in its distal half, $\frac{2}{5}$ the length of head. Seven very short gill-rakers on lower part of anterior arch. Dorsal II–III, 26; spinous dorsal short and high; soft dorsal elevated anteriorly, the longest rays $\frac{3}{4}$ to $\frac{9}{10}$ the length of head. Anal 17. Pectoral 19-rayed, $\frac{1}{2}$ length of head, extending to origin of anal; pelvics shorter. Caudal truncate above, rounded below, not more than $\frac{2}{3}$ length of head. Body marbled or irregularly barred; fins more or less spotted; caudal crossed by a dark band.

Two examples, 180 and 190 mm. in total length, from the entrance to McMurdo Sound, 77° 13′ S., 164° 18′ E., 207 fathoms.

Pogonophryne, Regan.

Pogonophryne, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, p. 13.

Differs from *Histiodraco* in the wide interorbital region and the strongly depressed head, as broad as long and much broader than deep.

18. *Pogonophryne scotti*, Regan (Pl. VI, fig. 1).

Pogonophryne scotti, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, p. 13.

Depth of body 4 in the length, length of head $2\frac{1}{2}$. Diameter of eye $5\frac{1}{2}$ in length of head, interorbital width $4\frac{1}{2}$. Maxillary extending to below middle of eye; lower jaw strongly projecting. Barbel blunt, papillose, shorter than eye. 10 very short gill-rakers on lower part of anterior arch. Dorsal II, 25; spines low. Anal 18. Pectoral 19-rayed, $\frac{1}{2}$ length of head; pelvics short, rounded. Caudal rounded. Body finely spotted and marbled; fins with series of dark spots on the rays; caudal with a dark cross-bar.

A single specimen, 290 mm. in total length, from the Ross Sea, 74° 25′ S., 179° 3′ E., 158 fathoms.

A coloured drawing of a fish from the Bransfield Straits reproduced by Lönnberg (Swedish S. Polar Exped. Fish. pl. II, fig. 7) as *Artedidraco skottsbergii* seems rather to represent a *Pogonophryne*, perhaps even the species here described.

This species is named in memory of Captain R. F. Scott, R.N., C.V.O.

BATHYDRACONIDAE.

Gymnodraco, with its depressed naked body, pointed snout, and compressed uniserial teeth with strong anterior canines, is connected with the genera with the body subcylindrical and more or less scaly, the snout spatulate, and the teeth villiform or cardiform, in bands, without canines, by the little known *Parachaenichthys*. Examples of *P. georgianus* Fisch. recently brought back from South Georgia by Mr. P. Stammwitz, show that *Parachaenichthys* has nothing to do with the Chaenichthyidae, but is a member of the Bathydraconidae, with the depressed form and naked body of *Gymnodraco*, but the mouth and teeth of *Bathydraco* and its allies.

In *Parachaenichthys* and *Gymnodraco* the feeble ribs are attached to the long epipleurals at some distance from the centra,* but in *Prionodraco* the ribs are stronger, are inserted directly on the short parapophyses and bear the epipleurals near their proximal ends.

Prionodraco, Regan.

Prionodraco, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, p. 13.

Body elongate, compressed, quadrangular, with a series of V-shaped, serrated, bony plates at each angle; each plate with a backwardly directed spine. Lower series of plates ending in a group of nearly normal serrated scales behind pectoral fin; usually a series of similar scales along middle of side; body otherwise naked. Lateral line single, incomplete. Snout spatulate; mouth slightly protractile; teeth small, villiform, in bands. Vertebrae 16 + 34.

19. *Prionodraco evansii*, Regan (Pl. VII, fig. 1).

Prionodraco evansii, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, p. 13.

Depth of body 7 to 8 in the length, length of head 3 to $3\frac{1}{2}$. Snout as long as or a little longer than diameter of eye, which is 3 to $3\frac{1}{2}$ in length of head; interorbital width 15 or more in length of head. Lower jaw a little projecting; maxillary extending to below anterior margin of eye. Operculum ending in a flat antrorse hook. 18 gill-rakers on lower part of anterior arch. Dorsal 34–37. Anal 29–31. Pectoral $\frac{2}{3}$ to $\frac{3}{4}$ length of head, extending beyond origin of anal; pelvics not reaching the vent. Caudal rounded or subtruncate. About 50 plates in upper series; lateral line ending below anterior part of dorsal fin. Dark spots on body; usually a well-defined lateral series of large oblong or squarish spots; a blackish spot on base of anterior part of dorsal; dorsal, caudal and pectorals with series of spots on the rays.

Eleven specimens, measuring up to 132 mm. in total length, from the Ross Sea, 74° 25′ S., 179° 3′ E., 158 fathoms; and the entrance to McMurdo Sound, 76° 56′ S., 164° 12′ E., 160 fathoms, and 77° 13′ S., 164° 18′ E., 207 fathoms.

This species is named after Commander E. R. G. R. Evans, R.N., C.B.

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* As in the Gobiesocidae, which also have the body depressed.

CHAENICHTHYIDAE.

The "Terra Nova" collection includes examples of two species of a new genus of this family, and also new species of *Chionodraco* and *Cryodraco*, genera new to the British Museum collection. The synopsis of the genera given in the "Scotia" report may be modified as follows:—

I. Middle rays of pelvic fin longest; two lateral lines.
  A. Lateral line without bony plates.
    D. IX–X, 33–40. A. 32–38. no rostral spine . . . . . *Champsocephalus.*
    D. XII–XV, 28–31. A. 25–27. a rostral spine . . . . . . *Pagetopsis.*
  B. Lateral line with bony plates; a rostral spine . . . . *Chaenichthys.*

II. Two outer soft rays of pelvic fin longest.
  A. Sub- and inter- operculum not spinate; rostral spine reduced or absent.
    Pelvic fins comparatively short, with the rays branched or bifid; spinous dorsal large, of seven or eight spines, separated by a short interspace from soft dorsal; two lateral lines . . . . *Chaenocephalus.*
    Pelvic fins long, with the rays simple; spinous dorsal reduced, of three to five spines, separated by a long interspace from soft dorsal; three lateral lines . *Cryodraco.*
  B. Sub- and inter- operculum bearing a pair of spines behind angle of praeoperculum; rostral spine well developed; three lateral lines.
    Pelvics I 5; gill-rakers reduced to a few vestiges near the angles of the arches *Chionodraco.*
    Pelvics I 4; gill-rakers developed as dentigerous knobs or patches . . *Chaenodraco.*

20. *Pagetopsis macropterus*, Bouleng.

Three examples from McMurdo Sound, 100 to 200 fathoms.

21. *Cryodraco atkinsoni*, Regan (Pl. VII, fig. 2).

Cryodraco atkinsoni, Regan, Ann. Mag. Nat. Hist. (8), XIII, 1914, p. 13.

Depth of body $7\frac{1}{2}$ in the length, length of head $3\frac{1}{4}$. Diameter of eye 5 in length of head, interorbital width $4\frac{2}{3}$. Snout $\frac{1}{2}$ the length of head. Maxillary nearly reaching middle of eye. Rostral spine and symphysial tubercle of mandibles vestigial. Dorsal III, 42; spinous dorsal above base of pectoral, its spines connected by membrane, the first and second subequal, $\frac{1}{4}$ the length of head. Anal 46; origin a little in advance of that of dorsal, nearer to end of snout than to base of caudal. Pectoral nearly $\frac{3}{5}$ length of head, extending to seventh ray of anal; pelvics $1\frac{1}{3}$ as long as head, extending to middle of dorsal fin. Caudal slightly emarginate. Dark spots on head and cross-bars on body; spinous dorsal blackish; pelvics dusky.

A single specimen, 292 mm. in total length, from the Ross Sea, 74° 25′ S., 179° 3′ E., 158 fathoms.

This species is named after Surg. E. L. Atkinson, R.N.; it differs from *C. antarcticus*, Dollo, in the smaller eye, shorter pelvic fins, etc. *C. pappenheimi*, Regan, has the pelvic fins still shorter, and in its large head and 5-rayed dorsal fin seems to approach *Chaenocephalus.*

Chionodraco, Lönnberg.

Body naked, elongate; three lateral lines without bony plates. Eye somewhat behind middle of head; supraorbital ridges crenulated; a rostral spine; teeth bi- or tri- serial; gill-rakers absent except for a few vestiges near the angles of the arches; sub- and inter- operculum bearing a pair of spines just behind angle of praeoperculum. Spinous dorsal well-developed, of six or seven spines; pelvics comparatively short, of a spine and five branched or bifid rays, the two outer the longest and enveloped in thick skin. Skeleton essentially similar to that of *Champsocephalus*. Vertebrae 64.

22. *Chionodraco kathleenae*, Regan (Pl. VIII).

Chionodraco kathleenae, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, p. 13.

Depth of body about 5 in the length, length of head $2\frac{3}{4}$ to 3. Diameter of eye 5 to 6 in length of head, interorbital width $3\frac{1}{2}$ to 4. Snout a little less than $\frac{1}{2}$ length of head. Rostral spine erect or retrorse. Maxillary extending to below anterior part or middle of eye. Dorsal VI–VII, 38–42, the two fins separated by an interspace. Anal 34–38. Pectoral $\frac{1}{2}$ length of head or a little more, extending to above vent or anterior rays of anal; pelvics $\frac{3}{5}$ to $\frac{3}{4}$ length of head, extending to origin of anal or beyond. Head and body with dark spots and bars; spinous dorsal blackish.

Five specimens, 250 to 500 mm. in total length, from the Ross Sea, 74° 25′ S., 179° 3′ E., 158 fathoms, and McMurdo Sound, 100–200 fathoms. Also an example in bad condition from off Granite Harbour, McMurdo Sound, 50 fathoms.

C. hamatus, Lönnberg, known from a specimen of 330 mm., has a larger eye ($4\frac{1}{3}$ in length of head, including opercular flap) and shorter pelvic fins, not reaching the vent.

This species is named in honour of Lady Scott.

Chaenodraco, Regan.

Chaenodraco, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, p. 13.

This genus differs from *Chionodraco* in having the supraorbital ridges not crenulated, the gill-rakers developed as dentigerous prominences, and the pelvic fins each formed of a spine and only four rays.

23. *Chaenodraco wilsoni*, Regan (Pl. IX, fig. 1).

Chaenodraco wilsoni, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, p. 14.

Depth of body 6 in the length, length of head $3\frac{1}{6}$. Snout $2\frac{2}{5}$, diameter of eye 4, interorbital width $3\frac{2}{3}$ in length of head. Maxillary extending to below anterior $\frac{1}{4}$ of eye. Rostral spine antrorse. Dorsal VII, 39, the two fins continuous at the base. Anal 33. Pectoral $\frac{3}{5}$ length of head, extending to third or fourth ray of anal; pelvics $\frac{5}{6}$ length of head, extending to seventh ray of anal; rays bifid. A large dark spot on the spinous dorsal.

A single specimen, 250 mm. in total length, from McMurdo Sound, 100 to 200 fathoms.

This species is named in memory of Dr. E. A. Wilson.

CARCHARIIDAE.

2. *Galeus australis*, Macleay.

SQUALIDAE.

3. *Squalus megalops*, Waite.

STOMIATIDAE.

4. *Idiacanthus niger*, Regan (Pl. x, fig. 2).

Idiacanthus niger, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, p. 14.

Depth of body 22 in the length, length of head 13½. Snout longer than diameter of eye, which is 8½ in length of head; interorbital width 5. Barbel twice as long as head. Dorsal 59; origin above posterior part of pelvic fins. Anal 38; origin a little nearer to base of caudal than to that of pelvics, which is equidistant from head and origin of anal. Photophores in ventral series about 37 from isthmus to pelvics, 21 from pelvics to anal. Blackish.

A single specimen, 400 mm. in total length, from the stomach of a "Groper."

Brauer (Valdivia Tiefsee Fische, p. 60) has given a synopsis of the four species of this genus hitherto described, in all of which the origin of the dorsal fin is above or in advance of the base of the pelvics. *I. niger* is nearest to *I. ferox*, Günth., which has a shorter barbel, the dorsal origin above the base of the pelvics, and a longer anal fin commencing at a point nearer to the insertion of the pelvics than to the caudal fin.

The following measurements, in millimetres, are taken from the types of *I. niger* and *I. ferox*:—

	I. niger.	I. ferox.
Lower jaw	28	14
Barbel	58	24
Length to base of caudal	380	192
,, ,, origin of dorsal	170	66
,, ,, base of pelvics	150	66
,, from base of pelvics to origin of anal	120	58
,, ,, origin of anal to base of caudal	110	68

GONORHYNCHIDAE.

5. *Gonorhynchus gonorhynchus*, Linn.

A small example from a rock-pool at Whangaroa.

MURAENIDAE.

6. *Muraena nubila*, Richards

HEMIRHAMPHIDAE.

7. *Hemirhamphus intermedius*, Cant.

Lyttelton Harbour.

Exocoetidae.

8. *Exocoetus spilonotopterus*, Bleek.

Macrorhamphosidae.

Notopogon, Regan.

Notopogon, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, p. 14.

This genus is distinguished from *Macrorhamphosus* by the deeper form, the dorsal fins continuous at the base, the strong second spine followed by five nearly equidistant and gradually decreasing in length backwards, and by the development of a patch of bristles on the nape in the adult fish. From *Centriscops* it differs in the last character and in having only three well-developed plates in each dorso-lateral series.

9. *Notopogon lilliei*, Regan (Pl. XII, fig. 4).

Centriscops humerosus (*non* Richards) McCulloch, "Endeavour," Fish. p. 24, fig. 5, and pl. IX (1911).
Notopogon lilliei, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, pp. 14, 20.

Depth of body $2\frac{2}{3}$ in length, length of head 2. Distance from base of dorsal spine to vent $1\frac{2}{5}$ in that from head to caudal fin. Diameter of eye $3\frac{1}{2}$ in length of snout, a little more than postorbital part of head, twice depth of cheek. Interorbital space convex, with blunt median ridge; width $\frac{3}{4}$ diameter of eye. Back slightly, belly more strongly convex. Two series of bony plates on each side of back; only three large plates in each series; ventral plates keeled in front of, spinate behind pelvic fins. Dorsal VII, 14, the two fins continuous; second spine strong, serrated, inserted above middle of anal fin, its length a little more than $\frac{1}{2}$ distance from operculum to caudal fin. Anal 19. Pectoral as long as head without snout. Caudal truncate.

A single specimen, 125 mm. in total length, from New Zealand, caught by fishermen; the species is also known from the south coast of Australia; it is named after Mr. D. G. Lillie.

10. *Notopogon xenosoma*, Regan (Pl. XII, fig. 5).

Notopogon xenosoma, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, pp. 14, 20.

Body elevated, the distance from base of dorsal spine to vent a little greater than that from head to caudal fin. Head $2\frac{1}{6}$ in the length. Diameter of eye a little longer than postorbital length of head, $\frac{2}{5}$ length of snout, twice depth of cheek. Interorbital space flat, its width $\frac{5}{7}$ diameter of eye. Upper profile with a moderate hump; belly convex. Only three large plates in each dorso-lateral series; last of dorsal series bearing a spine; ventral plates spinate; a pair of spines at posterior end of lower jaw; a patch of scales behind dorsal hump modified into short bristles. Dorsal VII, 15, the two fins subcontinuous; second spine rather slender, serrated, inserted above caudal peduncle, its length $\frac{3}{5}$ distance from operculum to caudal. Anal 17. Pectoral as long as head without snout. Caudal truncate.

A single specimen, 80 mm. in total length, from Cape North; 70 fathoms.

Compared with *N. schoteli* this species is still more aberrant in form, with the insertion of the dorsal spine higher and further back, behind instead of in front of the soft dorsal fin. It agrees more closely with *N. fernandezianus*, which has been figured by Delfin on the cover of his Catalogue of Chilean Fishes. The type of *N. fernandezianus* measures 167 mm., and it may be owing to its larger size that the eye is smaller ($5\frac{1}{2}$ in length of head), the snout longer ($1\frac{3}{5}$ instead of $1\frac{1}{5}$ rest of head) than in *N. xenosoma*; also the greater length of the dorsal bristles is doubtless due to age. The difference in structure and position of the dorsal spine may be more important, and in all probability direct comparison would reveal other differences between the two forms.

SYNGNATHIDAE.

11. *Solenognathus spinosissimus*, Günth.

12. *Stigmatophora macropterygia*, Duméril.
D'Urville Island.

TRACHICHTHYIDAE.

13. *Paratrachichthys traillі*, Hutton.
Elmsley Bay, South Island.

GEMPYLIDAE.

14. *Thyrsites atun*, Euphras.

TRICHIURIDAE.

15. *Lepidopus caudatus*, Euphras.

SERRANIDAE.

16. *Caprodon longimanus*, Günth.

Serranops, Regan.

Serranops, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, p. 15.

Related to *Plectranthias*, Bleek, but with the serrations of the lower praeopercular limb weak, not antrorse, and the scales spinulose. Distinguished externally from *Lepidoperca* by the larger mouth, naked maxillary, and almost naked spinous dorsal fin. Skeleton as in *Plectranthias*, the frontals smooth and convex behind the orbits and narrow between them, with the mucous canals in contact and the supraorbital flanges little developed. Vertebrae 10 + 16.

17. *Serranops maculicauda*, Regan (Pl. XI, fig. 3).

Serranops maculicauda, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, p. 15.

Depth of body $2\frac{2}{3}$ to 3 in the length, length of head $2\frac{1}{2}$ to $2\frac{2}{3}$. Snout shorter than diameter of eye, which is 3 in length of head; interorbital width 6. Upper surface and sides of head scaly; praeorbital and maxillary naked; lower jaw scaly. Maxillary extending to below middle or posterior part of eye. 16 gill-rakers on lower part of anterior arch. 33 or 34 scales in the lateral line. Dorsal x, 15; middle spines longest, $\frac{1}{3}$ to $\frac{2}{5}$ length of head; second soft ray more or less produced. Anal III 7; second spine longest, longer than highest spines of dorsal fin. Pectoral $\frac{3}{4}$ length of head. Caudal truncate; ray at upper angle sometimes produced. A large dark spot on each side of caudal peduncle, usually another below spinous dorsal.

Eight specimens, 60 to 100 mm. in total length, from seven miles E. of Cape North; depth 70 fathoms; bottom sand.

Lepidoperca, Regan.

Lepidoperca, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, p. 15.

External characters of *Caesioperca*, except that the interorbital region is flat instead of convex, the caudal fin truncate instead of emarginate, the scales larger and the dorsal and anal rays slightly less numerous. Skeleton differing from that of *Caesioperca* in the absence of a transverse ridge in front of the occipital crest and in having the mucous canals of the frontals separated by a narrow groove, whereas in *Caesioperca* they border a fossa which broadens out anteriorly. Vertebrae 10 + 16.

18. *Lepidoperca inornata*, Regan (Pl. XI, fig. 4).

Lepidoperca inornata, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, p. 15.

Depth of body $2\frac{1}{2}$ in the length, length of head $2\frac{3}{4}$. Diameter of eye $2\frac{1}{2}$ in the length of head, interorbital width 4. Interorbital space flat; praeorbital scaly; maxillary not quite reaching vertical from middle of eye; 25 gill-rakers on lower part of anterior arch. Dorsal x, 16; fourth spine longest, nearly $\frac{1}{2}$ length of head, $1\frac{1}{2}$ as long as last spine. Anal III 8; second spine a little longer than longest of dorsal. Pectoral slightly shorter than head; ninth ray from above (eighth from below) longest. Caudal truncate. 38 scales in a lateral longitudinal series, 41 in the lateral line. Traces of reddish longitudinal stripes.

A specimen of 135 mm. from near Cape North, 70 fathoms, bottom sand; also a second much smaller example, 60 mm. in total length.

This species is closely related to the recently described *L. coatsii*, Regan (Trans. R. Soc. Edinburgh, XLIX, 1913, p. 237, pl. VI, f. 1), from Gough Island, but is distinguished by the deeper body, fewer scales, scaly praeorbital, shorter maxillary, higher last dorsal spine and immaculate dorsal fin.

PLESIOPIDAE.

19. *Acanthoclinus littoreus*, Forst.

CARANGIDAE.

20. *Seriola lalandii*, Cuv. and Val.

CEPOLIDAE.

21. *Cepola aotea*, Waite.

CHILODACTYLIDAE.

22. *Chilodactylus macropterus*, Forst.

PARAPERCIDIDAE.

23. *Parapercis gilliesii*, Hutton.

HEMEROCOETIDAE.

24. *Hemerocoetes pauciradiatus*, Regan (Pl. XII, fig. 1).

Hemerocoetes pauciradiatus, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, p. 15.

Depth of body about 8 in the length, length of head $3\frac{1}{2}$ to $3\frac{2}{3}$, distance from tip of snout to origin of dorsal fin $3\frac{1}{3}$ to $3\frac{2}{3}$, to origin of anal about $2\frac{1}{2}$. Snout as long as or shorter than diameter of eye, which is $3\frac{1}{3}$ to $3\frac{2}{3}$ in the length of head; interorbital space narrow; maxillary extending to below middle of eye; 13 very short gill-rakers on lower part of anterior arch. About 45 scales in a longitudinal series. Dorsal 36; origin above anterior $\frac{1}{4}$ of pectoral. Anal 32. Pectoral $\frac{2}{3}$ length of head; pelvics reaching vent. Caudal subtruncate. A lateral series of dark spots.

Two specimens, 50 and 62 mm. in total length, from seven miles east of Cape North; depth 70 fathoms; bottom sand.

25. *Hemerocoetes macrophthalmus*, Regan (Pl. XII, fig. 2).

Hemerocoetes macrophthalmus, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, p. 15.

Depth of body about 10 in the length, length of head $3\frac{3}{4}$ to 4, distance from tip of snout to origin of dorsal fin $3\frac{1}{4}$ to $3\frac{1}{2}$, to origin of anal $2\frac{2}{3}$ to $2\frac{3}{4}$. Snout shorter than diameter of eye, which is $2\frac{2}{3}$ to 3 in length of head; interorbital space very narrow; maxillary extending to below middle of eye; 15 very short gill-rakers on lower part of anterior arch. About 47 scales in a longitudinal series. Dorsal 39; origin above anterior $\frac{1}{3}$ of pectoral. Anal 36. Pectoral $\frac{3}{5}$ length of head; pelvics reaching vent. Caudal truncate; upper rays sometimes produced. A series of dark spots along middle of side, another series on back.

Two specimens, 90 and 120 mm. in total length, from seven miles east of Cape North; depth 70 fathoms; bottom sand.

I propose the new name *Hemerocoetes waitei* for the species described and figured by Waite (Rec. Canterbury Mus. I, 1911, p. 245, pl. LIV, f. 1) as *Hemerocoetes acanthorhynchus*. The dorsal has 42 rays and the anal 40, and these fins originate somewhat further forward than in *H. macrophthalmus*, which it closely resembles in other characters.

The true *H. acanthorhynchus*, Forster, is the species described and figured by Waite (t.c., p. 247, pl. LIV, f. 2) as *H. microps*. The original description, that the eye is less than $\frac{1}{4}$ of the length of the head in a specimen of 200 mm., leaves no doubt on this point. In examples of this species I count 40 to 42 dorsal and 38 to 40 anal rays.

STROMATEIDAE.

26. *Centrolophus maoricus*, Ogilb.

Depth of body $3\frac{1}{2}$ in the length; length of head $3\frac{1}{4}$ to $3\frac{1}{2}$. Snout from a little shorter to a little longer than diameter of eye, which is $3\frac{1}{4}$ to $4\frac{1}{3}$ in the length of head and less than interorbital width. Maxillary extending to below anterior $\frac{1}{4}$ or $\frac{1}{3}$ of eye. 14 gill-rakers on lower part of anterior arch. Dorsal 43; origin above base of pectoral. Anal 27. Pectoral $\frac{2}{3}$ length of head; pelvics a little shorter. Caudal emarginate. Caudal peduncle nearly twice as long as deep. 180 scales in a longitudinal series; lateral line curved anteriorly, becoming straight above origin of anal. Purplish; longitudinal series of oblong pale spots more or less distinct on sides of body; two broad dusky bands across the body, one in front of and one above the anal fin.

Three Kings Islands, north of New Zealand; surface.

Here described from two specimens, 150 and 280 mm. in length, which have the body a little deeper and the head a little larger than in young examples of the Atlantic *C. niger*, Gmel.; also the fin-rays are somewhat more numerous and the origin of the dorsal fin is further forward; it is probable that these specimens pertain to *C. maoricus*, Ogilby (Rec. Austral. Mus. II, 1893, p. 64), described from a larger fish.

Since my revision of the genus *Centrolophus* (Ann. Mag. Nat. Hist. (7) x, 1902, p. 194) Waite* has described a new species, *C. huttoni*, from New Zealand, well distinguished by the large number of fin-rays. *C. britannicus* has been rediscovered,† and I have examined the type of the Californian *Icichthys lockingtoni*, Jord. and Gilb., in the Smithsonian Institution; this is a *Centrolophus*, very similar to *C. niger*.

27. *Cubiceps caeruleus*, Regan.

Cubiceps caeruleus, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, p. 15.

Depth of body nearly equal to length of head, $3\frac{2}{5}$ to $3\frac{3}{5}$ in length of fish. Snout as long as or a little shorter than diameter of eye, which is $3\frac{1}{2}$ to $3\frac{2}{3}$ in length of head and a little less than interorbital width. Maxillary not quite reaching vertical from anterior margin of eye; praeorbital narrowed posteriorly, not completely concealing maxillary. 14 or 15 gill-rakers on lower part of anterior arch. Dorsal XI, I 23. Anal III 21. Pectoral as long as head, extending to origin of anal. Caudal forked. Probably not more than 50 scales in a longitudinal series. Bluish.

Three Kings Islands.

Two specimens, 100 and 110 mm. in length, from the stomach of a *Seriolella*.

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* Trans. N. Z. Inst. XLII, 1910, p. 388.

† Pellegrin, Bull. soc. zool., XXXVII, 1912, p. 20.

In the Atlantic *C. gracilis*, Lowe, the body is less deep, the snout shorter, and the eye larger; also the maxillary is completely hidden, and the pectoral fin extends beyond the origin of the anal. Owing to the imperfect condition of the types of *C. caeruleus* the number of scales cannot be certainly stated, but they seem to be larger than in *C. gracilis*, which has 58 to 66 in a longitudinal series.

Since my revision of the genus *Cubiceps* (Ann. Mag. Nat. Hist. (7) x, 1902, p. 122), when four species were recognised, Jordan and Snyder have described a species from Honolulu under the name *Ariomma lurida*. This is figured by Jordan and Evermann (Bull. U. S. Fish. Comm. xxiii, 1905 p. 217, pl. xxxvii), and is evidently closely related to *Cubiceps pauciradiatus*, Günth. and *C. brevimanus*, Klunz.

Brotulidae.

Pyramodon, Radcliffe.

Pyramodon, Radcliffe, Proc. U.S. Nat. Mus. xliv, 1913, p. 175.
Cynophidium, Regan, Ann. Mag. Nat. Hist. (8) xiii, 1914, p. 16.

Head and body naked, compressed; tail tapering; no lateral line. Head unarmed, without large muciferous channels, smooth and convex above; eyes well-developed; no barbels. Mouth large, protractile, terminal, with the lower jaw included; teeth subconical, in a narrow band in praemaxillaries, uniserial and unequal in lower jaw and on palatines; upper jaw with a rather wide toothless interspace between a pair of canines, which are outside the mouth when it is closed; lower jaw with a pair of strong recurved anterior canines; vomer with a very strong curved canine followed by a few smaller teeth. Gill-membranes separate, free; 7 branchiostegals; 4 gills; pseudobranchiae very small. Vent and origins of dorsal and anal fins a short distance behind head; vertical fins confluent at end of tail; no distinct caudal fin; pectorals well-developed; pelvics jugular, a pair of simple filaments.

This genus differs from *Snyderidia*, Gilbert, 1905 (Bull. U. S. Fish. Comm. 1903, p. 654), in the presence of pelvic fins. In many respects these two genera seem to connect the Brotulidae with the Fierasferidae, but I have ascertained that *Pyramodon* agrees with the Brotulidae in the structure of the upper surface of the skull, the supraoccipital separating the rather small parietals.

28. *Pyramodon punctatus*, Regan (Pl. xii, fig. 3).

Cynophidium punctatum, Regan, Ann. Mag. Nat. Hist. (8) xiii, 1914, p. 16.

Depth of body nearly equal to length of head, which is 6 in the length of the fish; distance from end of snout to origin of dorsal fin $4\frac{3}{4}$. Snout, diameter of eye and interorbital width subequal, about $\frac{1}{5}$ the length of head. Maxillary extending beyond eye. Three gill-rakers and several rudiments on lower part of anterior arch. Origin of dorsal fin slightly in advance of vent; pectoral $\frac{4}{5}$ length of head; pelvics $\frac{1}{3}$ length of head, or $\frac{1}{2}$ distance from their base to origin of anal. Olivaceous, powdered with little dark spots.

Snout twice as long as longitudinal diameter of eye with spiracle; interorbital width equal to transverse diameter of eye. Internasal width less than $\frac{1}{2}$ praeoral length of snout, less than distance of either nostral from edge of disc. Teeth obtuse, close-set; about 40 series in upper jaw, which has a median emargination. Disc smooth below, above with scattered spines with radiating bases, set more closely near the anterior and posterior margins; a series of spines at inner margin of each orbit; a triangular patch on scapulary region; tail with three series posteriorly, five anteriorly, continued forward on the disc as two only; two spines between the well-separated dorsal fins. Brownish, with scattered darker and paler spots.

A single specimen, a young female, 220 mm. in total length. In the spination and in the separation of the dorsal fins this species is nearer to the Chilean one described by Garman from an adult male as *Malacorhina mirus* than to *Psammobatis rudis*, Günth. *Malacorhina* seems to be a synonym of *Psammobatis*, and the adult male of *Ps. cirrifer* may have the anterior margins of the disc notched as in *Ps. mirus*; similar differences in form due to sex and age are known in *Raia fyllae*, Lütken.

MURAENIDAE.

2. *Muraena ocellata*, Agass.

CONGRIDAE.

3. *Congromuraena balearica*, Delaroche.

SYNODONTIDAE.

4. *Trachinocephalus myops*, Forst.

SYNGNATHIDAE.

5. *Hippocampus punctulatus*, Guichen.

SERRANIDAE.

6. *Serranus auriga*, Cuv. and Val.

TRIGLIDAE.

7. *Prionotus brachychir*, Regan (Pl. XI, fig. 1).

Prionotus brachychir, Regan, Ann, Mag. Nat. Hist. (8) XIII, 1914, p. 16.

Depth of body about $3\frac{1}{2}$ in the length, length of head (without opercular spine) $2\frac{3}{5}$ to 3. Diameter of eye nearly equal to length of snout or postorbital part of head; interobital space a little concave, its width $\frac{2}{5}$ diameter of eye. Maxillary extending to below anterior $\frac{1}{4}$ of eye. Opercular and praeopercular spines strong; no other spines on head; a short cleithral spine; 10 gill-rakers on lower part of anterior arch. 50 to 60 scales in a lateral series, 45 to 50 in lateral line; chest naked. Dorsal VIII–XI, 10–12; second or third spine longest, nearly $\frac{1}{2}$ length of head. Anal 10–12. Pectoral shorter than head, extending to origin of anal or slightly beyond. Caudal emarginate. A blackish spot near edge of spinous dorsal, between fourth and sixth spines; soft dorsal with series of small dark spots; caudal with three dark cross-bars; pectoral blackish.

Several specimens, 70 to 80 mm. in total length.

8. *Prionotus tribulus*, Cuv.

OPHIDIIDAE.

9. *Ophidium brevibarbe*, Cuv.

BOTHIDAE.

10. *Etropus microstomus*, Gill.

11. *Paralichthys oblongus*, Mitch.

12. *Xystreurys brasiliensis*, Regan (Pl. x, fig. 1).

Xystreurys brasiliensis, Regan, Ann. Mag. Nat. Hist. (8) XIII, 1914, p. 17.

Depth of body $2\frac{1}{3}$ in the length, length of head 4. Snout $\frac{3}{5}$ diameter of eye, which is 3 in length of head. Eyes separated by a narrow ridge. Maxillary extending a little beyond anterior $\frac{1}{3}$ of eye; lower jaw $\frac{1}{2}$ length of head. Gill-rakers moderately elongate, 10 on lower part of anterior arch. 85 scales in a longitudinal series. Dorsal 83. Anal 66. Left pectoral nearly as long as head, right scarcely more than $\frac{1}{2}$ length of head. Caudal pointed. A large double ocellus at end of arch of lateral line; a small ocellus between it and dorsal fin; a large dark spot posteriorly on lateral line.

A single specimen, 170 mm. in total length.

The only other known species of this genus is *X. liolepis*, Jord. and Gilb., from the coast of southern California.

CYNOGLOSSIDAE.

13. *Symphurus plagiusa*, Linn.

BATRACHOIDIDAE.

14. *Porichthys porosissimus*, Cuv. and Val.

LOPHIIDAE.

15. *Lophius piscatorius*, Linn.

II.—GENERAL PART.

1. THE DISTRIBUTION OF ANTARCTIC AND SUBANTARCTIC FISHES.

A. COAST FISHES.

It is convenient to distinguish between coast fishes and oceanic fishes, including in the former not only the littoral forms but also fishes that may occur at no great distance

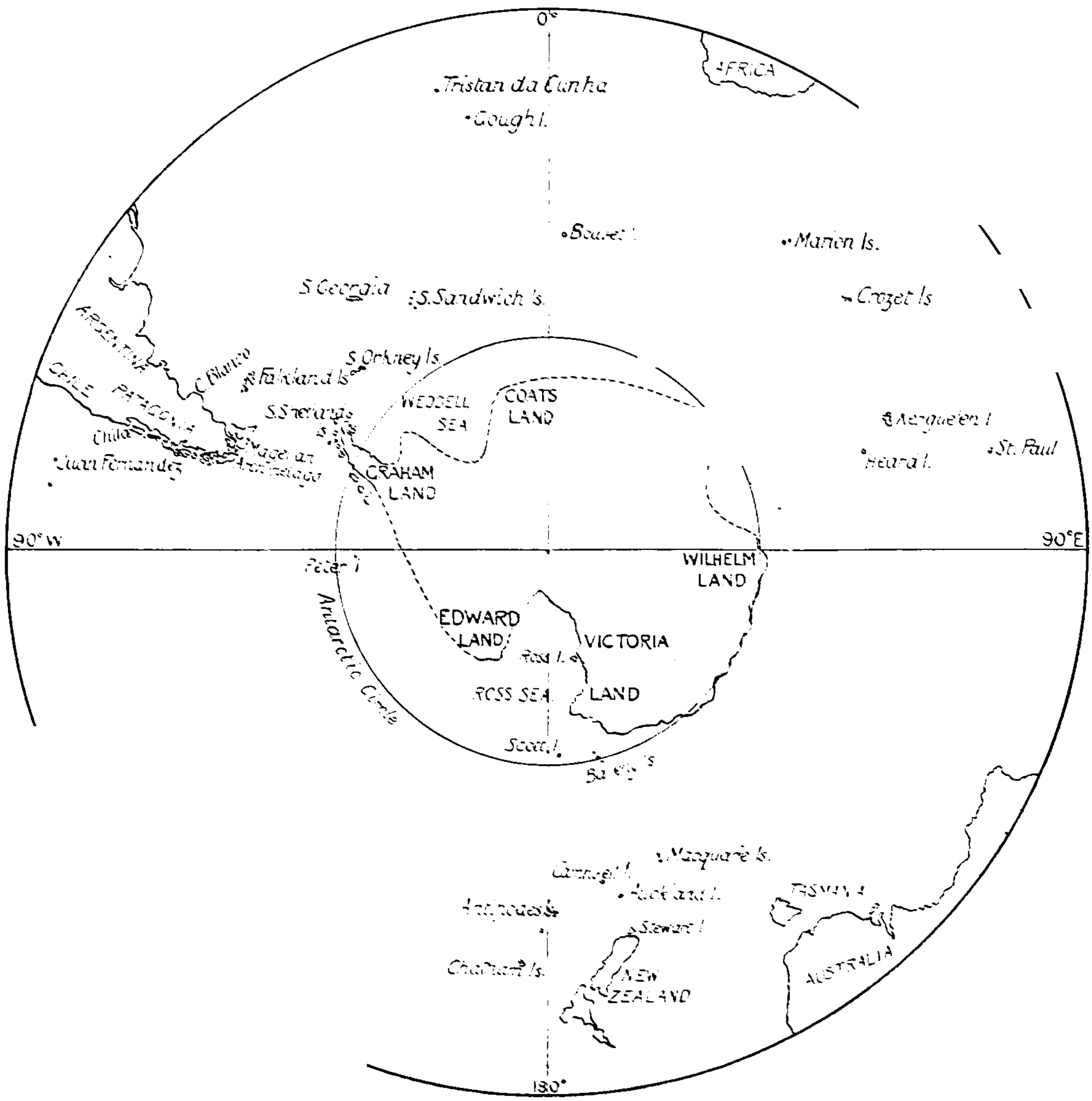

Fig. 1.—Map showing the principal localities mentioned in the text.

from the coasts in water down to two or three hundred fathoms deep, and are not pelagic or bathypelagic.

For the first time our knowledge of the fishes of the coasts of the Antarctic continent is sufficiently advanced to make it worth while to attempt to delimit an antarctic zone, and to divide it into districts.

For the purposes of reference it may be stated at once that the conclusions I have

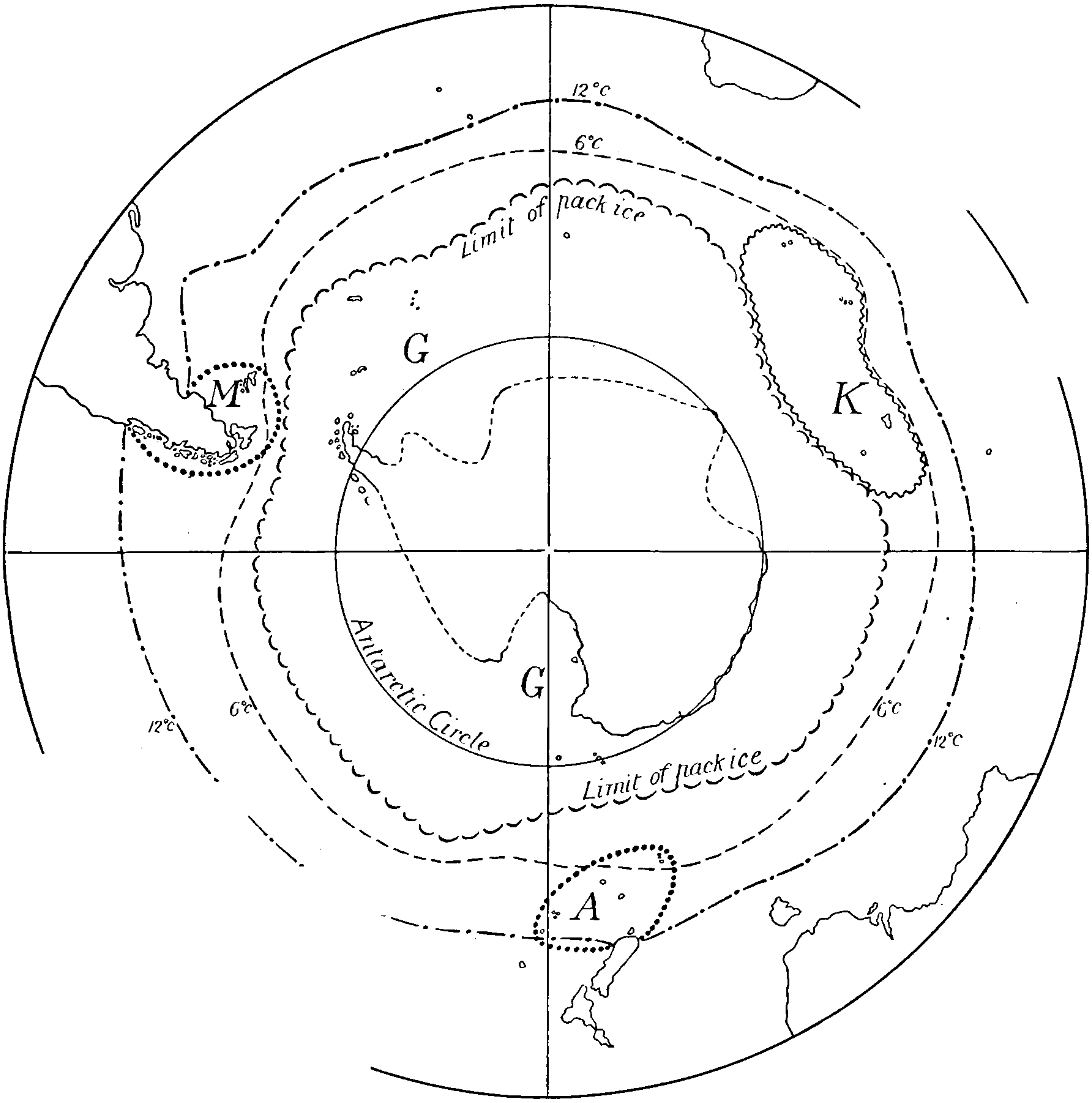

FIG. 2.—Map showing the mean annual surface isotherms of 6° C. — — — — — — and 12° C. ·—·—·—· , as calculated by Dr. Schott, respectively approximating to the northern boundaries of the Antarctic and Subantarctic Zones; the extreme limit of pack-ice ⌒⌒⌒ bounding the Glacial District (G); and the Kerguelen (K), Magellan (M) and Antipodes (A) Districts.

reached are that south of the tropical zone the distribution of coast fishes is best illustrated by the following classification:—

1. **South Temperate Zone,** with seven districts: Chile, Argentina, Tristan da Cunha, Cape, St. Paul, Australia, and New Zealand.

2. **Subantarctic Zone,** with two districts: Magellan and Antipodes.

3. **Antarctic Zone,** with two districts: Glacial and Kerguelen.

About 90 per cent. of the species of fishes known from the coasts of the Antarctic continent belong to the division Nototheniiformes; therefore it is evident that the delimitation of an Antarctic region or zone, so far as the fishes are concerned, must be based on the distribution of this group. Recognising this when working out the Antarctic fishes of the "Scotia" expedition about two years ago, I took the opportunity of monographing the Nototheniiformes. Since then Professor Roule's report on the fishes of the second Charcot Expedition has appeared, adding to our knowledge of the species and their distribution. Of the 25 Antarctic species of the "Terra Nova" collection 22 are Nototheniiformes, half of these being new species, and several others new records for Victoria Land. This being so, the list of the species and their distribution given below, whilst agreeing in the main with my monograph, includes several additions and alterations. The South Temperate localities are given first, the subantarctic next, and the strictly Antarctic last. "Magellan" includes the coast northwards to Chiloe and Cape Blanco, and "Antipodes" includes the extreme south of New Zealand and the neighbouring subantarctic islands.

DISTRIBUTION OF THE NOTOTHENIIFORM FISHES.

	S. Temperate Zone.						Subantarctic Zone.			Antarctic Zone.								
	Chile.	Argentina.	Tristan da Cunha.	St. Paul.	S.E. Australia.	New Zealand.	Antipodes.	Magellan.	Falklands.	Marion Island.	Kerguelen.	South Georgia.	South Orkneys.	Graham Land.	Victoria Land.	Wilhelm Land.	Coats Land.	
Bovichthyidae.																		
Pseudaphritis, *Casteln.*																		
urvillii, *Cuv. & Val.*					+													A fresh-water fish.
Cottoperca, *Steind.*																		
gobio, *Günth.*								+	+									
macrophthalma, *Regan*								+	+									
macrocephala, *Roule*								+										
Bovichthys, *Cuv. & Val.*																		
variegatus, *Richards.*					+	+	+											
angustifrons, *Regan*					+													
diacanthus, *Carmich.*			+															
chilensis, *Regan*	+																	*B. patagonicus* may be the same as *B. chilensis*, which may range southward to Magellan.
patagonicus, *Berg*		+																
veneris, *Sauvage*				+														
decipiens, *Regan*						+												
psychrolutes, *Günth.*							+											
roseopictus, *Hutton*						+												

	S. Temperate Zone.						Subantarctic Zone.			Antarctic Zone.								
	Chile.	Argentina.	Tristan da Cunha.	St. Paul.	S.E. Australia.	New Zealand	Antipodes.	Magellan.	Falklands.	Marion Island.	Kerguelen.	South Georgia.	South Orkneys.	Graham Land.	Victoria Land.	Wilhelm Land.	Coats Land.	
NOTOTHENIIDAE.																		
Trematomus, *Bouleng.*																		
newnesii, *Bouleng.*	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	..	..	
nicolai, *Bouleng.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	
borchgrevinkii, *Bouleng.*	..	..	..	..	..	..	..	..	..	..	..	..	+	+	+	+	..	
brachysoma, *Pappenh.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	..	
bernacchii, *Bouleng.*	..	..	..	..	..	..	..	..	..	..	..	..	+	+	+	..	..	
vicarius, *Lönnb.*	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	
dubius, *Lönnb.*	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	
hansoni, *Bouleng.*	..	..	..	..	..	..	..	..	..	..	..	+	..	+	+	+	+	
loennbergii, *Regan*	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	..	..	
pennellii, *Regan*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	
centronotus, *Regan*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	
scotti, *Bouleng.*	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	..	..	
lepidorhinus, *Pappenh.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	..	
eulepidotus, *Regan*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	
Pleuragramma, *Bouleng*																		
antarcticum, *Bouleng.*	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	+	..	
Notothenia, *Richards.*																		
trigramma, *Regan*	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	
canina, *Smitt*	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	
ramsayi, *Regan*	..	..	..	..	..	..	..	+	+	..	..	..	..	..	..	..	..	
tessellata, *Richards.*	..	..	..	..	..	..	..	+	+	..	..	..	..	..	..	..	..	
wiltoni, *Regan*	..	..	..	..	..	..	..	+	+	..	..	..	..	..	..	..	..	
brevicauda, *Lönnb.*	..	..	..	..	..	..	..	+	+	..	..	..	..	..	..	..	..	
longipes, *Steind.*	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	
sima, *Richards.*	..	..	..	..	..	..	..	+	+	..	..	..	..	..	..	..	..	
squamifrons, *Günth.*	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	
larseni, *Lönnb.*	..	..	..	..	..	..	..	..	..	..	..	+	..	+	..	..	..	
gibberifrons, *Lönnb.*	..	..	..	..	..	..	..	..	..	..	..	+	+	+	..	..	..	
acuta, *Günth.*	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	
vaillanti, *Regan*	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	
mizops, *Günth.*	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	
nudifrons, *Lönnb.*	..	..	..	..	..	..	..	..	..	..	..	+	+	+	..	..	..	
marionensis, *Günth.*	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	
angustifrons, *Fisch.*	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	
elegans, *Günth.*	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	
cornucola, *Richards.*		..	..	..	..	+	+	+	+	..	..	..	..	..	..	..	..	Northward to Milford Sound and Chatham Island.
cyaneobrancha, *Richards*	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	
coriiceps, *Richards.*	..	..	..	..	..	..	..	..	..	..	+	+	+	+	+	..	..	
rossii, *Richards.*	..	..	..	..	..	..	..	..	..	..	..	+	+	..	..	..	..	
macrocephala, *Günth.*	+	..	..	..	..	+	+	+	+	..	..	..	..	..	..	..	..	Northward to Concepcion and Lyttelton.
microlepidota, *Hutton*	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	
colbecki, *Bouleng.*	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	
filholi, *Sauvage.*	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	
Dissostichus, *Smitt*																		
eleginoides, *Smitt*	..	..	..	..	..	..	..	+	..	..	..	..	..	+	..	..	..	
Eleginops, *Gill*																		
maclovinus, *Cuv. & Val.*	+	+	..	..	..	..	..	+	+	..	..	..	..	..	..	..	..	Ranges to northern Chile and the La Plata.
Artedidraco, *Lönnb.*																		
orianae, *Regan*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	
mirus, *Lönnb.*	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	

	S. Temperate Zone.						Subantarctic Zone.			Antarctic Zone.								
	Chile.	Argentina.	Tristan da Cunha.	St. Paul.	S.E. Australia.	New Zealand.	Antipodes.	Magellan.	Falklands.	Marion Island.	Kerguelen.	South Georgia.	South Orkneys.	Graham Land.	Victoria Land.	Wilhelm Land.	Coats Land.	
Artedidraco—*cont.*																		
skottsbergii, *Lönnb.*														+	+			
shackletoni, *Waite*															+			
loennbergii, *Roule*												+		+	+			
Dolloidraco, *Roule*																		
longidorsalis, *Roule*														+				
Histiodraco, *Regan*																		
velifer, *Regan*															+			
Pogonophryne, *Regan*																		
scotti, *Regan*															+			
Harpagifer, *Richards.*																		
bispinis, *Forst.*								+	+	+	+	+	+	+				
Bathydraconidae.																		
Bathydraco, *Günth.*																		
antarcticus, *Günth.*																+		S.E. of Heard Isd. 1,260 fathoms.
macrolepis, *Bouleng.*															+			S.W. of Balleny Is. 252 fathoms.
scotiae, *Dollo*																	+	Off Coats Land, 1,410 fathoms.
Gerlachea, *Dollo*																		
australis, *Dollo*														+				
Racovitzaia, *Dollo*																		
glacialis, *Dollo*														+				
Prionodraco, *Regan*																		
evansii, *Regan*															+			
Parachaenichthys, *Bouleng.*																		
georgianus, *Fisch.*												+		+				
Gymnodraco, *Bouleng.*																		
acuticeps, *Bouleng.*															+	+		
Chaenichthyidae.																		
Champsocephalus, *Gill*																		
esox, *Günth.*								+										
gunnari, *Lönnb.*												+						
Pagetopsis, *Regan*																		
macropterus, *Bouleng.*														+	+	+		
Chaenichthys, *Richards.*																		
rhinoceratus, *Richards.*											+							
rugosus, *Regan*											+							
Chaenocephalus, *Regan*																		
aceratus, *Lönnb.*												+						
Cryodraco, *Dollo*																		
antarcticus, *Dollo*														+				
atkinsoni, *Regan*															+			
pappenheimi, *Regan*																+		
Chionodraco, *Lönnb.*																		
hamatus, *Lönnb.*														+				
kathleenae, *Regan*															+			
Chaenodraco, *Regan*																		
wilsoni, *Regan*															+			
fasciatus, *Regan*															+			

Zone. These have the interorbital region narrow, but resemble the *tessellata* group in the scaling of the head.

(4) the *marionensis* group, differing from the last in that the cheeks and opercles are scaly above, naked below. This includes only *N. marionensis*, from Marion Island, and *N. angustifrons*, from South Georgia.

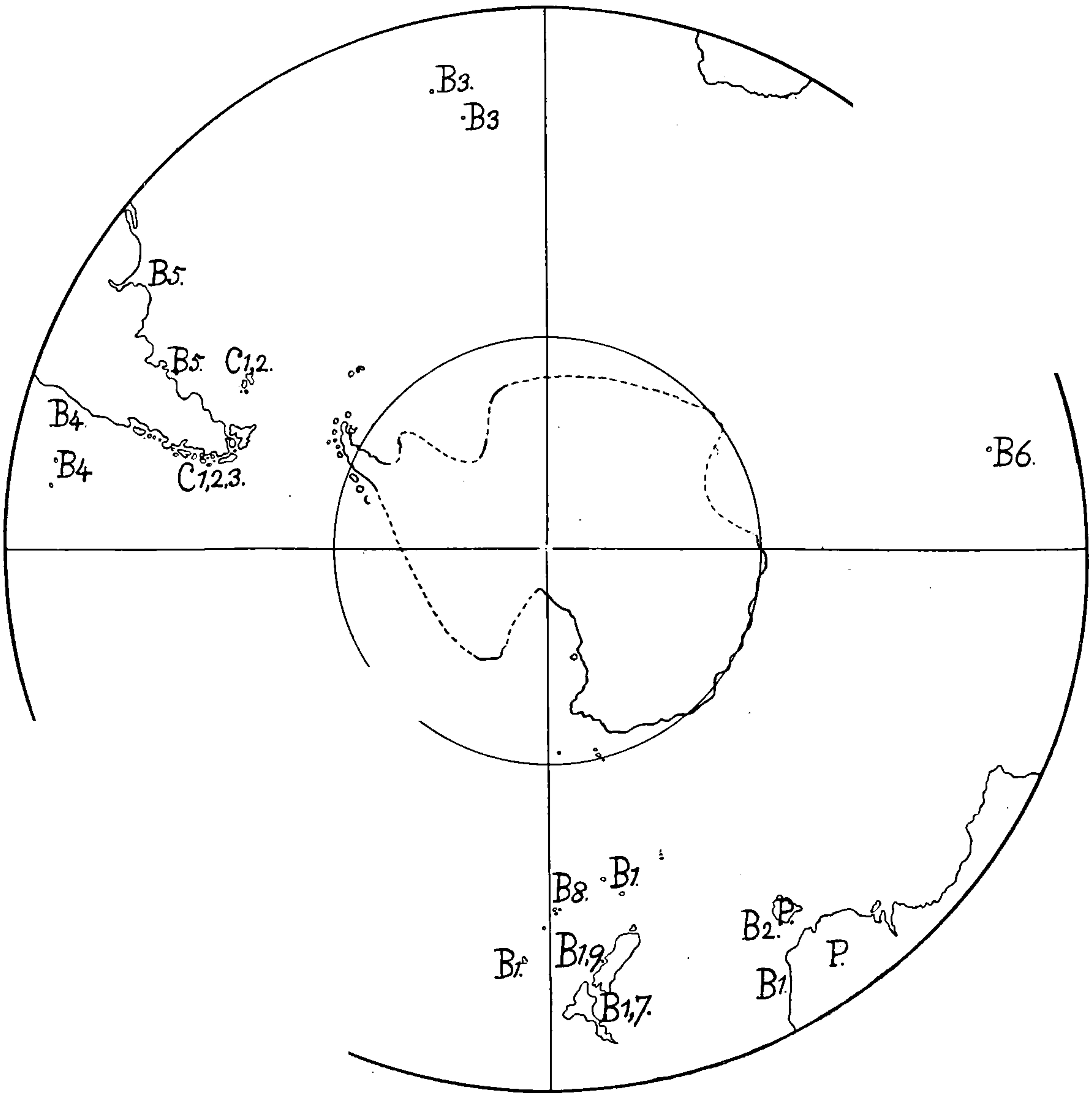

FIG. 3.—Distribution of Bovichthyidae: P. *Pseudaphritis urvillii*; C 1, *Cottoperca gobio*; C 2, *C. macrophthalma*; C 3, *C. macrocephala*; B 1, *Bovichthys variegatus*; *B* 2, *B. angustifrons*; B 3, *B. diacanthus*; B 4, *B. chilensis*; B 5, *B. patagonicus*; B 6, *B. veneris*; B 7, *B. decipiens*; B 8, *B. psychrolutes*; B 9, *B. roseopictus*.

(5) the *coriiceps* group, with the upper surface of the head naked and the opercles scaled only on the upper part of the operculum. This includes the last eight species and is the only group found in both zones.

Next to the Nototheniiformes the Zoarcidae are of importance. This is principally a northern-family and includes both oceanic and coast fishes, many of the latter frequenting rather deep water. South of the tropics the Zoarcidae are represented by

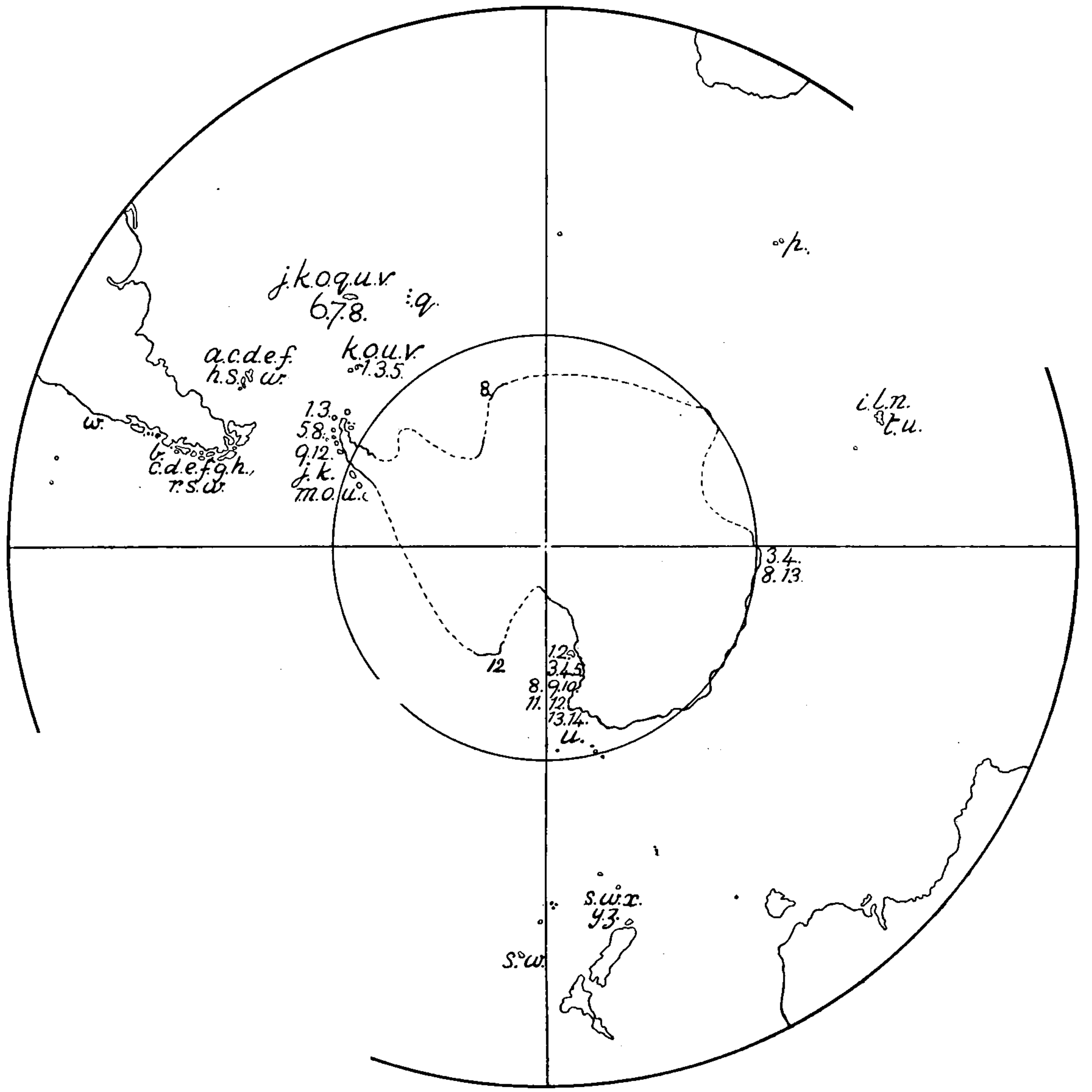

FIG. 4.—Distribution of *Trematomus* and *Notothenia*: 1, *T. newnesii*; 2, *T. nicolai*; 3, *T. borchgrevinkii*; 4, *T. brachysoma*; 5, *T. bernacchii*; 6, *T. vicarius*; 7, *T. dubius*; 8, *T. hansoni*; 9, *T. loennbergii*; 10, *T. pennellii*; 11, *T. centronotus*; 12, *T. scotti*; 13, *T. lepidorhinus*; 14, *T. eulepidotus*. a, *N. trigramma*; b, *N. canina*; c, *N. ramsayi*; d, *N. tessellata*; e, *N. wiltoni*; f, *N. brevicauda*; g, *N. longipes*; h, *N. sima*; i, *N. squamifrons*; j, *N. larseni*; k, *N. gibberifrons*; l, *N. acuta*; m, *N. vaillanti*; n, *N. mizops*; o, *N. nudifrons*; p, *N. marionensis*; q, *N. angustifrons*; r, *N. elegans*; s, *N. cornucola*; t, *N. cyaneobrancha*; u, *N. coriiceps*; v, *N. rossii*; w, *N. macrocephala*; x, *N. microlepidota*; y, *N. colbecki*; z, *N. filholi*.

a number of genera from the coasts of America and Antarctica. The following list is based on my revision in the "Scotia" report, modified by the study of a paper by

Prof. Lahille * that I had overlooked, as it had been omitted from the Zoological Record.

DISTRIBUTION OF THE SOUTHERN ZOARCIDAE.

	S. Temperate Zone.						Subantarctic Zone.			Antarctic Zone.								
	Chile.	Argentina.	Tristan da Cunha.	St. Paul.	S.E. Australia.	New Zealand.	Antipodes.	Magellan.	Falklands.	Marion Island.	Kerguelen.	South Georgia.	South Orkneys.	Graham Land.	Victoria Land.	Wilhelm Land.	Coats Land.	
Lycenchelys, *Gill*																		
antarcticus, *Regan*													+					62° 10′ S., 41° 20′ W., 1,775 fathoms; other species from deep water N. of the equator.
Ophthalmolycus, *Regan*																		
macrops, *Günth.*								+										
concolor, *Roule*														+				
Caneolepis, *Lahille*																		
acropterus, *Lahille*		+																
Iluocoetes, *Jenyns*																		
fimbriatus, *Jenyns*								+	+									
elongatus, *Smitt*								+										
Lycodichthys, *Pappenh.*																		
antarcticus, *Pappenh.*																+		
Austrolycichthys, *Regan*																		
brachycephalus, *Papph.*																+		
bothriocephalus, *Papph.*																+		
Austrolycus, *Regan*																		
morenoi, *Lahille*		+																
depressiceps, *Regan*								+	+									
platei, *Steind.*								+										
Phucocoetes, *Jenyns*																		
latitans, *Jenyns*									+									
Crossostomus, *Lahille*																		
fimbriatus, *Lahille*								+										
fasciatus, *Lönnb.*									+									
Platea, *Steind.*																		
insignis, *Steind.*								+										
Maynea, *Cunningh.*																		
patagonica, *Cunningh.*								+	+									
antarctica, *Fisch.*												+						
Melanostigma, *Günth.*																		
gelatinosum, *Günth.*								+										Magellan Straits, 24 fathoms; other species from deep water of N. Atlantic and Pacific.

Two species are the southern representatives of the northern deep-water genera *Lycenchelys* and *Melanostigma*. The rest are all generically distinct from the northern

* Lahille, "Nota sobre los Zoarcidos Argentinos," An. Mus. Nac. Buenos Aires XVI, 1908, pp. 403–441. The net result of this paper is to add *Austrolycus morenoi* and *Caneolepis acropterus* and to replace *Crossolycus* by *Crossostomus*, unless the latter is regarded as preoccupied by *Crossostoma*. *Lycodalepis laticinctus* is probably a synonym of *Austrolycus platei*.

members of the family ; two genera are peculiar to the Antarctic, two common to the Antarctic and Magellan, four peculiar to the Magellan District, one common to Magellan and Argentina, and one peculiar to the last-named.

The Magellan District is the headquarters of the southern Zoarcidae, which may have reached it originally from the north along the American coast, perhaps migrating in rather deep and cold water. It is of interest to note that no Zoarcidae are known from the South Temperate and Subantarctic Zones outside the Argentine and Magellan Districts. Evidently the southern coast fishes of this family have been able to extend their range only along a nearly continuous shore line ; this is in harmony with what is known as to their breeding and development.

THE ANTARCTIC ZONE.

This includes the coasts of the Antarctic continent and the islands that lie to the south of the isotherm of 6° C., with the probable exception of Macquarie Island.

It is characterised by the complete absence of South Temperate types, by the absence of Bovichthyidae and the great development of the other Nototheniiformes. It is more sharply marked off than any other zone, the percentage of peculiar genera being extremely high and that of species that range beyond its limits very low.

Glacial District.

This includes the coasts of the Antarctic continent and neighbouring islands, together with South Georgia, the South Sandwich Islands, and probably Bouvet Island, all lying within the extreme limit of pack-ice. About 90 per cent. of the coast fishes of this district are Nototheniiformes and most of the rest are Zoarcidae.

Nototheniidae. The Nototheniinae are represented by *Trematomus* (14 spp.), *Pleuragramma* (1 sp.), *Notothenia* (6 spp.), and *Dissostichus* (1 sp.). *Eleginops* is absent. The two first-named genera are confined to this area ; five of the six species of *Notothenia* are peculiar, the exception being *N. coriiceps*, which ranges to Kerguelen. *Dissostichus eleginoides* is common to Graham Land and Magellan.

The Harpagiferinae (*Artedidraco*, *Dolloidraco*, *Histiodraco*, *Pogonophryne*, *Harpagifer*) are confined to this district, with the exception of *Harpagifer bispinis*, which extends also to the Kerguelen and Magellan Districts.

Bathydraconidae are confined to the district. *Bathydraco* must be regarded as oceanic, and probably the related genera *Gerlachea*, *Racovitzaia* and *Prionodraco* should go with it ; but none of these has been found far from the coast of Antarctica, the most northerly being *B. antarcticus*, taken midway between Wilhelm Land and Heard Island. *Parachaenichthys georgianus* from South Georgia and *Gymnodraco acuticeps* from the coasts of the Antarctic continent may be reckoned as coast fishes.

Chaenichthyidae are characteristic, the only extralimital forms being the two species of *Chaenichthys* (Kerguelen) and *Champsocephalus esox* (Magellan).

ZOARCIDAE are represented by a species of *Maynea* from South Georgia, the only other species of the genus inhabiting the Magellan District, and by three species from the coasts of Antarctica, belonging to two endemic genera, *Lycodichthys* and *Austrolycichthys*, related to the Magellan *Iluocoetes* and *Austrolycus* respectively.

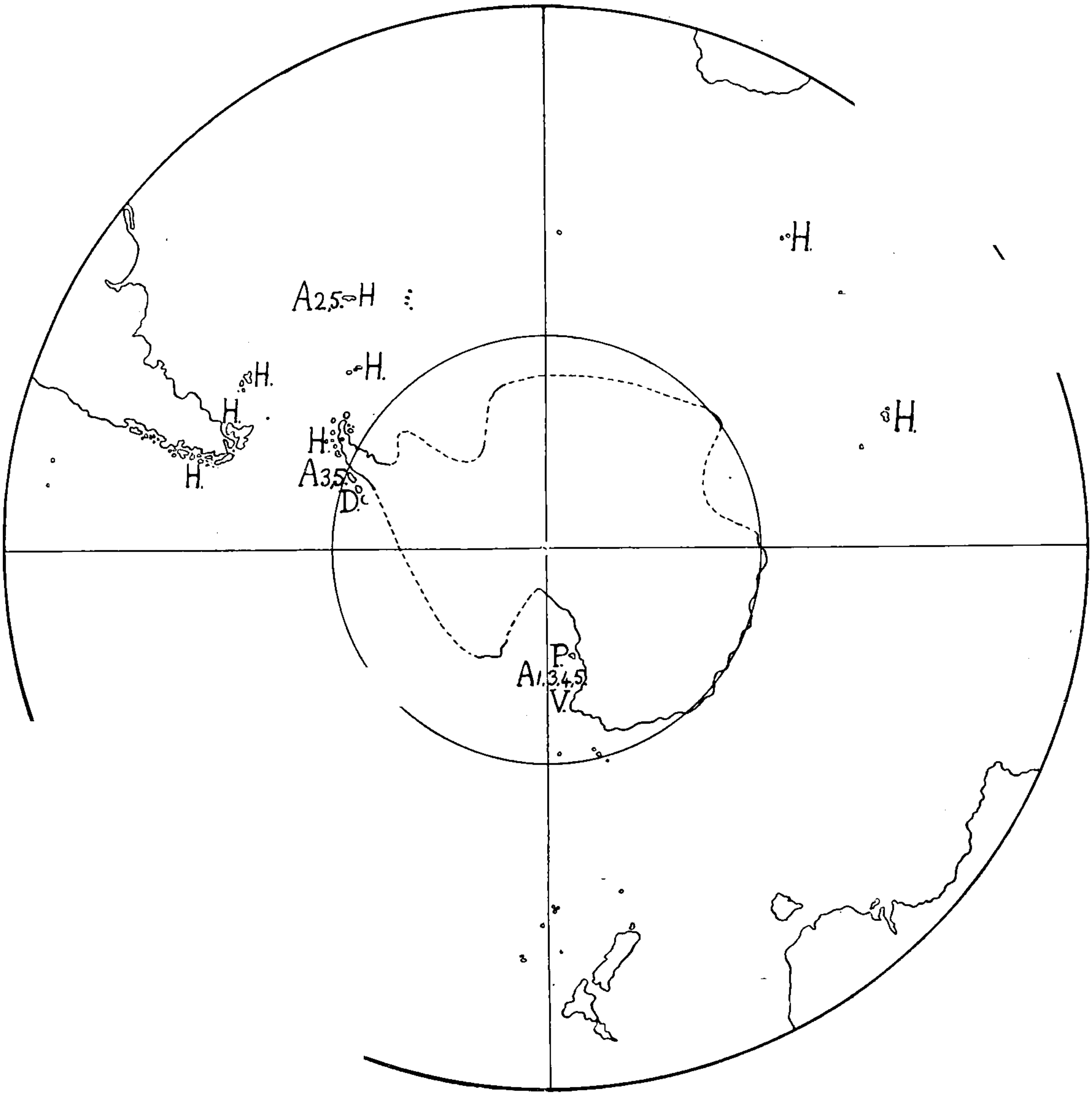

FIG. 5.—Distribution of *Harpagiferinae*: A 1, *Artedidraco orianae*; A 2, *A. mirus*; A 3, *A. skottsbergii*; A 4, *A. shackletoni*; A 5, *A. loennbergii*; D, *Dolloidraco longidorsalis*; V, *Histiodraco velifer*; P, *Pogonophryne scotti*; H, *Harpagifer bispinis*.

MURAENOLEPIDAE. This family comprises but a single genus with one species from Magellan, another from Kerguelen, and a third, *Muraenolepis microps*, from the district now under consideration.

COTTIDAE. *Sclerocottus schraderi*, Fisch., from South Georgia parallels the

Antarctic Zoarcidae as the representative of a northern family generically distinct from the northern members of the group.

In the present state of our knowledge subdivision of the Glacial District would be premature; many of the species are known to have a circumpolar distribution,

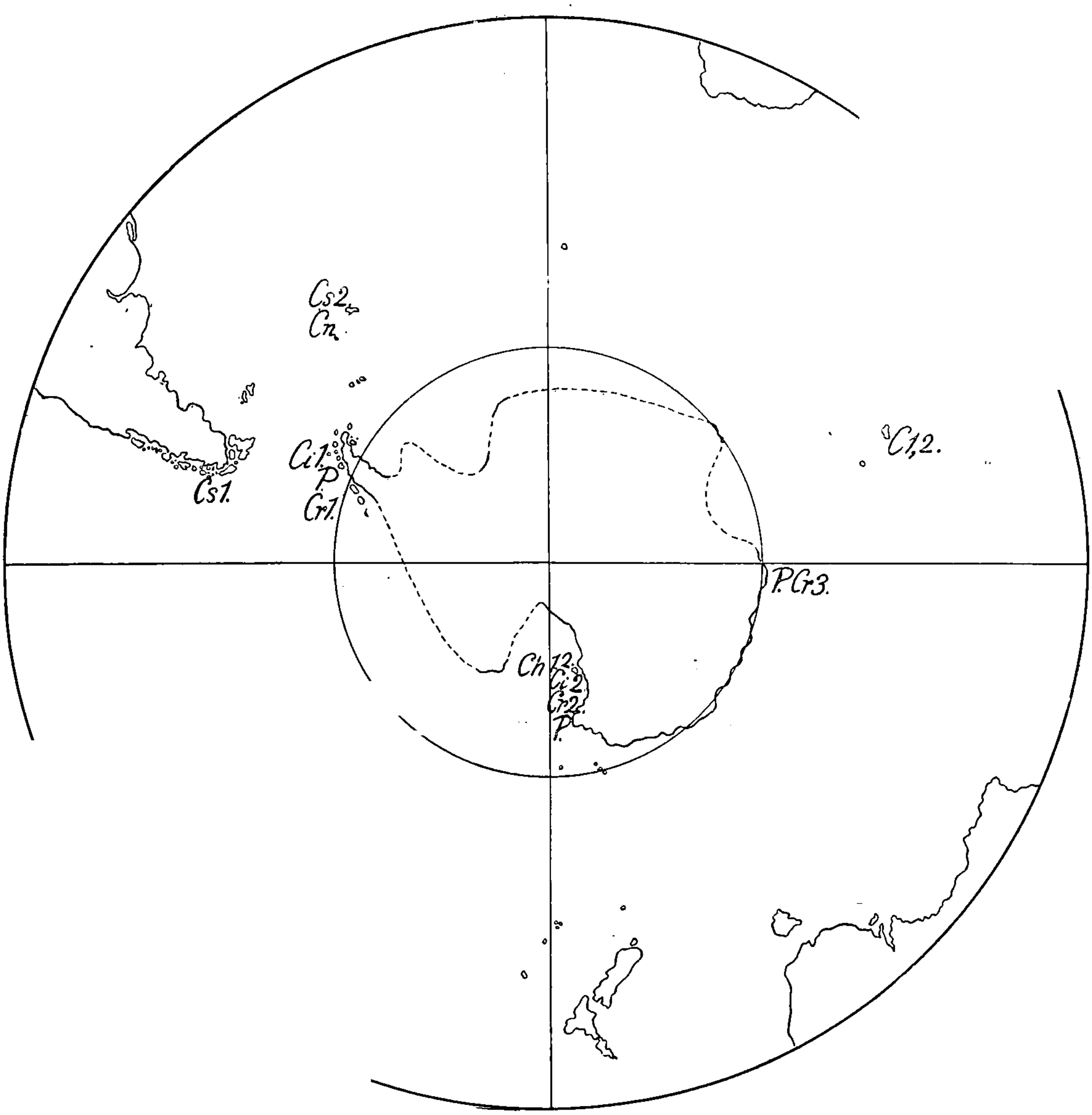

Fig. 6.—Distribution of *Chaenichthyidae*: Cs, *Champsocephalus*: 1, *esox*; 2, *gunnari*; P, *Pagetopsis macropterus*; C, *Chaenichthys*: 1, *rhinoceratus*; 2, *rugosus*; Cn, *Chaenocephalus aceratus*; Cr, *Cryodraco*: 1, *antarcticus*; 2, *atkinsoni*; 3, *pappenheimi*; Ci, *Chionodraco*: 1, *hamatus*; 2, *kathleenae*; Ch, *Chaenodraco*: 1, *wilsoni*; 2, *fasciatus*.

and further researches will doubtless increase their number. It may be noted that from Victoria Land 12 species of *Trematomus* and only one of *Notothenia* have been described, from Graham Land six of *Trematomus* and five of *Notothenia*, and from South Georgia three of *Trematomus* and six of *Notothenia*. That South Georgia is rightly included can hardly be questioned; of its 15 species of Nototheniiform fishes nine are known also from Graham Land, and the remaining six include species of *Trematomus* and *Artedidraco*, whilst only one (*Champsocephalus gunnari*) has Magellan affinities.

KERGUELEN DISTRICT.

This includes the island of Kerguelen and also Heard Island, the Crozet Islands, and Marion and Prince Edward Islands.

The fish-fauna of Kerguelen is known from the collections made there by the "Erebus" and "Terror" and the "Challenger"; recently the "Gauss" collected there, but obtained no additional species.

There are two species of the cosmopolitan genus *Raia*; *Muraenolepis marmoratus* is related to *M. microps* and *M. orangiensis* of the Glacial District and of Magellan respectively, and *Zanclorhynchus spinifer* is a genus and species peculiar to the island, its nearest relative being the south temperate *Congiopus* (*Agriopus*).

The rest are Nototheniiformes, viz., five species of *Notothenia*, one of *Harpagifer* and two of *Chaenichthys*. Of these *Notothenia coriiceps* and *Harpagifer bispinis* are found on the coast of the Antarctic continent; the rest are peculiar, but show relationship to species known from South Georgia and Graham Land, for *N. squamifrons* is closely related to *N. larseni*, *N. acuta* to *N. gibberifrons*, *N. mizops* to *N. nudifrons*, and *N. cyaneobrancha* to *N. coriiceps*, whilst *Chaenichthys*, a genus peculiar to the island, belongs to the Antarctic family Chaenichthyidae. Little is known of the other islands that may pertain to this area, but it may be noted that at Marion Island *Notothenia marionensis* is the representative of the South Georgian *N. angustifrons*.

At the first glance it may seem that as so many characteristic Antarctic genera appear to be absent and most of the Nototheniidae belong to *Notothenia*, which is well represented in the Subantarctic Zone, the Kerguelen District might be included in the latter. But a more critical examination shows that the *tessellata* group, characteristic of Magellan, is absent, that the *squamifrons*, *acuta* and *marionensis* groups are present and are found elsewhere only in the Glacial District, and that the *coriiceps* group is represented by *N. coriiceps*, an Antarctic species, and by the related *N. cyaneobrancha*.

The only way to mark the dissimilarity of the fish-fauna of Kerguelen from that of Magellan or of the subantarctic islands of New Zealand, and to express its affinity to that of Antarctica, is to include it in the Antarctic Zone as a separate district, small and impoverished, but with well-marked characters.

THE SUBANTARCTIC ZONE.

This includes the Falklands and the southern extremity of South America, northwards about to Chiloe and Cape Blanco, and the extreme south of New Zealand, with the adjacent islands, Stewart, Auckland, Campbell, Antipodes, and perhaps Macquarie. Its limits correspond approximately to the isotherms of 12° C. and 6° C.

distinctive feature is the presence of five species of *Notothenia* of the *coriiceps* group, three of them peculiar, and the other two found also in the Magellan District and extending in New Zealand somewhat to the north of the boundaries assigned above. *Galaxias attenuatus* is marine south to Campbell Island and at least as far north as Cook's Straits and Tasmania; in fresh water the genus extends to New Caledonia.*

B. OCEANIC FISHES.

It has been mentioned above that the Glacial District, for coast fishes, comprises the islands that lie within the extreme limit of pack-ice. It may be of some interest to consider the known distribution of the oceanic fishes, whether pelagic, bathypelagic or abyssal, that have been recorded from within this limit.

ARGENTINIDAE.

The widely distributed genus *Bathylagus* is represented by three species—*B. antarcticus*, Günth., *B. gracilis*, Loennb., and *B. glacialis*, Regan. Of these the first ranges north to 37° S., the second to 49° S., and the third is known only from specimens taken off Coats Land.

GONOSTOMATIDAE.

Cyclothone microdon, Günth., is cosmopolitan.

STOMIATIDAE.

Stylophthalmus paradoxus, Brauer, is a larval form recorded from near Bouvet Island, and also from the South Atlantic and Indian Oceans.

SUDIDAE.

Notolepis coatsii, Dollo, is a genus and species that may be peculiar to the area within the extreme limit of pack-ice. It is circumpolar (cf. Regan, Trans. R. Soc. Edinb. XLIX, 1913, p. 233); a larva from Graham Land has recently been figured by Prof. Roule (Deuxième Expéd. Antarct. Franç. Poiss. pl. III).

MYCTOPHIDAE.

The cosmopolitan genera *Myctophum* and *Lampanyctus* are each represented by a single species. *M. antarcticum*, Günth., is circumpolar, and ranges north to 28° S. *L. braueri*, Loennb., is known from a specimen from off Coats Land, and another from 49° 56′ S., 49° 56′ W.

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* Weber and Beaufort, Zool. Anz. XLII, 1913, p. 172.

Scopelarchidae.

Dissoma anale, Brauer, is known from near Bouvet Island, and from the South Atlantic and Indian Oceans.

Alepidosauridae.

Eugnathosaurus vorax, Regan, is a genus and species known only from off Coats Land.

Gadidae.

Melanonus gracilis, Günth., originally described from the Antarctic, is now known to range in the Atlantic to 36° N.

Macruridae.

Cynomacrurus piriei, Dollo, is a genus and species known only from the type taken off Coats Land. The other species belong to widely distributed genera :— *Chalinura ferrieri*, Regan, and *C. whitsoni*, Regan, are from Coats Land, and the latter from 48° S., 10° W. also: *Nematonurus lecointei*, Dollo, has been taken off Graham Land, near the South Orkneys, and in 48° S., 10° W. *N. armatus*, Hect., is known from near the Crozet Islands and to the north of Wilkes Land, also from the Pacific as far north as 37° N. *Lionurus filicauda*, Günth., ranges north to the latitude of Valparaiso and the La Plata, and has been taken in the Antarctic Ocean to the north of Wilkes Land.

Bathydraconidae.

As mentioned above, *Bathydraco* certainly and three related genera probably should be classed as oceanic ; they are not known to occur beyond the limits of the Glacial District.

Zoarcidae.

Lycenchelys antarcticus, Regan, from near the South Orkneys, is the first southern species of *Lycenchelys*.

Brotulidae.

Holcomycteronus brucei, Dollo, is from near the South Orkneys ; a second species has been described by Garman from 2°–26° N., 82°–110° W.

Cyclopteridae.

Liparis steineni, Fisch., and *Careproctus georgianus*, Loennb., from South Georgia, and *Paraliparis antarcticus*, Regan, from Victoria Land, are the Antarctic representatives of genera that seem to be cosmopolitan, but may be best represented in northern seas and include many deep water species.

Our knowledge of the distribution of the pelagic and deep sea fishes of the Antarctic Ocean is obviously not sufficiently complete to permit of an attempt to co-ordinate the results so far obtained.

2. THE ANTARCTIC CONTINENT DURING THE TERTIARY PERIOD.

Many authorities believe that in the early Tertiary the Antarctic continent was connected with Australia and with South America; some think with Africa also. The distribution of the Fishes, and of other groups of animals, has been considered to support this hypothesis.

Fishes.

The distinctive features of the fish-fauna of the coasts of Antarctica are that nearly all the genera and species are peculiar and that they nearly all belong to a single group, the Nototheniiformes, which is characteristic of and almost restricted to the Antarctic and Subantarctic Zones. In the Antarctic Zone this group has developed into a large number of types that differ greatly in structure, appearance and habits. These facts seem to point to the conclusions that Antarctica may have long been isolated and that its coasts may have been washed by a cold sea for a long time, probably throughout the Tertiary Period.

It has been suggested that identical or related species of different parts of the South Temperate Zone are part of the fauna of the coasts of an Antarctic continent that formerly connected America, Africa and Australia. It is very difficult to make this view harmonise with the facts. Tristan da Cunha and St. Paul, 4,500 miles apart, have at least two species of shore fishes (*Labrichthys ornatus* and *Chilodactylus monodactylus*) in common. Have these persisted unchanged whilst the coasts of Antarctica have receded to their present position, and whilst the fauna of Kerguelen has become differentiated? It seems far more likely that the distribution of these species is due to present conditions; Tristan da Cunha and St. Paul are nearly in the same latitude and on the same isotherm, and the Antarctic Drift runs directly from one to the other. In all probability it will be found that the species common to both islands have floating eggs and larvae that swim at the surface; it is even possible that the adult fish may occasionally migrate from one island to the other. The case of related species, as for example *Seriolella velaini* from St. Paul, and *S. antarctica* from Tristan da Cunha, may be explained on similar lines; it is evident that the distance between the islands is too great to be traversed by these species, but under somewhat different conditions the parent form may have lived at both and either at the Cape or at Marion and the Crozets, or at other islands that may have existed and served as stepping stones, but have now disappeared. Whatever may be the true explanation, it is certain that the construction of

Tertiary land-bridges to account for all cases of this sort would reduce the oceans to a few puddles.

Much has been made of the distribution of the Galaxiidae and Haplochitonidae, for some time regarded as fresh-water fishes found in Southern Australia and Tasmania, New Zealand, and the southern part of America. It is now known that *Galaxias attenuatus*, the only species common to all these regions, breeds in the sea. In the "Scotia" report I have shown that these two families are Salmonoids related to the Osmeridae, and their marine origin may be regarded as certain. Like the northern Salmonoids they are establishing themselves in fresh water, and it is interesting to note that *Galaxias* occurs at the Cape and even in New Caledonia, where, like the Trout of Algeria, it remains as the witness of a glacial epoch.

None of the families of true fresh-water fishes of either South America or Africa occurs in Australia, except the Osteoglossidae, a generalised and ancient type. Even in this case the relationship is not with America or Africa, but with Asia, *Scleropages* comprising one species from Queensland and New Guinea, and one from Borneo and Sumatra.

Thus neither marine nor fresh-water fishes support the theory that the Antarctic continent connected America with Australia during the Tertiary Period. This being the case, I have been led to examine somewhat critically the other zoogeographical evidence in support of this theory. Some of this is derived from the similarity of marine faunas, or from the distribution of fresh-water organisms that may have had a marine origin. Of more importance are the land animals, and Dollo, in his monumental report on the "Belgica" fishes, comes to the conclusion, "C'est *l'Antarctide Tertiaire* de M. Osborn—ou une Antarctide analogue, indispensable pour les *Marsupiaux* et *Miolania*—qui explique le mieux la *Biogéographie* des *Poissons Antarctiques* et *Sub-antarctiques*." Unable to accept this for the Fishes, I have looked into the question of the Marsupials and *Miolania*.

MARSUPIALS.

It has been suggested that *Caenolestes* and the extinct Patagonian members of the Epanorthidae may be related to the Australian group Diprotodontia. This is by no means generally accepted, and several authorities believe that the Epanorthidae may have been derived from a primitive Didelphoid type which has evolved a diprotodont dentition independently. This view is supported by the fact that the Epanorthidae are eleutherodactyle, whereas the Australian Diprotodonts are syndactyle.*

It has recently been shown by Gidley † that the Multituberculates are "Diprotodonts," so that Marsupials of this type date back to the Triassic, and even if they be monophyletic, their occurrence in Australia and South America loses its significance.

* Thomas, Proc. Zool. Soc. 1895, p. 870; Gregory, Bull. Amer. Mus. XXVII, 1910, p. 211.

† Proc. U. S. Nat. Mus. XXXVI, 1909, p. 611.

Recently some American writers * claim to have proved the relationship of the Sparassodonts of Ameghino, *Borhyaena*, *Prothylacinus*, etc., of the Miocene of Patagonia to the Tasmanian *Thylacinus*, and even unite them in a family Thylacinidae, distinct from the Dasyuridae ; for this there seems to be but little justification.

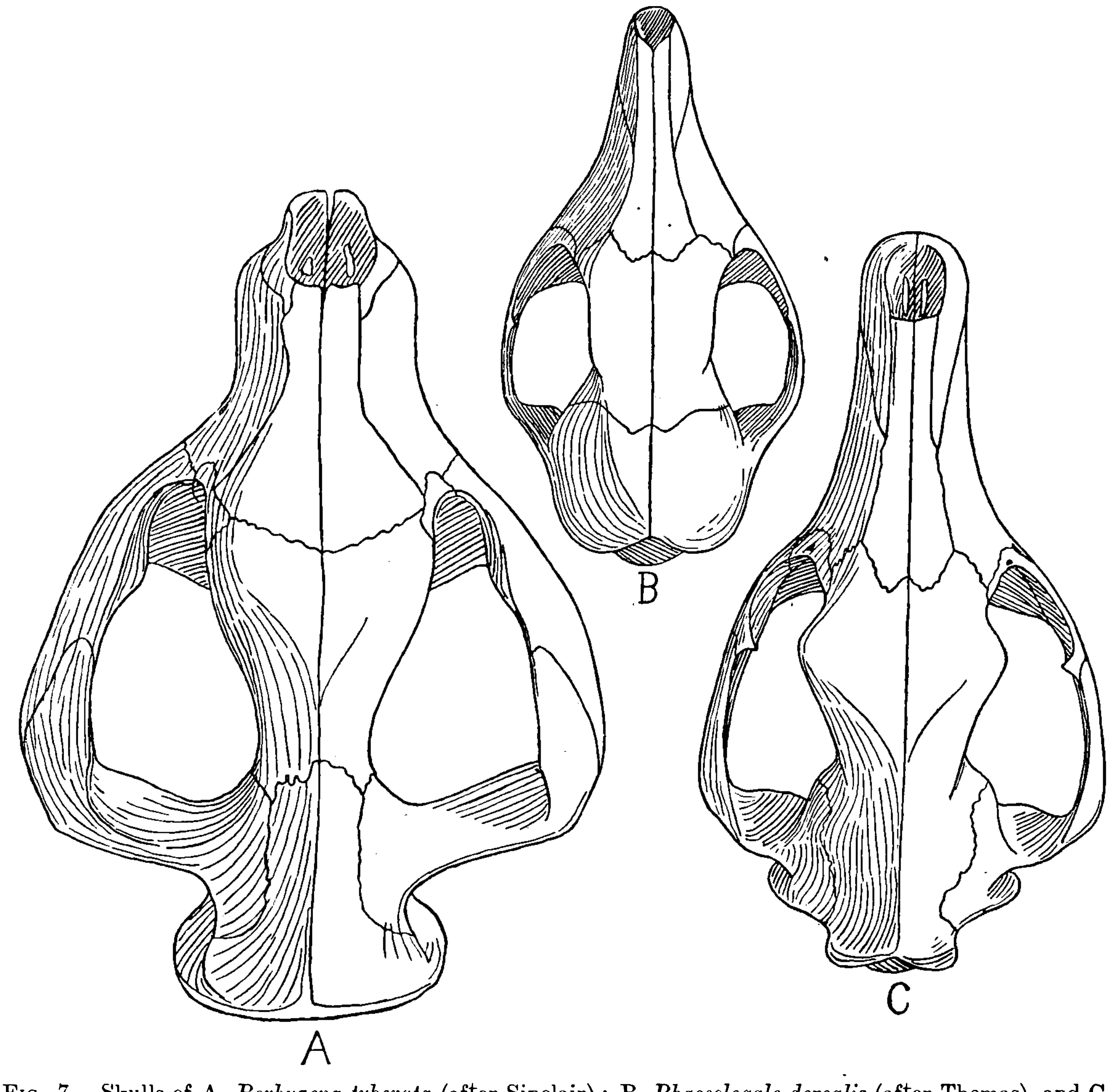

FIG. 7.—Skulls of A, *Borhyaena tuberata* (after Sinclair) ; B, *Phascologale dorsalis* (after Thomas), and C, *Thylacinus cynocephalus* ; seen from above. *Phascologale* has been selected for comparison as a small insectivorous type, differing from the large carnivorous *Thylacinus* in the form of the cranium and zygomatic arch, but resembling it in many important structural characters.

Tomes † has shown that in *Borhyaena* the enamel of the teeth resembles in structure that of Creodonts and Carnivores, lacking tubules, and with the groups of

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* Sinclair, Rep. Princeton Exped. Patagonia, IV, 1901, p. 333; Gregory, Bull. Amer. Mus. XXVII, 1910, p. 207.

† Proc. Zool. Soc. 1906, I, p. 45.

prisms interlacing to produce a characteristic pattern in cross-section. In *Thylacinus* and *Dasyurus*, on the contrary, the enamel is typically Marsupial in that it is penetrated by tubules continuous with those of the dentine and has the prisms straight and parallel. The two genera mentioned show a special agreement in that the tubules end at some distance from the surface. Ameghino states that in the Sparassodonts not only the third praemolar, but the canine and sometimes the second praemolar, have deciduous predecessors. In *Thylacinus*, as in the other Dasyuridae, only the third praemolar is preceded by a milk tooth. I have examined the skulls of *Thylacinus* and several other Dasyuridae (Fig. 7, B, C) and find that they agree in having the orbits well backward, the nasal processes of the praemaxillaries long, the nasals but moderately expanded posteriorly, the maxillary and frontal meeting in a suture, the jugal emitting a postorbital process just before its junction with the squamosal, the occipital region triangular in outline, the basisphenoid foramina paired and palatal vacuities present (said to be absent in some species of *Phascologale*).

The Sparassodonts, as described and figured in Sinclair's admirable monograph, differ in the more anterior position of the orbits, shorter nasal processes of the praemaxillaries, nasals strongly expanded posteriorly, meeting the lachrymals and separating the maxillaries from the frontals, the absence of a distinct postorbital process, the semicircular occipital outline, the unpaired basisphenoid foramen, and the absence of palatal vacuities (Fig. 7, A).

The dentition of *Thylacinus* is readily derivable from the primitive Dasyurid type (*Phascologale*); the teeth of the Sparassodonts correspond closely to those of *Thylacinus* in form and number, except that the metacone of the fourth upper molar is vestigial or absent, whereas in *Thylacinus* it is well-developed.

There appears to be no escape from the conclusion that *Thylacinus* is a true but aberrant member of the Dasyuridae, and that it has nothing to do with the Borhyaenidae, a family well characterised by peculiarities in the skull, and in the structure and perhaps in the succession of the teeth. The specialised carnivorous dentition, superficially similar to that of *Thylacinus*, has been independently evolved.

MIOLANIA.

The family Miolaniidae includes some large extinct Pleurodiran Tortoises that are remarkable for the development of a caudal sheath of bony rings and the presence of dermal bony bosses on the head.

There are two genera, *Miolania*, Owen, and *Niolamia*, Ameghino. The former includes two species, *M. platyceps*, Owen,* from the Pleistocene of Lord Howe Island, and *M. oweni*, A. S. Woodward,† from the Pleistocene of Queensland. *Niolamia*

* Owen, Phil. Trans., 1886, pp. 471–480, pls. XXIX, XXX; and 1888, pp. 181–191, pls. XXXI–XXXVII.
† Woodward, Ann. Mag. Nat. Hist. (6) I, 1888, p. 89.

comprises a single species, *N. argentina*, Ameghino,* from Patagonian deposits that were at first stated to be Cretaceous, but may prove to be Miocene.

In *Miolania* (Fig. 8, B) the skull, seen from above, is somewhat oblong in form, with the snout broadly rounded. The dermal bosses all have the appearance of separate elements. On the upper surface may be recognised a large but low parietal pair; behind them is an occipital pair that project backwards, and in front of them a smaller frontal pair mesially, and a postfrontal pair laterally. A pair of subconical bosses, rounded or ovate in transverse section, on each side of the parietal pair, project as lateral "horns"; a much smaller pair are placed directly in front of them. Other features of the genus that may be mentioned are that the praemaxillaries have a median pit for the reception of the symphysial beak of the mandible, that the palatal extensions of the praemaxillaries and maxillaries bear two sharp ridges within

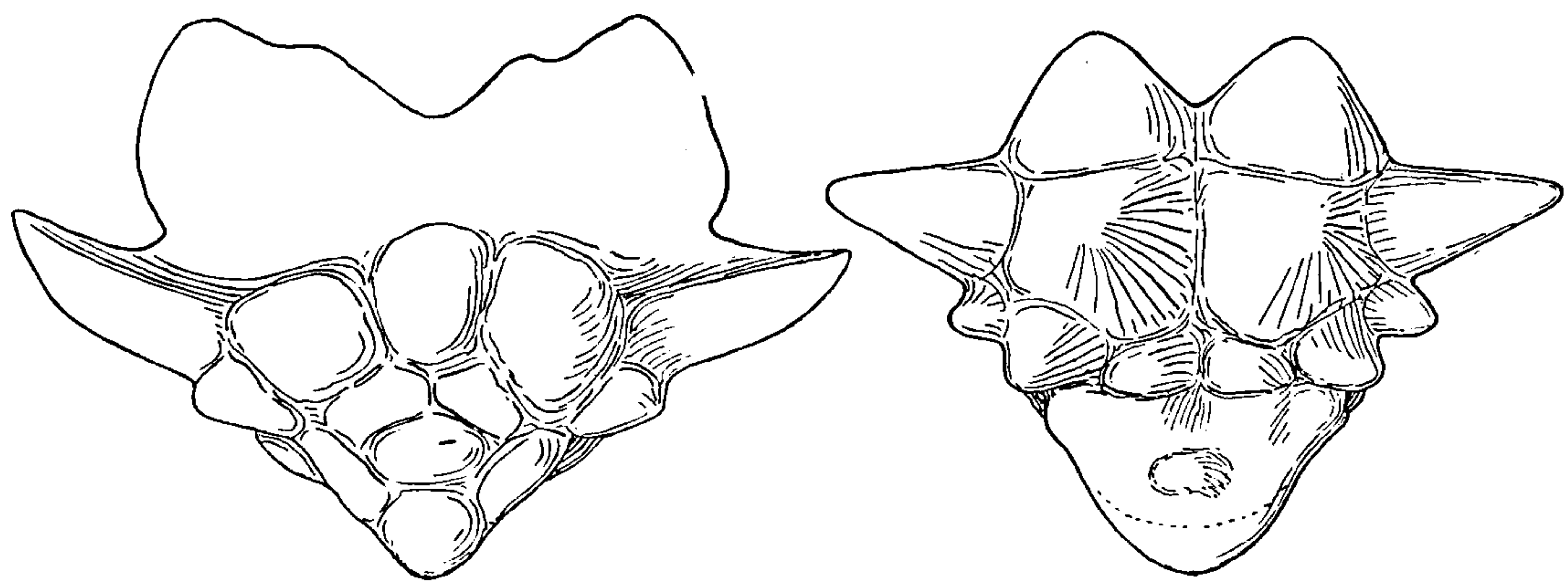

FIG. 8.—Skulls of A, *Niolamia argentina*, and B, *Miolania oweni*, seen from above. In B the position of the anterior margin of the praemaxillaries is indicated by a dotted line.

and parallel to the margin of the upper jaw, that the nasals project beyond the praemaxillaries, and that there is a bony internasal septum.

In *Niolamia* (Fig. 8, A) the skull is nearly triangular in outline, with the snout more acute than in *Miolania*. The bosses differ considerably from those of *Miolania*, as there are three instead of two parietal bosses, the occipital pair are enormous laminar expansions, the lateral "horns" are broad and flat, triangular in section, and have no smaller pair in front of them. Further differences from *Miolania* are that the praemaxillaries are not pitted, the mandible is not beaked, the upper jaw has a single blunt intramarginal ridge, the nasals do not project beyond the praemaxillaries, and there is no internasal septum.

These differences have already been pointed out by Dr. Smith Woodward (Proc. Zool. Soc. 1901, I, pp. 174–176), but he has not insisted on them so much as on

* Woodward, Proc. Zool. Soc., 1901, I, p. 170, pls. XV–XVIII.

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EXPLANATION OF THE PLATES.

PLATE I.

FIG. 1.—Trematomus bernacchii.
,, 2.— ,, hansoni.

PLATE II.

FIG. 1.—Paraliparis antarcticus.
,, 2.—Muraenolepis microps.
,, 3.—Trematomus brachysoma.

PLATE III.

FIG. 1.—Trematomus centronotus.
,, 2.— ,, pennellii.

PLATE IV.

FIG. 1.—Trematomus lepidorhinus.
,, 2.— ,, scotti.
,, 3.— ,, eulepidotus.

PLATE V.

FIG. 1.—Artedidraco skottsbergii.
,, 2.— ,, loennbergii.
,, 3.—Histiodraco velifer.

PLATE VI.

FIG. 1.—Pogonophryne scotti (reduced to $\frac{5}{6}$).
,, 2.—Artedidraco orianae.

PLATE VII.

FIG. 1.—Prionodraco evansii.
,, 2.—Cryodraco atkinsoni (reduced to $\frac{5}{6}$).

PLATE VIII.

Chionodraco kathleenae (reduced to $\frac{2}{3}$)

PLATE IX.

FIG. 1.—Chaenodraco wilsoni.
,, 2.— ,, fasciatus.

PLATE X.

FIG. 1.—Xystreurys brasiliensis.
,, 2.—Idiacanthus niger.

PLATE XI.

FIG. 1.—Prionotus brachychir.
,, 2.—Arnoglossus mongonuiensis.
,, 3.—Serranops maculicauda.
,, 4.—Lepidoperca inornata.

PLATE XII.

FIG. 1.—Hemerocoetes pauciradiatus.
,, 2.— ,, macrophthalmus.
,, 3.—Pyramodon punctatus.
,, 4.—Notopogon lilliei.
,, 5.— ,, xenosoma.

PLATE XIII.

Psammobatis cirrifer.

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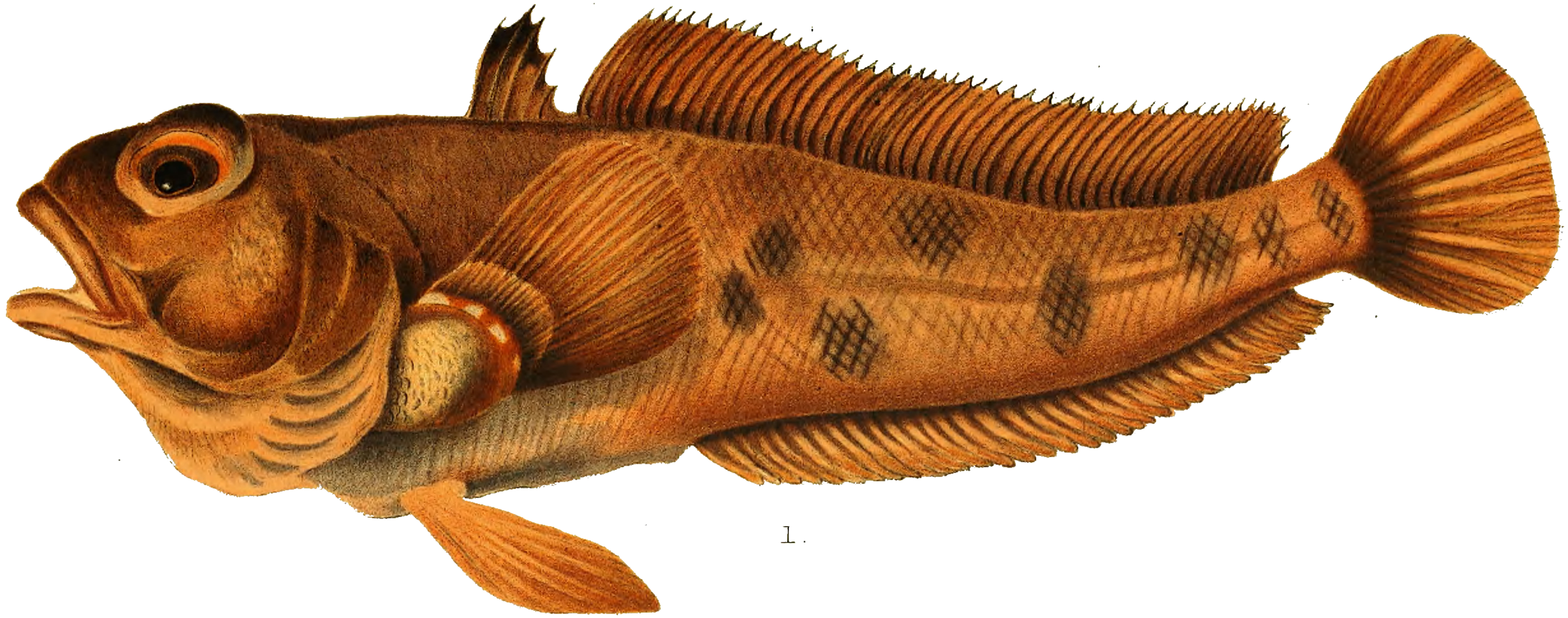

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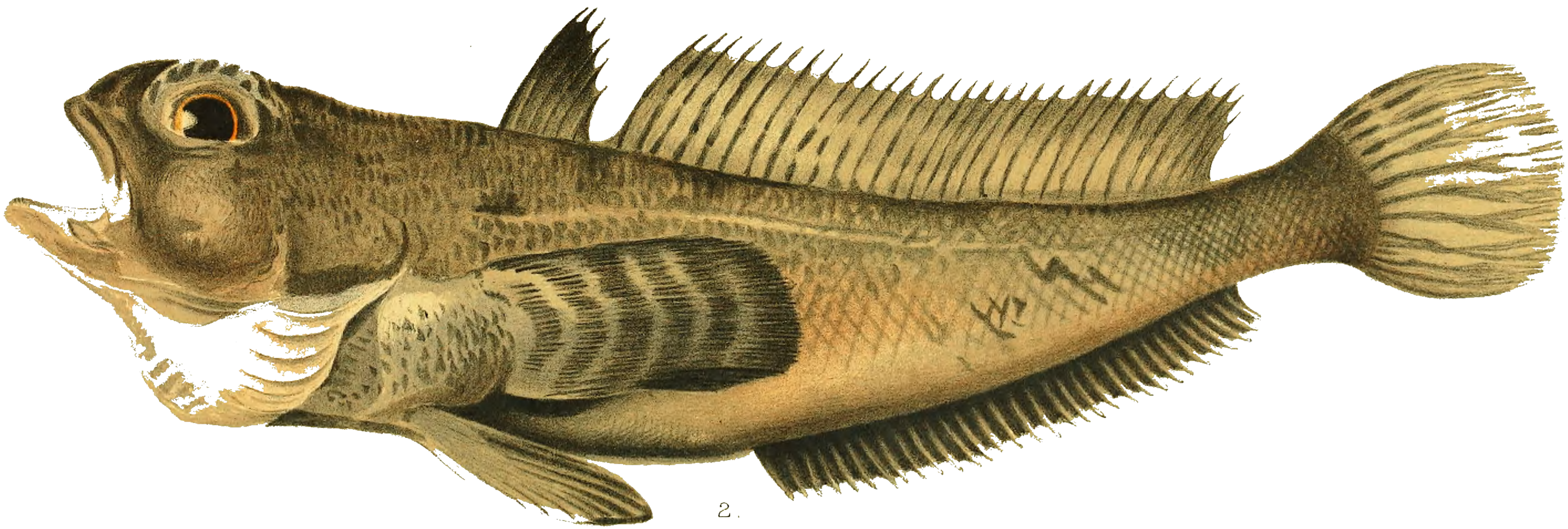

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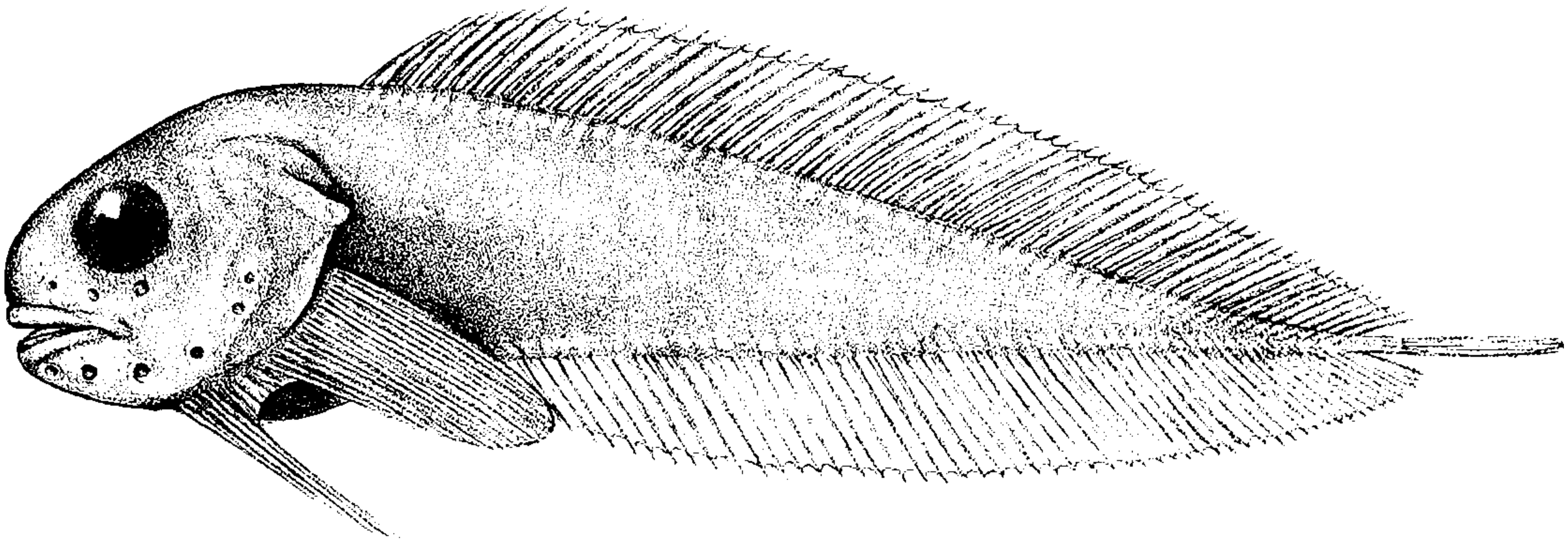
Fishes, Pl. I



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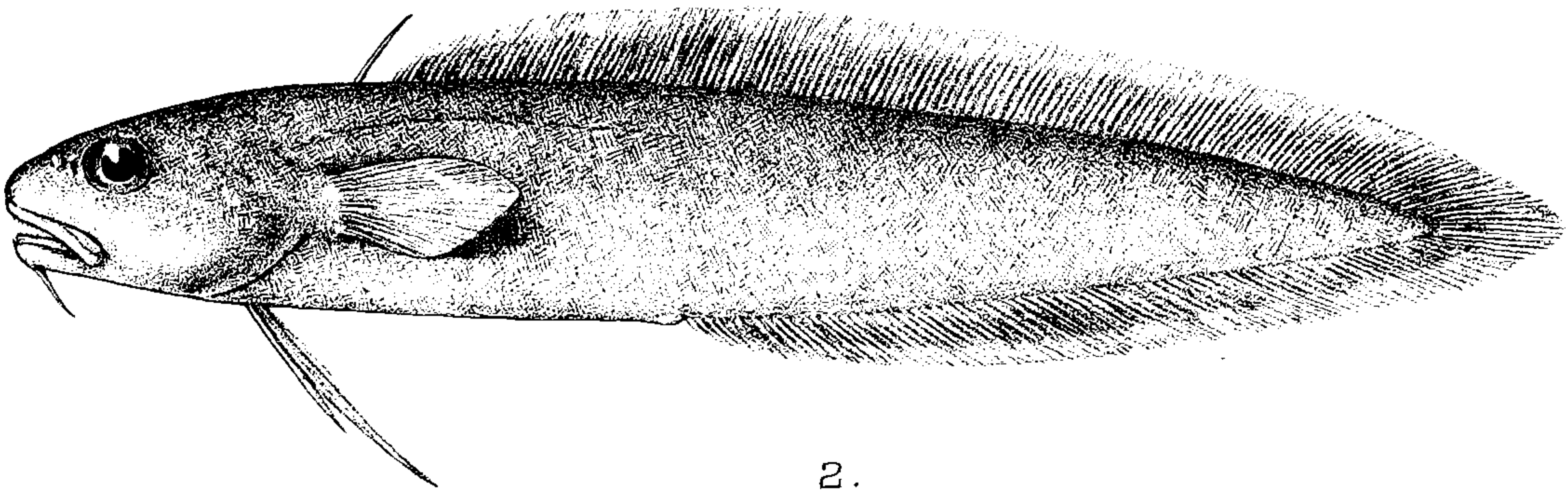

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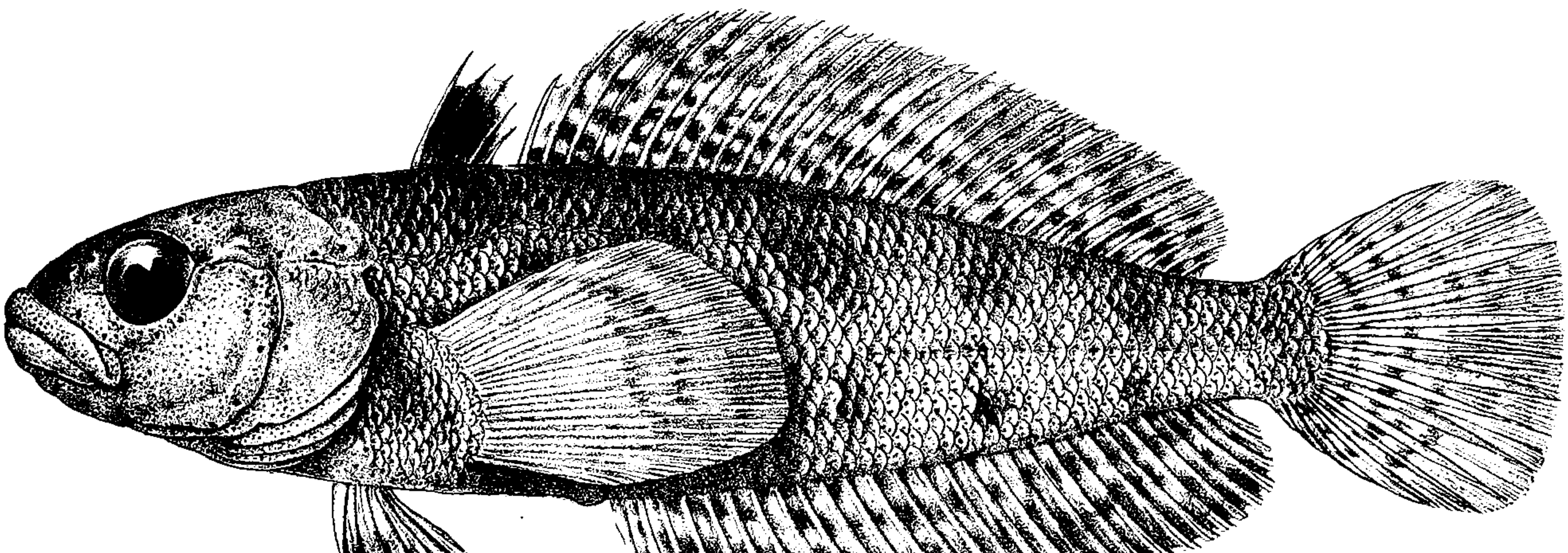

3.

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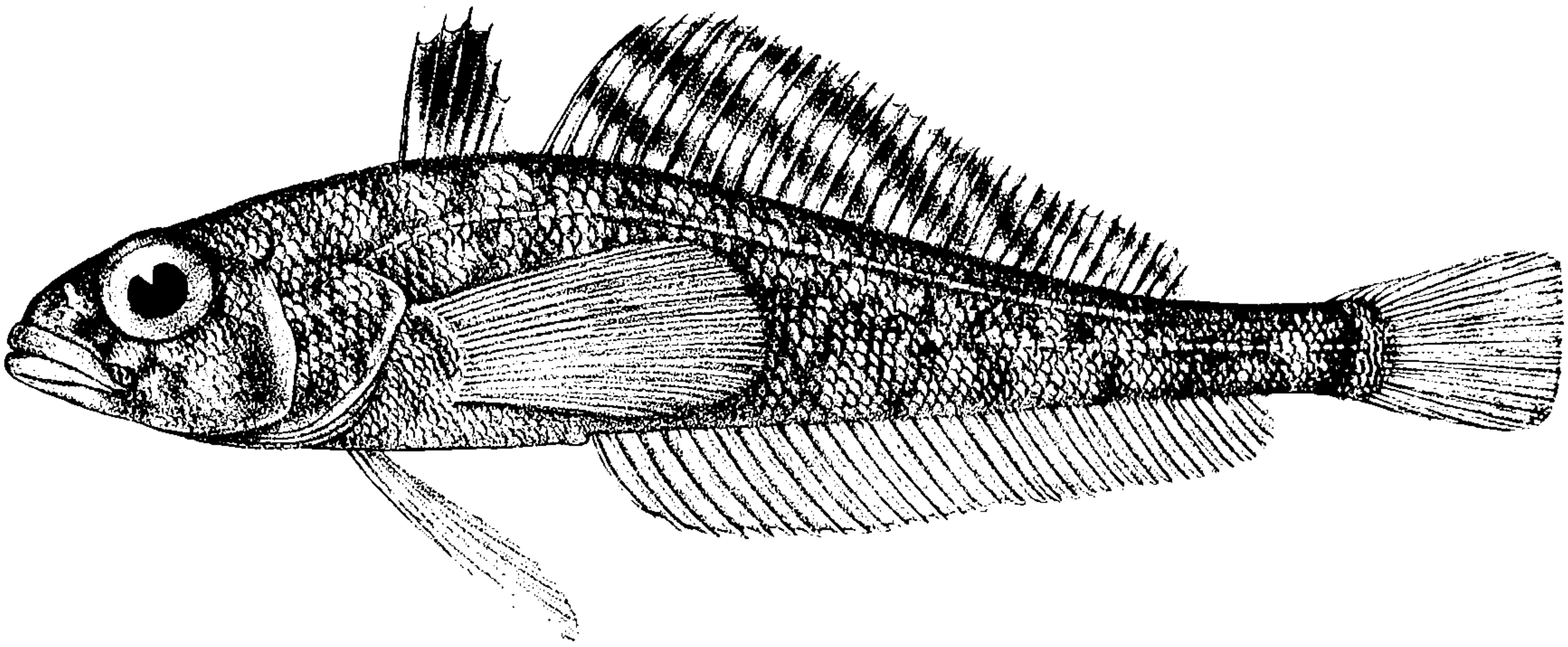
1. *Paraliparis antarcticus.* 2. *Muraenolepis microps.* 3. *Trematomus brachysoma.*



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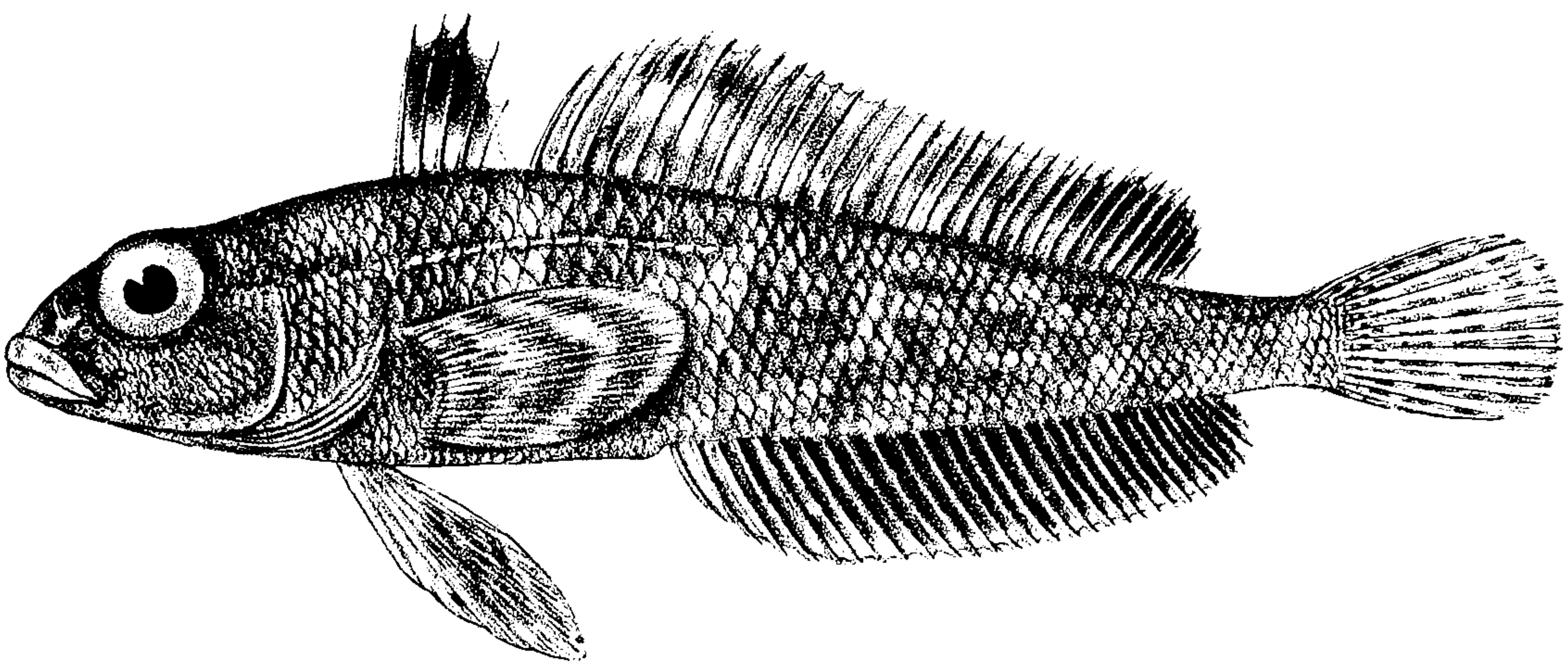

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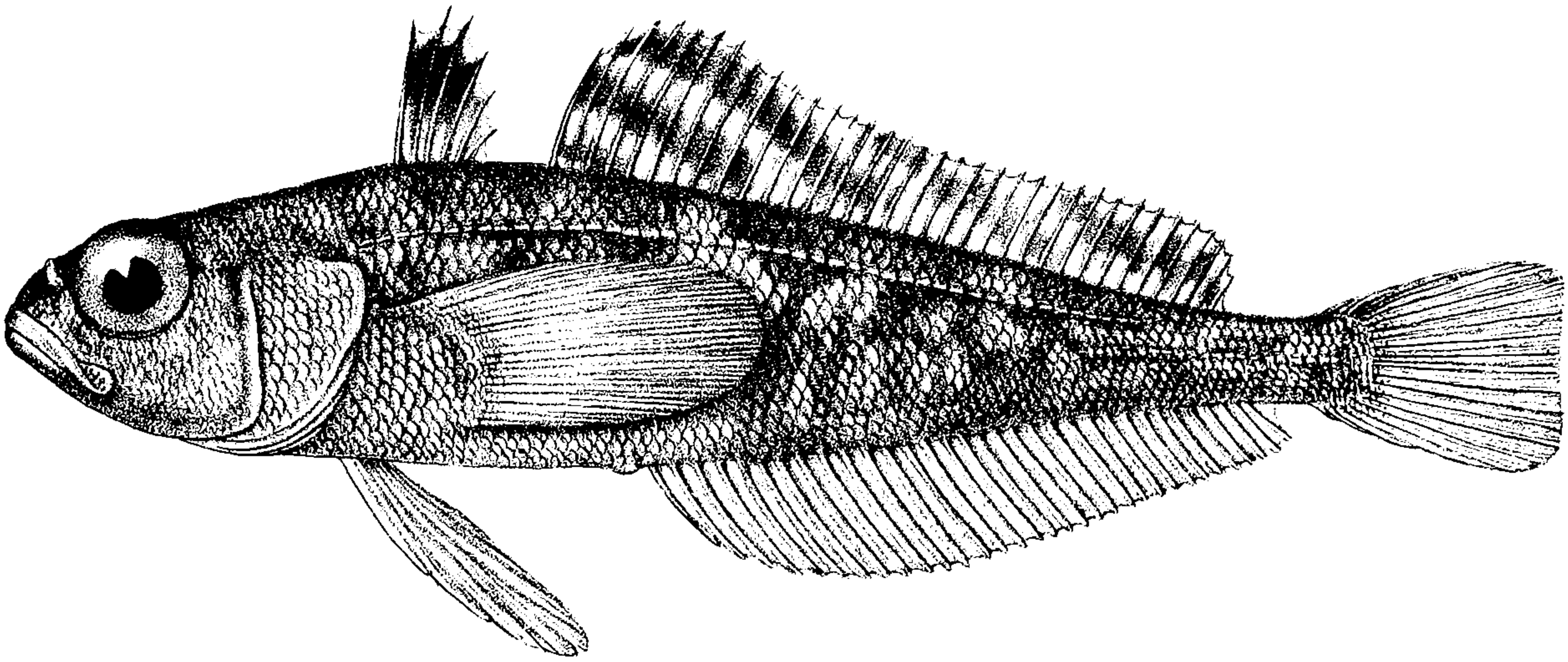

3.

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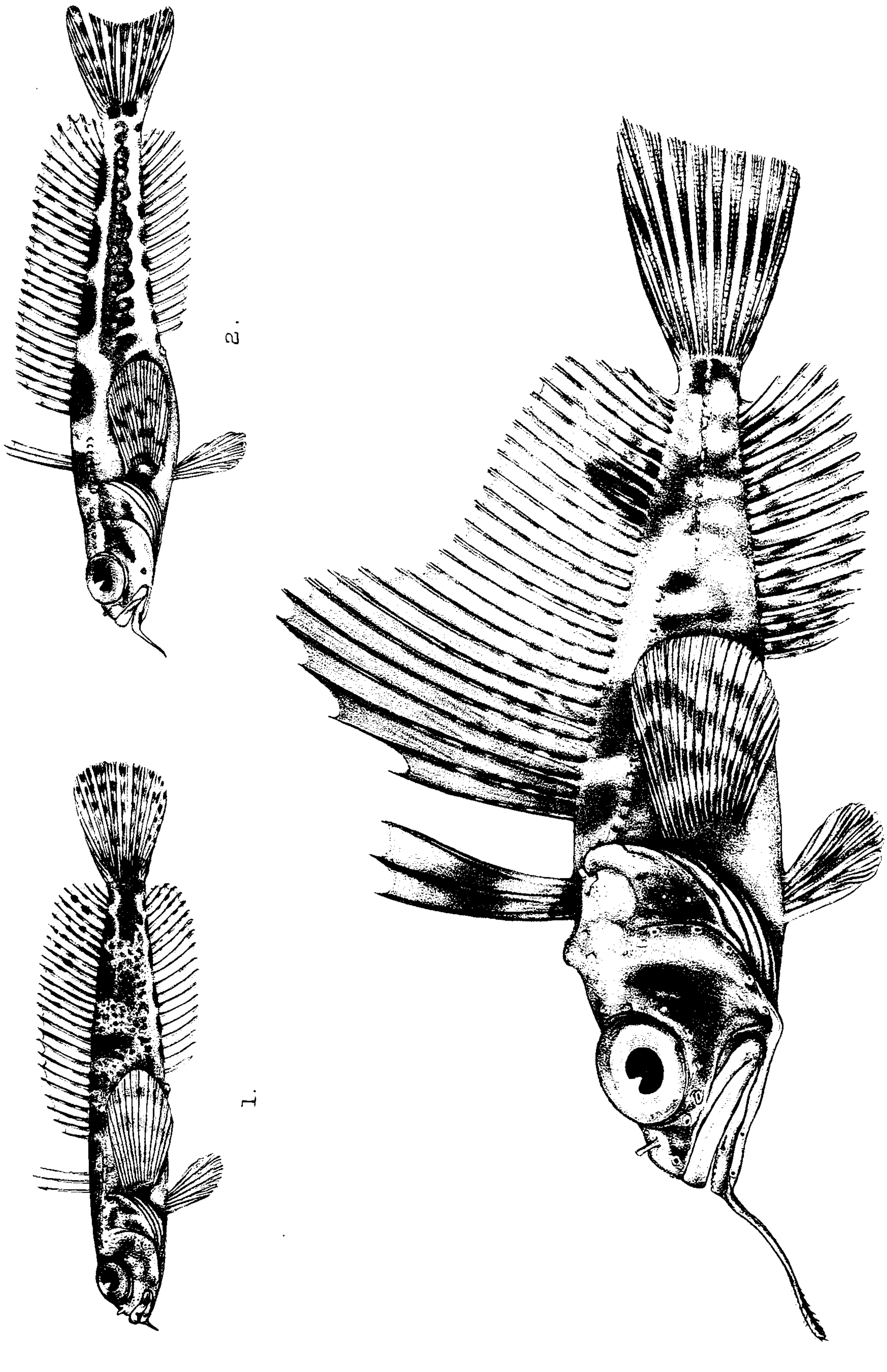
1. Trematomus lepidorhinus. 2. T. scotti. 3. T. eulepidotus.



1. Artedidraco skottsbergii. 2. A. loennbergii. 3. Histiodraco velifer.

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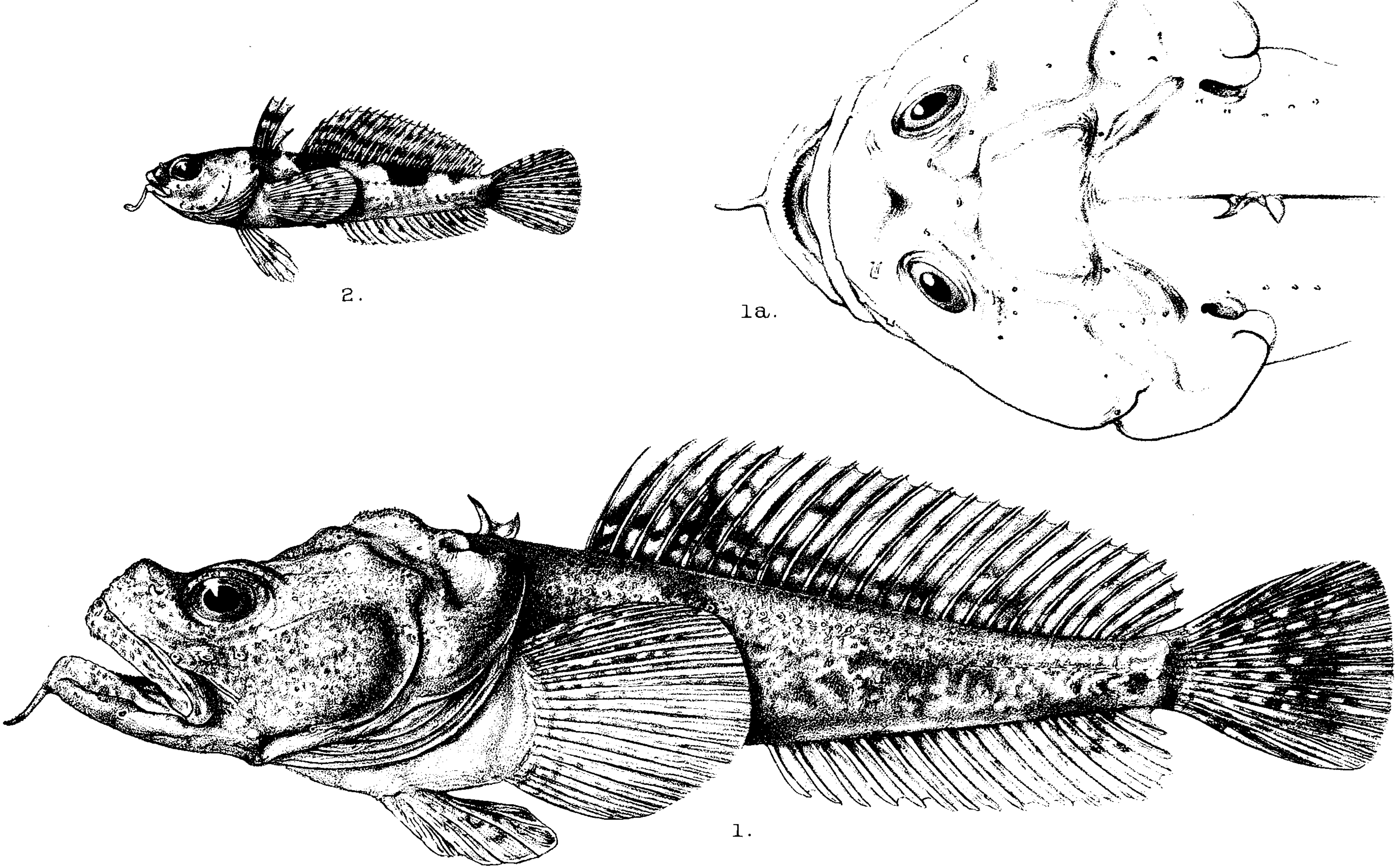

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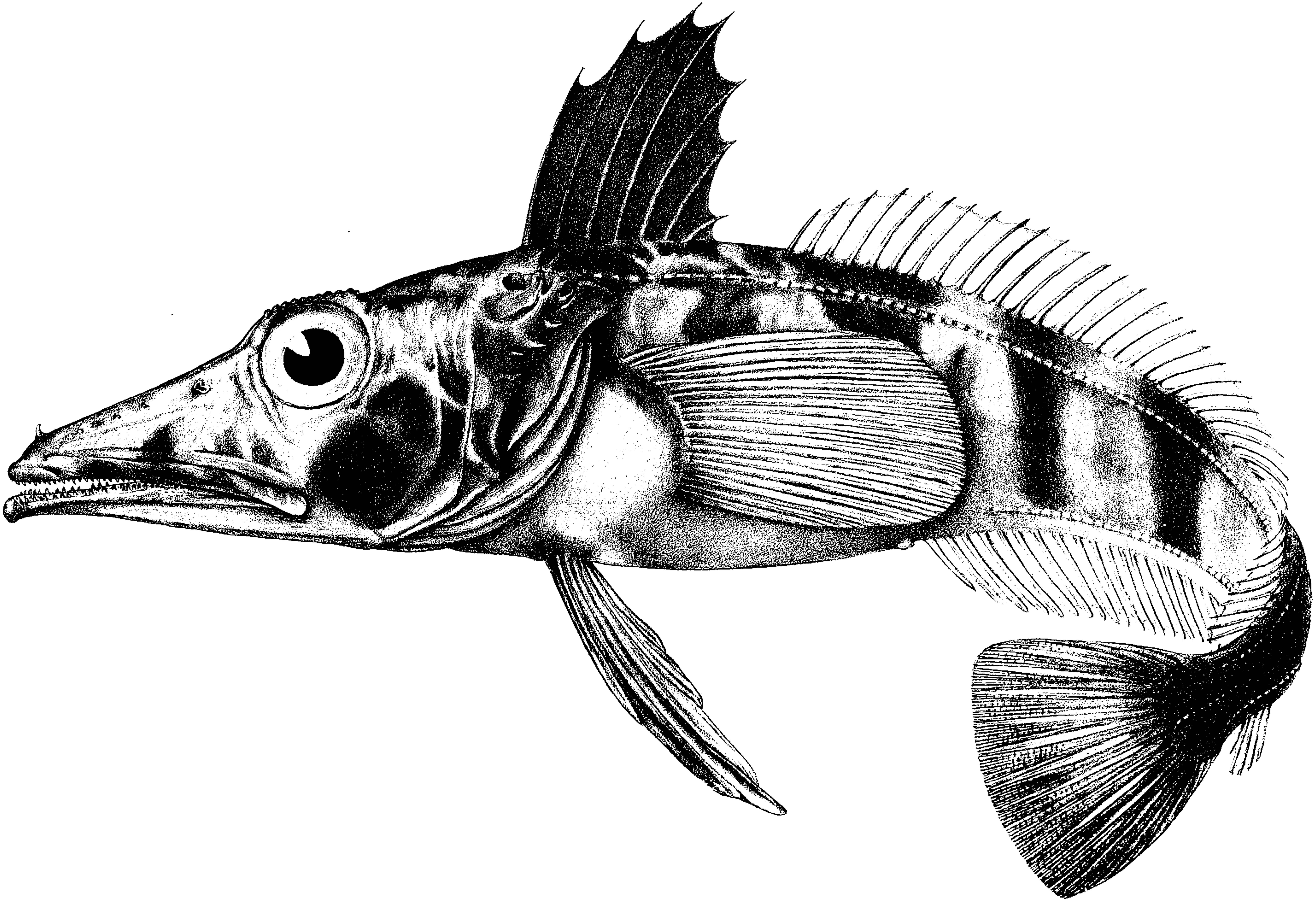
1. Pogonophryne scotti. 2. Artedidraco orianae.



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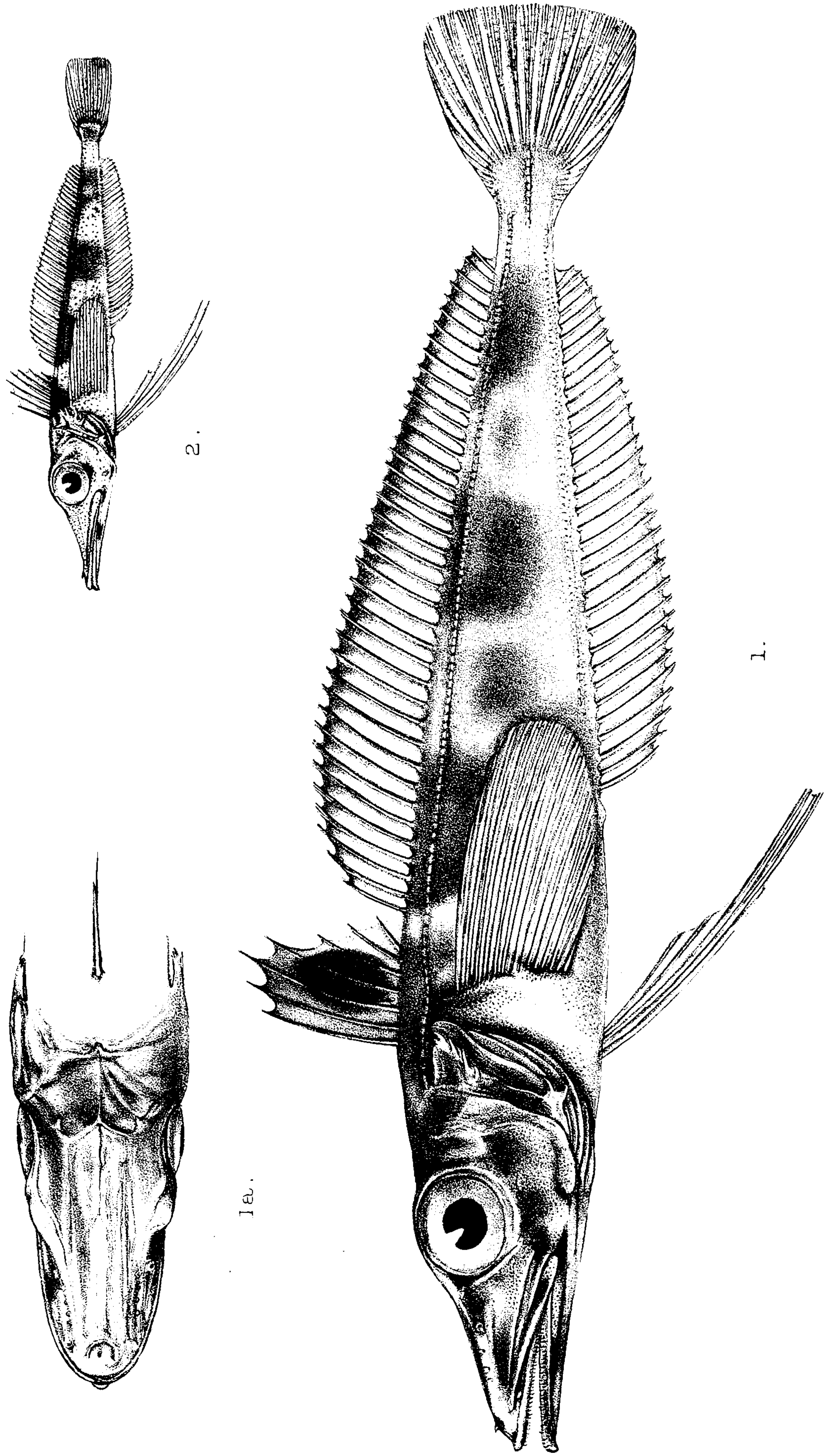
Chionodraco kathleenae.



1. *Chaenodraco wilsoni*. 2. *C. fasciatus*.

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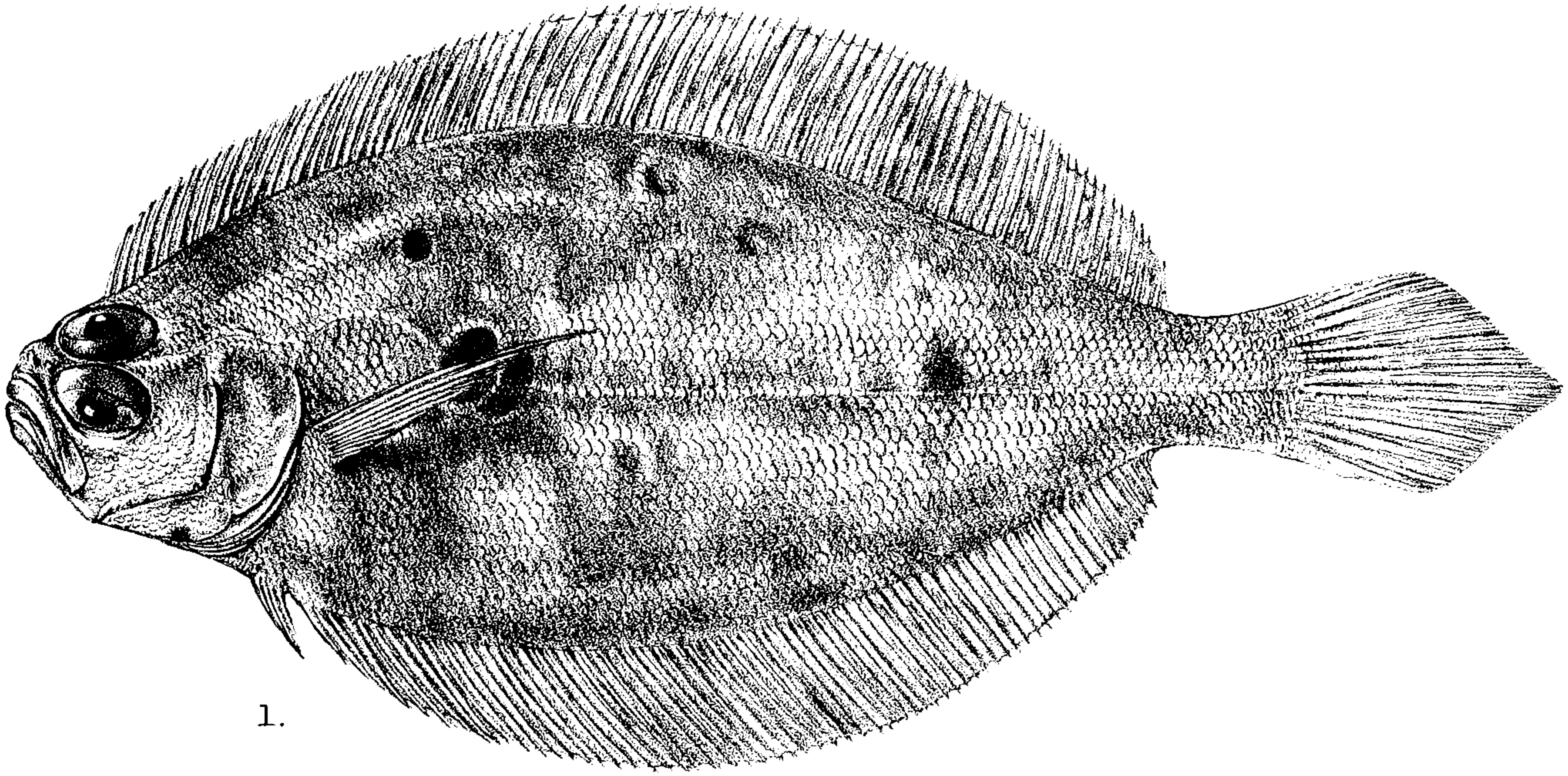

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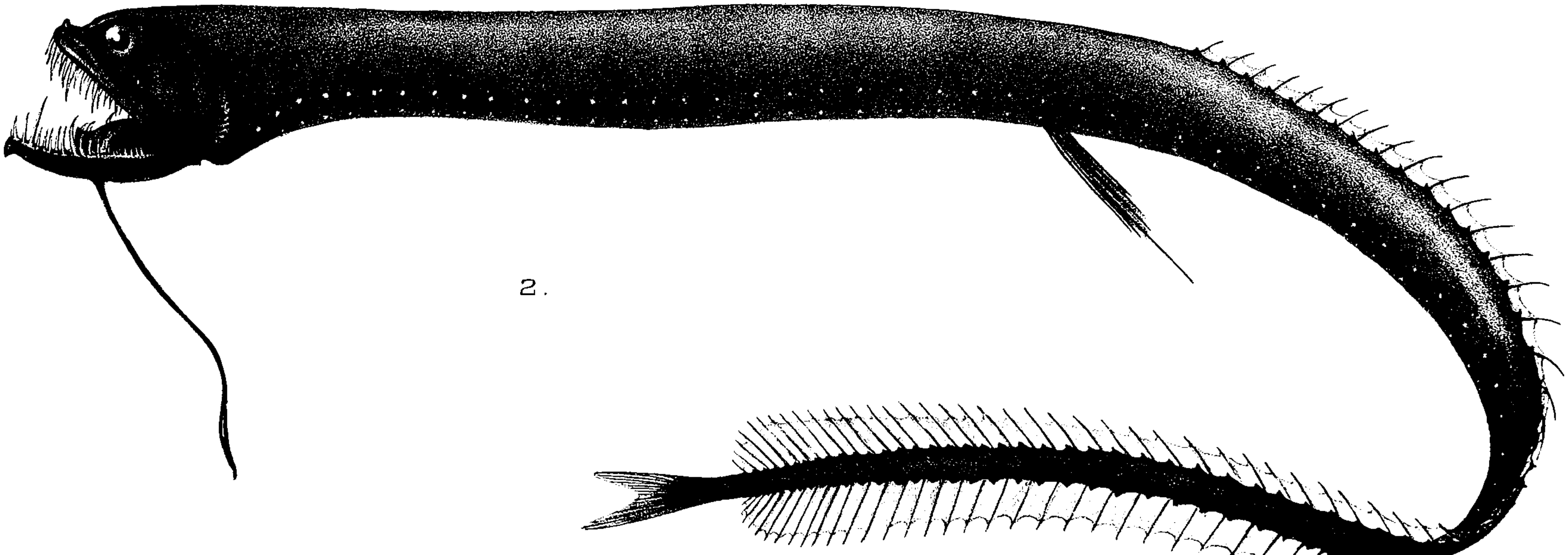

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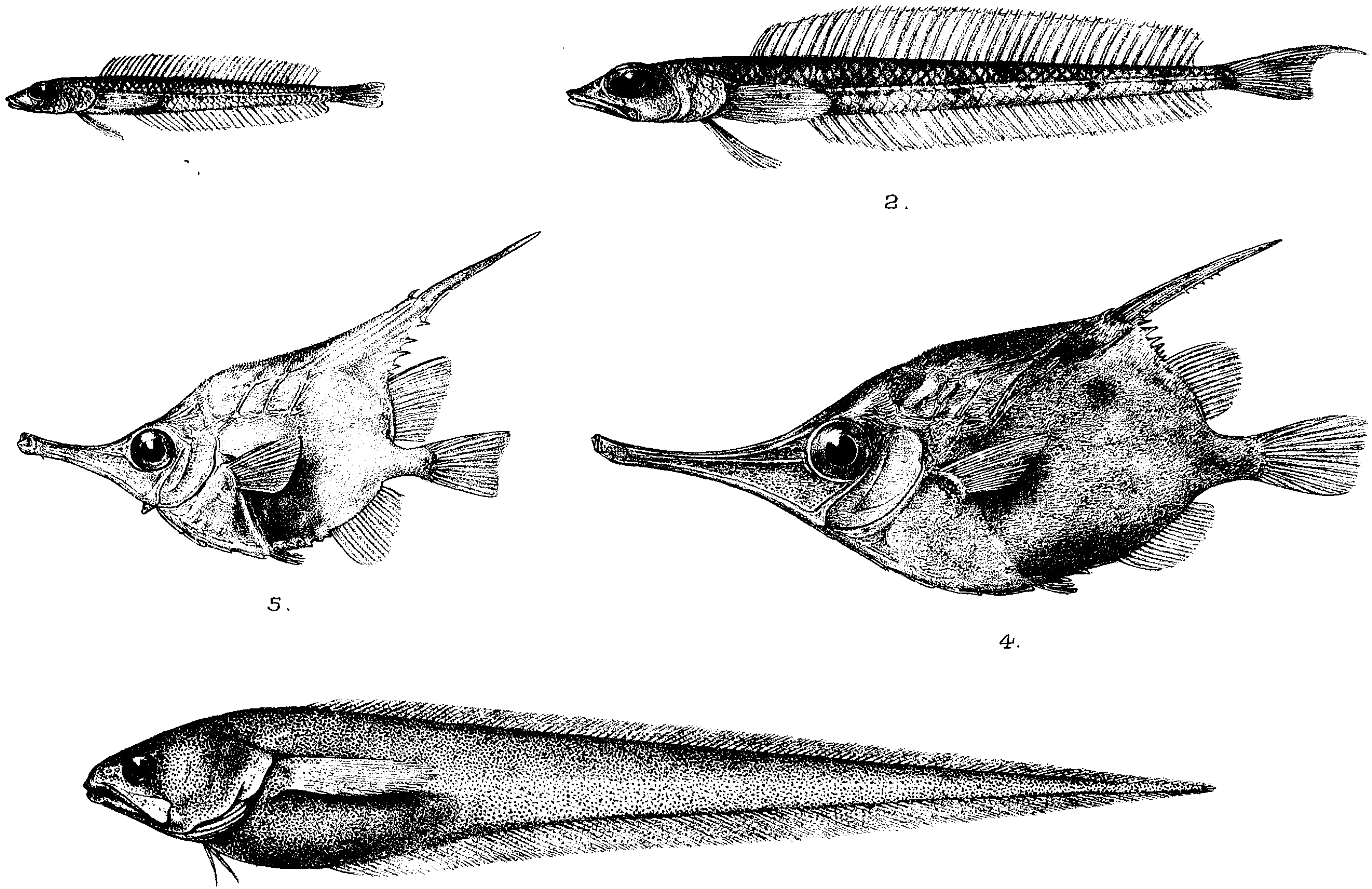
Fishes, Pl.



2. 5. 4. 3.

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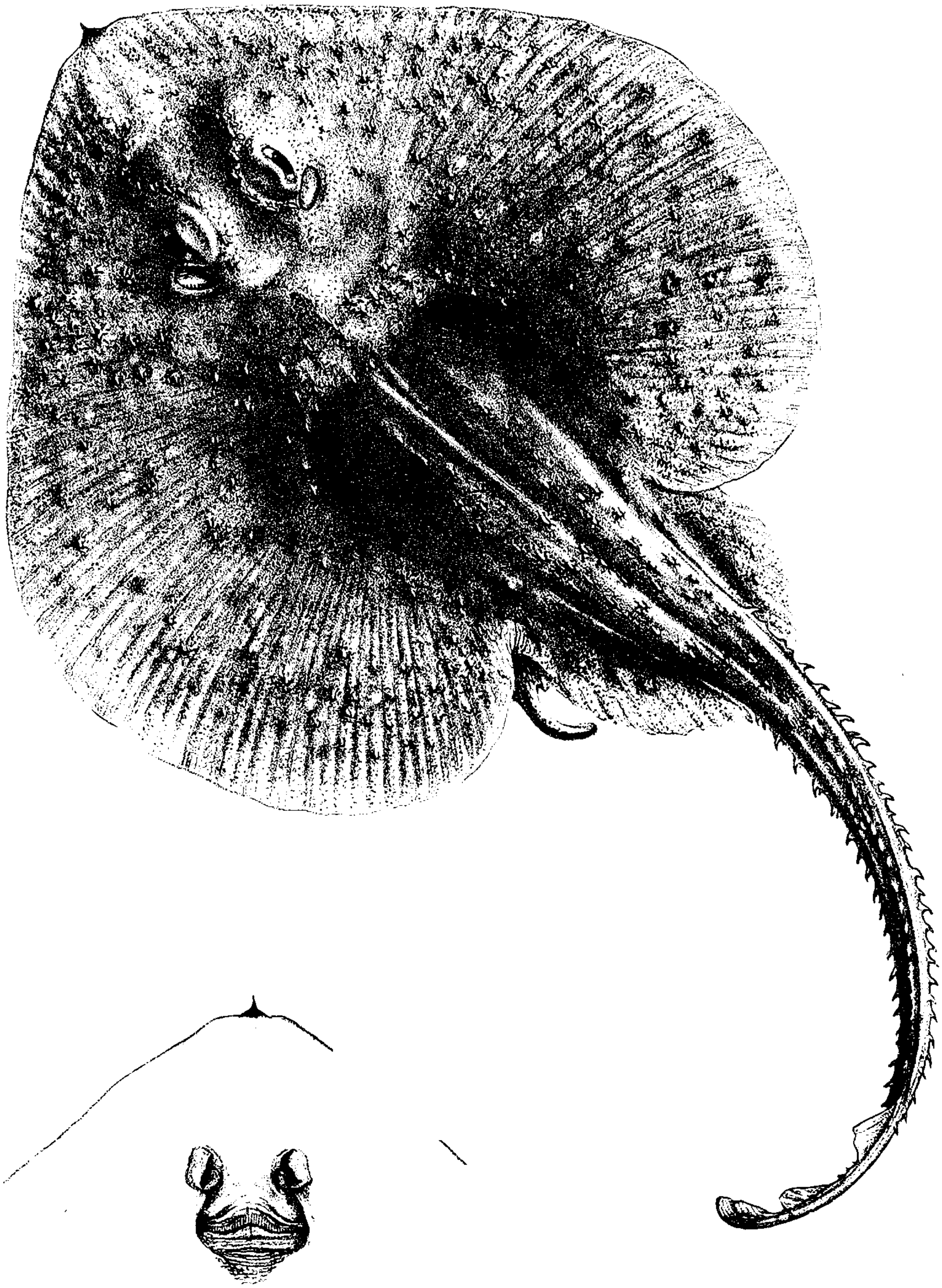

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to study Dr. Wilson's more thorough and more scientific pages. Reference may also be made to:—

"*Report on the Collections of Natural History made in the Antarctic Regions during the Voyage of the 'Southern Cross.'*" (British Museum, 1902.)

III. Extracts from the private Diary of the late Nicolai Hanson.

IV. Aves, by R. Bowdler Sharpe.

Information is here meagre, owing to the sad death of the Expedition's zoologist, N. Hanson, at an early date. His work was carried on by Mr. H. Evans, another member of the Expedition, but both Hanson's and Evans' notes were handed over to the commander, and have not been published. Mr. Bernacchi also contributes some notes in this volume.

"*To the South Polar Regions.*" (Hurst & Blackett, 1901.)

Beginning on page 190, Mr. Bernacchi tells us a good deal about Adélie Penguins, some of his observations differing somewhat from those of the present work. The photographs are very interesting.

"*Report on the Scientific Results of the Voyage of S.Y. 'Scotia,'* 1902–1904," Part I, "*Zoological Log.*" Scottish Nat. Antarctic Exp., Vol. IV, Zool. (1908).

These notes are brief and incomplete.

"*The Penguins of the Antarctic Regions.*" Smithson. Rep. for 1912, pp. 475–482, with plates 1–9 (1913).

Here Dr. Louis Gain, the zoologist of Dr. Charcot's Expedition (1908–1910), gives a brief sketch of the Adélie Penguin's habits. He proves that some at any rate, and probably all, return to the same rookeries year after year to breed. This is of great importance, as it definitely settles the question of the penguins' "sense of direction," which alone guides them over their hundreds of miles of migration. It is surprising that he names *Lobodon carcinophagus* and *Leptonychotes weddelli* as formidable enemies of the Adélie Penguin. His photographs are particularly good. The subject is also treated by the same author under the title:—

"*La Vie et les Mœurs du Pingouin Adélie.*" IX^e^ Congrès Internat. Zool., Monaco, 1913, pp. 501–521, figs. 1–13 (1914).

With the exception of Dr. E. A. Wilson's account, referred to above, perusal of these publications, as well as the casual references to *Pygoscelis adeliæ* to be found among the other works dealing with antarctic exploration, conveys the impression that the writers have either lacked opportunity, or have not done full justice to the habits of these wonderful birds.

THE NATURAL HISTORY OF THE ADÉLIE PENGUIN
(*Pygoscelis adeliae*).

1.—ARRIVAL AT THE ROOKERY.

On October 13th, 1911, one Adélie Penguin was seen on the rookery at Cape Adare. As a blizzard came on then, with thick drift, nothing more could be seen until the next day, when no birds were visible.

On October 15th two were walking about the beach: they were separate in the forenoon, but later they kept company, and hung about the south-east corner of the rookery, under the cliff, where they were sheltered from the cold wind that was blowing.

On October 16th, at 11 a.m., about twenty penguins arrived, all remaining very inactive, and quietly sitting or walking about. By 4 p.m. their numbers had increased to about a hundred, and for the most part they still squatted listlessly about the rookery. They were well scattered, some being solitary, and others in small groups, but all keeping to the hollows and making no attempt to start work on the nesting sites up on the knolls. There was no sign of any pairing taking place. All the birds were in fine plumage and condition.

During the night of October 16th the number of arrivals increased greatly, so that on the morning of the 17th there was a thin sprinkling scattered over the rookery, a few in pairs or threes, but most in groups of a dozen or more, and all were very phlegmatic, lying on their breasts with outstretched beaks, apparently asleep, and still away from the nesting sites.

During October 17th the arrivals became very much more frequent, and soon, as we looked across the sea-ice to the northwards, we could see a long line of Adélies approaching, tailing out in snake-like fashion, as far as the horizon (Pl. I). On this date some few birds took possession of old nests on the higher grounds. They merely squatted in these, making no attempt to repair them in any way, and afterwards I found that they were unmated hens, waiting for mates to come to them, and that this was the usual custom among them.

About 9 p.m. a light snowstorm came on, and those few who had taken possession of nests left them to join the other birds in the hollows. One group, which had arrived at the ice-foot in the morning, halted on the sea-ice, without ascending the little slope leading to the rookery, and stayed there all day.

From their general appearance and behaviour it was evident that some of the penguins were fatigued after their long journey, and although when the weather cleared on October 18th a fair number paired and started to build nests, the great majority still sat quietly about.

The first birds to build all took their stones from old nests, as so many lay unoccupied at this time.

In every case where I was able to distinguish between the cock and the hen, the latter remained on or by the nest, and built it with the stones which the cock brought her, and I think the work is always divided between them in this way.

After watching very carefully for some days, I came to the conclusion that pairing never takes place before the birds arrive at the rookery. All those in the long line that approached the breeding ground seemed quite independent of one another.

During the march across the sea-ice on their way to the rookery, they use both the methods by which a penguin travels over solid ground; viz.: by walking and tobogganing (Pl. II). It was most interesting to walk some way out along the approaching line, and then to stand and watch it stream past.

First would come a string of birds toddling along, their little legs enabling them to advance only about six inches at each step; but, going at the rate of about 130 steps per minute, they covered some two-thirds of a statute mile per hour. In the still air their little wheezy respiration could be heard distinctly, and they seemed to be somewhat out of breath.

Close on their heels would come another string, tobogganing on their breasts, and using their legs as propellers, the rate of progression being exactly the same as when they walked, so that the procession kept its formation as it passed over the ice. Every now and then those that walked would flop forward on to their breasts and toboggan, and those that tobogganed would as suddenly pop up on to their legs and walk.

On October 19th nest-building was in full swing, with all the squabbling and thieving that has so often been described by different writers.

Some of the birds seemed inveterate thieves, and collected most, if not all, of their stones in this way. Depredators, when caught, were driven off with great fury by those whom they attempted to rob, and were sometimes chased for some distance. It was curious to see the difference in the appearance of the fleeing thief and his pursuer. As the former raced away among the nests, doubling on his tracks, and attempting by every artifice to get lost in the crowd, and so rid himself of his pursuer, his feathers lay close back on his skin, giving him a sleek aspect which made him appear half the size of the irate bird who sought to catch him, with feathers ruffled in indignation.

To the human eye there is not the slightest difference in the outward appearance of the cock and the hen. Even when a particular pair have been watched for many days, so that they are quite familiar to the observer, not the least distinction can be seen, though after some experience differences in their behaviour may be noted at once, whilst the muddy marks of the cock's feet on the hen's back, when these are present, serve to distinguish one from the other at a glance.

Without cessation the stream of arrivals continued until October 30th, when it became intermittent, and two days later had stopped altogether. By this time the

Abandoning this quest, he went straight up to another couple who were established near by, but seeing him coming, and evidently knowing what he was after, the cock immediately flew at him, and after a sharp fight in which each used his flippers energetically, the interloper was driven down the side of the knoll and away from the nests, when the victor returned to his hen. With the persistence of his kind, the newcomer came straight back to the nest, but weariness seemed to overcome him, for he settled himself for a doze, in which he continued until I was too cold to await further developments.

Little knots of cocks were to be seen about the rookery thirsting for battle, and keeping a jealous guard on each other's movements.

Seeing that this was going on all around, one day I took out my camera and selected a typical case for illustration.

A group of three cocks were engaged in bitter rivalry round a hen who was cowering on her scoop, in which she had been waiting. She appeared to be bewildered and agitated by the desperate behaviour of the cocks. In a further development of the scene, two of the cocks are shown squaring up for battle (Pl. IV). The combatants, hard at it, used their weight as they leant their breasts against one another, whilst they rained in the blows with their powerful flippers. At the end of the fight the victor rushed the vanquished cock before him, out of the crowd on to a patch of snow, on which he held him down and gave him a terrible hammering. When his conqueror at length left him he lay for some two minutes or so on the ground, his heaving breast alone showing that he was alive, so completely exhausted was he ; but recovering himself, he at length arose and crawled away, a damaged flipper hanging limply by his side, and he took no further part in the proceedings.

It is only occasionally that one sees a cock so thoroughly beaten as this. As a rule when one of the combatants is too exhausted to go on, or has been knocked down, the other is content, and runs back to the hen or to the other cocks who may be gathered near her. When he has vanquished these, or got rid of them in some way, he generally goes up to the hen, who then feels or feigns some reluctance to take him, and I have seen a victorious cock run up to the hen's scoop and squat in it whilst she pecked him cruelly, he merely hunching himself up with closed eyes, until she desisted, after which, with pretty overtures and soothing sounds, he pacified her, and soon they appeared to be mated permanently.

As time went on, and the proportion of unmated to mated birds became smaller and smaller, the cocks watched each other more jealously, and began to go about in little batches in consequence, squabbling and fighting continually, and hindering one another in the quest for mates.

Desperate as their encounters are, I think that one penguin never kills another. In many cases blood is drawn. I saw one with its eye put out, and that side of its beak (the right side) covered with blood, whilst the crimson mark of a blood-stained flipper across a white breast was no uncommon sight.

It is evident that during the first days of his wedded life a cock only keeps his mate by dint of constant vigilance and some further battles; I often saw errant cocks making overtures to mated hens. I do not think, however, that this ever takes place after the eggs are laid and regular family life has begun.

With red paint I marked the breasts of a good many couples, renewing the paint as it faded, through the whole breeding season, and in every case the couples remained perfectly faithful to one another.

3.—NESTING, EGGS, INCUBATION, FEEDING AND FIGHTING.

Just outside our hut door our geologist left some chips of white quartz lying on the ground. Shortly afterwards, I found two of these chips in a nest about thirty yards away, and they showed up brightly and distinctly against the black basalt of which all the pebbles on the rookery are composed. As a rule the penguins are careful to select rounded stones for their nests (Pl. V), and as these fragments of quartz were jagged and uncomfortable, they were most unsuitable for nest building, and it was evidently the brightness of the stones which attracted them. As I looked on, the owners of the pieces of quartz were wrangling with some neighbours, and a penguin in the nest behind them shot out its beak and stole one of the pieces, which it placed in its own nest. Later, both pieces were stolen from nest to nest, till I lost them.

This incident suggested an experiment which I tried immediately. I painted some pebbles a bright vermilion, and had others covered with a bright green material, as I had no other coloured paint. Mixing a handful of these coloured stones together, I placed them in a little heap near a nest-covered knoll. Some hours later, I returned to find nearly all the red stones and one or two of the green ones gone, and afterwards found them in nests. Later still, the rest of the red stones vanished, and, last of all, the green ones.

All these coloured stones were taken to nests, and some time later, like the pieces of quartz, they were stolen from nest to nest, and soon were distributed widely in all directions.

On other occasions I saw pieces of tin, pieces of glass, half a stick of chocolate, and the head of a bright metal teaspoon in various nests near our hut, the articles evidently having been taken from our scrap heap. It then became evident that penguins like bright colours, and they seem to prefer red to green, as instanced by the selection of the coloured pebbles.

Though most nests are built of a mixture of pebbles varying in size from very small to as big as the birds can carry, some individual couples make theirs entirely with very big stones, and some entirely with very small ones (Pl. VI); and a large stoned nest and a small stoned nest may be seen side by side, in places where pebbles of all sizes may be collected. Some of the penguins choose stones so large that it is a matter for wonder how they can lift and carry them. As a rule, fairly large stones are chosen, their comparative sizes being well shown in some of the photographs.

In selecting sites for their nests, the penguins at Cape Adare have shown a very remarkable instinct.

The beach on which is the rookery is raised into a series of undulations and knolls, and some of the lower lying ground is covered by little lakes of thaw water, rendered slimy and muddy by the guano that is blown into it by the frequent gales.

Rising from one of these lakes is a big knoll that appears to be in every way suitable for nesting. When the birds arrive at the rookery, and for the first half of the breeding season, the water of the lakes is frozen hard, and like most of the solid ground is covered by a thin layer of wind-blown snow, so that the surface of the ice is scarcely to be distinguished from the land, and the island knoll in question is perfectly accessible. Yet not a nest is to be seen on it, nor any sign of an attempt having been made in past years to build one.

It is evident from this that the penguins realise that in some six weeks' time they will only be able to reach the spot by wading through the muddy water. They not only realise that there will be water where the solid ice now is, but that it will be slimy, and make them in a mess, and accordingly the island is taboo. It is not that they object to fresh water, as in other places they are frequently to be seen wading through clean fresh-water pools.

Not far from the above-mentioned islands there is another mound rising from the lake, but connected with the mainland by a narrow pathway of stones rising just above the water. This mound is covered with nests. While the lake is frozen they approach it across the ice; later, when this thaws, they have the narrow path by which to reach their nests without covering themselves with mud.

The barren island was a very distinct feature of the rookery when the available ground was inconveniently crowded with nests.

Where selection has brought about such remarkable uniformity as is to be seen in the whole species, individual traits of character are hardly to be expected in any great degree, but some differences exist nevertheless.

The sizes of the stones selected for nests by different birds have already been commented on. Also, some of them prefer to build their nests at a great height, whilst others prefer the lower ground. This is evident, as both high and low sites are chosen when there is still ample room on the flat beach as well as up the cliff of Cape Adare, to a height of 1,000 feet; yet in order to get at many of the nests up the cliff, their occupants have to make frequent journeys involving a difficult and arduous climb to the top of the cliff, and then a walk across a precipitous snow slope hanging over the brink of a clear drop of many hundreds of feet on to the ice below.

Again, some have less alertness and general force of character than others, a difference evidenced in a striking manner in some of the little colonies.

Nests are seen which are incessantly losing stones from their walls owing to the

getting more used to the process as time went on, became more exasperated with me each time I went to her nest, though I was very gentle indeed, both with her and the chick, and as she saw me approach, when I was still some way off, would rise from the nest and ruffle her feathers, trembling with indignation, and making a great noise. I always gave her a fur mit to peck at while I temporarily borrowed her chick.

The instinct which causes a bird to procure food and bring it to the nest for its offspring is, as we know, common to all species, this duty being equally shared by both cock and hen, in the case of the Adélie Penguin, from the time when the chicks first appear.

On one occasion, however, I noticed an unusual trait of character on the part of a cock. As the season advanced and the sun's altitude increased, almost all the snow which had covered the rookery during the early spring disappeared owing to thawing and ablation, leaving the ground bare and dry.

Whilst the snow remained the birds, as they sat on their eggs, used to quench their thirst by gobbling that which lay within reach. Afterwards, however, they seemed to suffer greatly for want of water, and were to be seen panting with their beaks open and tongues exposed. Those who were not engaged in incubating used to journey frequently to the various drifts that still remained, gobbling great quantities of snow; one drift in particular, which had formed in the lee of our hut, being visited by crowds who came incessantly to quench their thirst.

One day a cock was seen to pick up a lump of snow in his beak and carry it a considerable distance to his mate as she sat on the nest. He deposited it on the ground in front of her, and she ate it at once. When I mentioned this to Mr. Priestley, he told me that when he was at Cape Royds with Sir Ernest Shackleton's Expedition, he had seen the same thing occur. As this was seen only once at Cape Adare, it is evidently a very rare occurrence, and I mention it here as a characteristic development possessed by only a few individuals. The cock, when away from his mate, evidently had in his mind the fact of his hen being thirsty and unable to get snow as he could.

Owing to our having had several snowfalls without wind, and to the action of the sun's rays falling through that clear atmosphere on to the black rock, there were in some places masses of slush and then actual floods as the thaw water trickled down into the hollows. Some of the penguins having made their nests in these low-lying positions, these were threatened with destruction by the floods (Pl. VII). Here the occupants were to be seen doing everything they could to avert this calamity, and from each nest the cock worked busily, making journey after journey in quest of stones, with which the hen built the little castle higher and higher, and so kept the eggs above water, so that some of the pools were dotted with little islands on which the hens sat.

I noticed one nest in particular, by the side of a pool, which still remained a foot or so clear of the water and on dry ground, but nevertheless its inmates quite realised the emergency that threatened them, and that it must be provided against, and for hours the cock passed to and fro, wading across the little lake to the far side, from which he got his stones.

This scene is shown in Pl. VII. In the right hand corner of the picture the cock is seen in the act of delivering another stone to the hen, who is waiting to receive it, whilst some of the nests are seen actually surrounded by water.

Here I quote from my notes:—

"Nov. 10th. This evening I saw a hen penguin trying to sit on a nest with two eggs. The nest had no stones, as they had all been stolen by neighbours, and as it was scooped deeply in the ground, and in a slush of melting snow, the eggs were nearly covered with water. The poor hen stood in this, and kept trying to sit on the eggs, but each time she did so, sat in the water and had to get up again. She was shivering with cold and all bedraggled. I took the two eggs out of the nest, and Browning and I collected a heap of stones (partly from her richer neighbours!) and built the nest well up above the water. Then I replaced the eggs, and the hen at once gladly sat on them, put them in position, and was busily engaged in arranging the new stones around her when we left."

When one egg has been laid the hen still sits on the nest, as the egg would be frozen if it were left uncovered, besides which skua gulls are always ready to pounce on any that lie exposed, and it is not until the second egg is laid that she goes to feed, and the cock takes his turn on the nest for the first time.

As nearly as I could ascertain, pairing began on October 16th or 17th, and we found the first egg on November 3rd.

In order to determine the period between the laying of the two eggs, I numbered seven nests with wooden pegs, writing on the pegs the date on which each egg was laid, and the following was the result obtained:—

	Date of appearance of first egg.	Date of appearance of second egg.	Interval.
No. 1 nest . . .	November 14th	—	Only 1 laid.
No. 2 nest . . .	November 13th	November 16th	3 days.
No. 3 nest . . .	November 14th	November 17th	3 days.
No. 4 nest . . .	—	—	—
No. 5 nest . . .	November 12th	November 16th	4 days.
No. 6 nest . . .	November 8th	November 12th	4 days.
No. 7 nest . . .	November 24th	—	Only 1 laid.

the average interval in the four cases where two eggs were laid being 3·5 days.

The only notes I have on the lapse of time between the laying of the egg and the hatching of the chick are that the first chick appeared in No. 5 nest on December 19th

(37 days), and in No. 7 nest on December 27th (33 days), whilst in another case, in which observations were most carefully made, the period was only 31 days. This seems to show that the incubation of the embryo does not invariably begin as soon as the egg is sat upon, as the observations were most carefully made and recorded, each nest, as I have said, being marked and visited daily.

The following table enables a comparison to be made between my own results and those of Wilson and Bernacchi:—

	Wilson.	Bernacchi.	Levick.
First egg laid	Middle of November	Nov. 2nd	Nov. 3rd
Chick hatched	Middle of December	Dec. 9th	Dec. 4th
Nestling's down moulted . .	Jan. 9th to 16th.		

Not until the eggs have been laid does either of the birds go to feed. Then one of the pair goes off to the water for this purpose, and stays away in many cases for some days (about 7 to 10), after which it returns to relieve the other, who goes off for about the same period. Then, when the chicks are hatched, they relieve one another at more frequent intervals, as seen by the time-table given on pp. 67, 68.

A most astonishing fact is the long fast which the birds undergo between their arrival at the rookery and the hatching of the chicks, the shortest period of this total abstinence being about 18 days; but as the first of the pair to go off to feed remains away in many cases for ten days, the other must fast for about 28 days.

This fact, occurring as it does during the most arduous period of the penguins' year, furnishes a most surprising proof of the wonderful endurance possessed by these birds. They arrive tired after their journey to the rookery. In the case of the cocks, they go through a long period of repeated battle and continual anxiety. They propagate their species, and work to gather stones for their nests, yet for 28 days they eat nothing at all, and at the end of that time, though dirty and bedraggled, they seem little the worse for it.

The reason for this fasting is, perhaps, partly that they dare not leave their nests unprotected during the early part of the season, when building is in progress all around, and stones are in great request; and also because, as I have already remarked, until the eggs have come, strange cocks frequently make overtures to hens who are already mated, and thus the cock can only ensure the safety of his home by his constant protection.

Consequent on the penguins' abstinence from food, no guano is deposited about the rookery until the eggs have been laid, and so the brick-red colouring of the rookery described by previous authors is not seen during the early part of the season.

Instead of this, bright green watery excreta are dropped, consisting of bile, water, salts, and epithelial cells (the bile of penguins is bright green). The bird as it sits on its nest never fouls this, but squirts its excreta well clear of its walls. This taking

Jan. 1st.—10 a.m., both at nest.
12 noon, both at nest: the youngster complicating matters by running away every time he was passed by the observer, thus getting himself and his parents embroiled with their neighbours.
2 p.m. Hen on nest: cock gone.
,, 2nd.—10 a.m. Hen on nest.
12 noon. Chick disappeared.
2 p.m. Nest deserted.
4 p.m. Cock on nest: no chick.
,, 3rd.—Cock on nest, with chick.

From the above table it will be seen that the hen was not relieved by the cock until a fortnight after she had laid her egg, so that she must have been without food for a month. Then she left, and only returned to relieve the cock after the lapse of another fortnight, it being worth remembering that each was absent for the same length of time.

On the appearance of the chick, a different régime began, the chick having to be fed, and journeys made at regular intervals for the purpose of getting food. All over the rookery, as the young birds appeared, there was a marked change in the appearance of the parents as they came up from the water.

Hitherto they had been merely remarkable for their spotless plumage, in contrast to their former dirty state, but now their shape too was greatly altered, for their meals, in place of merely satisfying their own individual wants, had now to provide for the offspring as well, and they were in consequence so distended with their heavy load of *Euphausia* that they were obliged to lean back to counterbalance the weight of their bellies that bulged before them as they walked. Frequently they would find to their cost that they had attempted too much, and overcome by the labour of their journey over the rough ground, they would be sick, depositing the whole load on the ground, and having perforce to return to the sea for more. Little red heaps of mashed and partly digested *Euphausia* were consequently to be seen about the rookery. Once I saw a diligent parent, who, having actually arrived at the nest, could not contain himself long enough for the chicks to help themselves in the manner common to them—of thrusting their heads down his throat—and vomited the meal on to the ground. Seeing what was coming, I had my camera ready, and one of my photographs, not here reproduced, represents him in the act. The dismay shown by the hen, when she saw what was taking place, is indicated plainly by her expression.

Neither chicks nor adults ever attempt to eat food of any sort from the ground, the chicks *always* feeding directly from the throat of the parent (Pl. VIII), and the adults *always* from the water, and hence these little heaps of vomited food are invariably wasted.

Near our hut was a scrap heap, on which were thrown remains of all kinds of food, and the penguins' hatred of the skuas (Pl. IX) was well shown here.

None of the food was of the least use to the penguins, but we noticed after a time that one or two penguins were almost always there, guarding the heap against the skuas. In fact, a constant feature of this heap was the sentry penguin, making little runs hither and thither at the skuas, who would then simply rise a yard or two into the air out of reach, the penguin squalling in its anger at being unable to follow its enemy. At this time, the penguin would imitate the flying motion with its flippers, seeming instinctively to attempt to mount into the air as its remote ancestors did before their wings had been adapted solely to swimming.

Close to the scrap heap there was a large knoll crowded with nests, and it was this colony which supplied the sentries. Very rarely did one of these leave the heap until another came to relieve it, so long as there were skuas about, but when the skuas went so did the penguins. The instant the skuas returned, a penguin would be seen to run from the knoll to the heap. It seemed that there was some primitive understanding about the matter amongst the penguins, as there was never a crowd of them on the heap, the rest appearing satisfied as long as one of their number remained on guard.

As custodian of the nest, there is no doubt that the hen is very much more efficient and reliable than the cock. When the former is doing duty on the eggs, no ordinary circumstance induces her to leave them for a moment. She wrangles very frequently with her immediate neighbours, and she and they spend hours on end in pecking at each others' heads, but this only happens between those who can reach each other without leaving the nest. The cocks, on the other hand, behave very differently. Starting to squabble, they wax hotter and hotter, and frequently end by leaving their nests and going for one another in a proper battle with their flippers, fighting backwards and forwards over their nests and often scattering the eggs, large numbers of which are lost annually in this way.

On occasions we saved eggs by replacing them in the nests and stopping the fight, when the combatants would quickly forget the quarrel, and again settle down to their duties.

Two cocks, fighting like this in the midst of a crowded colony, were a danger to their neighbours, as they not only incommoded them by bumping into them and falling over them, but were apt to cause misunderstandings that ended in further dissension. Perhaps the other birds realised this, as they would evince every sign of anger when two of their number started a fight.

On this subject I find a note in my diary for November 24th, 1911, which seems important, and I give it word for word.

"This afternoon I saw two cocks (probably) engaged in a very fierce fight which lasted a good three minutes. They were fighting with flippers and bills, one of them being particularly clever with the latter, frequently seizing and holding his opponent just behind the right eye, whilst he battered him with his flippers. After a couple of minutes, during which each had the other down on the ground several times, three or four other penguins ran up, and apparently tried to stop the fight. This is the only construction I can put on their behaviour, as time after time they kept running in when the two combatants clinched, pushing their breasts in between them, but making no attempt to fight themselves, whilst their more collected appearance and smooth feathers were in marked contrast to the angry attitudes of the combatants.

"The fight which had started on the outskirts of a knoll crowded with nests, soon edged away to the space outside, and it was here that I (and Campbell, who was with me) saw the other penguins try to stop it.

"The last minute was a very fierce and vindictive 'mill,' both fighting with all their might, and ended in one of them trying to toboggan away from his opponent, but he was too exhausted to get any pace on, so that just as he got into the crowd again he was caught, and both fought for a few seconds more, when the apparent victor suddenly stopped and ran away.

"The other picked himself up and made his way rapidly among the nests, evidently searching for one in particular. Following him, I saw him run up to a nest near the place where the fight had begun. There was a solitary penguin waiting by this nest, which was evidently new, and not yet completed, being without eggs.

"The cock I had followed, ruffled and battered with battle, ran up to the waiting bird, and the usual side-to-side chatter in the ecstatic attitude began, and continued for half a minute, after which each became calmer, and I left them apparently reconciled, and arranging stones in the nest. This incident was after the usual nature of a dispute between two mates for a hen, but the pacific interference of the other birds was quite new to my experience. That it was pacific I am quite convinced, and Campbell agreed with me that there was little doubt of it. All the nests about had two eggs under incubation, and the pair in question must have been newcomers."

The above note, I am afraid, gives a rather meagre impression of an astonishing scene, of which I have a very distinct recollection.

As the two birds fought, several couples stood around them, who from time to time turned to one another, making sounds and gestures as if they were arguing some point, when one of them would turn and run in between the opponents, literally pushing itself in between them, and though striking no blow itself, doing everything possible to hinder them. As is often the case during a fight, many others looked on with apparent interest in the proceedings, pausing in their own affairs to do so.

4.—THE GAMES OF ADÉLIE PENGUINS.

That Adélies have developed a taste for playing certain primitive games seems perfectly evident. They never play on the ground of the rookery itself, but on the sea-ice, on their way to and from their bathe.

from the rookery, frequently both would stop, and the clean and the dirty mingle together and chatter with one another for some minutes. If they were not speaking words in some language of their own their whole appearance belied them, and as they stood, some in pairs, some in groups of three or more, chatting amiably together, it became evident that they were sociable animals, glad to meet one another, and like many men, pleased with the excuse to forget for a while their duties at home, where their mates were waiting to be relieved for their own spell off the nests. After a variable period of this intercourse, the two parties would separate and continue on their respective ways, a clean stream issuing from the crowd in the direction of the rookery, a dirty one heading off towards the open water, but here it was seen that a few of those who had bathed and fed, and were already perhaps half-way home, had been persuaded to turn and accompany the others, and so back they would all go, over the way they had come, to spend a few more hours in skylarking and splashing about in the sea.

On this strip of sea-ice the penguins would spend hours, and, gathered in small parties, play a sort of "touch last." Games of this sort are often seen to be played by the young of different species of mammalia, but I believe that among birds they are, at any rate, uncommon.

Another very favourite game of theirs is worth recording.

The tide in the vicinity of the rookery flowed at a considerable rate (some six knots at times), and on it there drifted a succession of ice-floes of different sizes. As one of these floes arrived at the top end of the rookery it would be boarded by a party of Adélies, who sometimes crowded on to it until it would hold no more. The "excursion boat," as we got into the habit of calling it, borne by the stream, would then drift the whole length of the rookery, its occupants showing every sign of enjoyment in the ride. Sometimes they stood silently contemplating the scenes on the ice-foot as they were borne past them; at others, especially when passing close to the shore, they would shout remarks to the other penguins that stood on the ice-edge, who would in turn shout back at them, so that a running fire of chaff seemed to pass between those on the bank and those on the floe as the crowded "excursion steamer" passed on its way.

Occasionally a knot of penguins who stood hesitating on the shore, on being shouted at by those on the floe, would make up their minds suddenly, and all plunge into the sea and swim off to the floe to board it; and if, as often happened, it were already crowded, many of those on the floe would be pushed off one side, as the fresh party boarded it on the other.

Arrived at the lower end of the rookery, every bird would suddenly plunge into the tide and swim all the way back against the stream, only to board a fresh floe for another ride down. Some of them must have spent many hours of the day in this manner.

During the nesting-season, at any rate, the clubbing of the penguins into parties takes place only after they have left the nesting-ground. Parties are never seen making their way among the nests, and when, after bathing, they reach the rookery, they invariably break up and go their several ways. Again, when on their way out from the rookery, groups are formed on the ice-foot, they consist of strangers from different parts of the rookery, not of neighbours from any particular spot.

The manner in which penguins swim in the water has already been described by many writers, and it is enough merely to allude in these pages to their two methods of progression, which are by swimming on the surface as a duck does, and secondly by "porpoising" (Pl. XIII)—a method distinctive of their order. When swimming on the surface they sit low in the water, the upper part of the back being submerged, so that the neck sticks up out of the water. In this position they make fair progress, attaining a speed of some six knots. This, however, is their slowest method of progression in the water, and when they travel quickly they always use the "porpoising" method.

It is beneath the surface that they are most agile. Here they use their powerful flippers for propulsion, the action of these appearing to be exactly that of a bird's wings in flying. Their speed and agility under water may be compared to those of fishes, and they can turn to either side, or completely double in their tracks in the flash of a moment. Their power of leaping from the water merits a special description, and I am able to show photographs taken whilst they are doing this.

After the sea-ice had broken away from the ice-foot on the shores of the rookery, a ledge of ice varying from three to twelve feet high rose precipitously from the water in many places, and here their leaping powers were to be seen at their best. The highest leap I saw was exactly five feet from the surface of the water.

When about to land on a high ledge a party of Adélies swim to within twenty or thirty yards of it, when all may be seen to stretch up their necks and survey their landing-place. Then in a moment all disappear beneath the surface, not a ripple showing the direction they are taking, till suddenly they all shoot clean out of the water, either together in a cloud, or in a stream, one after the other, and land with the greatest precision on to the top of the ice (Pl. XIV). The fact that this is very frequently undercut by the waves, and projecting some feet towards them, makes their accurate judgment all the more remarkable, as from the moment they disappear beneath the surface after their preliminary survey of their landing-place, twenty or thirty yards off, or sometimes more, to the moment they leap from the water, they must carry in their minds the exact distance from the spot where they are to rise at the ice, yet I never saw one of them misjudge the distance so far as to rise under the overhanging ledge, or jump short of the landing-place. My photographs show them leaving the water, in the air, and landing on the ice. When they land on a slippery surface (Pl. XV) they generally fall forward in the tobogganing position and slide forward a short distance before rising to their feet; but when they land on snow they throw their feet and heads well forward, finishing up in a "hollow back" position as they come to a standstill.

All their feeding is done beneath the surface. At Cape Adare the tall ice-foot, projecting sheer from the water, afforded good opportunities for observing them at this occupation, and in the clear water beneath they could be seen flashing hither and thither in quest of *Euphausia*. Every now and then a milky cloud is seen to issue from the mouth of one of them, and to float away down the tide, and this is made by their vomiting the whole meal into the water as they swim, so that they may have the pleasure of catching another one. After vomiting they never pause in their career for an instant, going straight on with the hunt as if nothing had happened.

Once as we were watching some Adélies at play in a narrow "lead" in the sea-ice, one of them suddenly leapt from the water and landed on the ice, holding in its beak a large pebble which it dropped on the snow, diving back into the water immediately.

The depth of the sea here was ten fathoms, the lead was a quarter of a mile from the shore; but it is difficult to believe that a bird could dive to such a depth! There were, however, no pebbles to be seen in the sea-ice here, which had been formed *in situ*.

In the art of diving the Adélies are very perfect. Some of the crags along the ice-foot rose to a height of some fifteen to twenty feet above the water (Pl. XVI). They did not commonly dive from such a height as this, and though very often they hesitated on the brink, generally descended to some lower part before entering the water. Twelve feet, however, was no uncommon height for them. In some places the water shoaled up to the edge, and they were to be seen diving (Pl. XII) from a height of six feet into a foot or so of water, in which case they generally fell fairly flat.

When diving into deeper water their positions were often very graceful and perfect.

5.—ENEMIES OF THE ADÉLIE PENGUIN.

Evidence goes to show that in the water the Adélie has only one enemy, the Sea-leopard (*Hydrurga leptonyx*), and that out of the water the adult has absolutely no deadly foe, except when man and his dogs are about.

It has been suggested that the Killer-whale (*Orcinus orca*) preys upon them, but this has been a doubtful point, and the following incident distinctly points the other way. One day as I watched a large number of Adélies at play in a wide open water-lead some half mile from the shore, a large Killer appeared suddenly from beneath the ice on one side of the lead, and coming up to breathe brought the upper half of his head and body above the surface as he crossed the open space, finally disappearing beneath the ice on the farther side. In spite of the swirl and commotion that he made, and of the fact that the water around him was crowded with penguins,

bird by the feathers and shaking it from side to side till a large portion of the skin comes away, when they drop this, take a fresh hold, and tear another piece off, and so on till, at any rate, the greater part of the skin and feathers is removed from the body.

It is evident that sometimes a penguin escapes, as occasionally we saw them making their way along the ice-foot, terribly injured, and these generally had the skin of the whole of their breasts peeled away and hanging from them like an apron, and their breast-muscles were bared and bleeding.

Greatly as they are terrified of the Sea-leopard in the water, they probably pay little attention to him when he is on the ice, as it is very common to see them walking about on a floe in close proximity to Weddell Seals, and it is hardly to be expected that they would distinguish the two species without close inspection. On one occasion, too, we shot two Sea-leopards on the same floe, and whilst I was skinning one, and the dead body of the other lay in a life-like position near by, a large crowd of penguins landed on the floe, and with their usual curiosity came right up to see what was going on, showing not the least fear of the enormous carcases of their enemies, one of which measured eleven feet in length.

6.—NESTING ON CLIFFS.

Hitherto I have made only passing remarks on the fact that the penguins built their nests far up the precipitous side of Cape Adare, but now I am going into this matter at some length, as so much has been said on the subject by other authors.

The cliff up which they build rises almost perpendicularly along the eastern side of the rookery, but is a good deal broken in places, affording foothold to the birds who have climbed to all its accessible parts, making their nests on ledges and in niches of the rock, whilst several colonies of nests have been made on the flat ground at the top.

There is one colony at the very summit, whose inhabitants can only reach it by a long and trying climb to the top, and then a walk of several hundred yards across a steep snow-slope hanging over the very brink of a sheer drop of 700 feet into the sea.

During the whole of the time when they are rearing their young, these mountaineers must make several journeys during each twenty-four hours, to carry their enormous bellyfuls of *Euphausia* all the way from the sea to their young on the nests—a weary climb for their little legs and bulky bodies, each upward journey taking them some two hours of strenuous climbing. The greater number who had undertaken this did so at a time when there were ample spaces unoccupied in the most eligible parts of the rookery.

There is evidence to show that Adélie Penguins have in them a strong inclination to climb heights. Already I have mentioned that large masses of ice have been stranded by the sea along the shores of the rookery. These fragments of bergs, some of them fifteen feet or so in height, have formed a miniature mountain-range along the shore. All day, and every day, parties of penguins are to be seen assiduously climbing the steep sides of this little range. Time after time they get half way, and have to descend to try a different route. Frequently, having with much pains scaled a slippery incline, one is seen to miss his footing, and come sliding down to the bottom again, only to pick himself up and have another try.

This climbing was generally undertaken by small parties who had clubbed together, as they generally do, from social inclination. Sometimes a little band of climbers would take an hour or more in finding a way to the summit, if they had chosen a difficult place. Arrived at the top, they would spend a variable period there, sometimes descending at once, sometimes spending a considerable time there, gazing contentedly about them, or peering over the edge to chatter at other parties below.

Again, about half a mile from the beach, a large berg, some 100 feet in height, was grounded in fairly deep water; it was accessible at first over the sea-ice, but later, when this had gone, was surrounded by open water. Its sides were sheer except on one side which sloped steeply from the water's edge to the top. From the time when they first went to the sea to feed, until the end of the season, there was a continual stream of penguins ascending and descending this berg. As I watched them through glasses, I saw that they had worn deep paths in the snow from base to summit. They had absolutely nothing to gain by going to all this trouble but the pleasure they seemed to derive from the climb, and when at the top merely had a good look round and came down again.

When the stream of penguins was pouring into the rookery at the beginning of the season, I kept a look-out for those who were to nest up the cliff, and several times saw birds, on arriving at the rookery, make for the heights without any hesitation, threading their way almost in a straight line through the nests to the screes at the bottom of the cliff, and up there to one or other of the paths leading up its side.

Probably these birds had been hatched there, or had nested there before, and were making for their old haunts, and I suppose they must have found mates when they got there.

But this lack of hesitation in making for a certain spot gives rise to some interesting speculation, because if one sex made for a particular nesting-site, why not the other, in which case cock and hen who had mated the previous year would meet again, and so possibly in many cases the same pairs may mate year after year, should both survive.

Battles took place up these heights, as they did below, and many times we saw one of the combatants, knocked off his feet, roll bumping down the slope from ledge to ledge until he recovered his footing, only to climb straight to the spot he had left, and give fresh battle to his opponent.

7.—MORTALITY.

The mortality among Adélies is very high during the breeding season, both among the young and the old, whilst an enormous number of eggs are wasted.

Waste of life is due to the following causes:—

The eggs.
- Skuas.
- Cocks fighting among the nests.
- Flood from thaw-water.
- Death of parents.
- Snow-drifts.
- Land-slides.

The young chicks.
- Skuas.
- Land-slides.
- Interference with by cocks.
- Getting lost.
- Death of parents.

The adults.
- Sea-leopards.
- Land-slides.
- Snow-drifts.

In the above lists I have left out the wanton depredations committed by some of the expeditions which visit the Antarctic, owing chiefly to the licence given to ignorant seamen, but such visits, being made at rare intervals, can have little effect on the population.

Two of the causes in my list which are not dealt with elsewhere in my text are land-slides and snow-drifts.

At Cape Adare, the screes at the foot of the cliff are perhaps the most thickly populated part of the rookery. As the thaw proceeds, boulders of different sizes are continually rolling down the cliff, some of them falling many hundreds of feet before they plunge in among the nests on the screes, doing terrible damage and often rolling some distance out into the rookery.

At other times, owing to the bursting out of thaw-water which has been dammed up at the top of the cliff, large land-slides are caused, which bury many hundreds of nests beneath them. Indeed, these great screes on which the nests are built have been formed by these land-slides taking place from year to year, and no doubt form the graves of thousands upon thousands of former generations.

One such slide took place whilst we were at the rookery, doing terrible damage,

each couple upon their clutch, the chicks are gradually massed into little groups, or crêches, and each crêche is guarded by a few birds who keep a good look-out on the chicks to prevent them from straying and so becoming an easy prey to the skuas, while the rest of the parents make journeys to the water for food.

The reason why the parents pool their offspring in this way is evidently because the voracious appetites of the chicks, as they get bigger, impose too great a demand on the industry of the parents, who like to spend a certain part of the day in playing games and enjoying themselves in the water. Hence, instead of one or other of each couple remaining constantly in charge, three or four remain to guard groups of chicks varying in number from twelve or so to large masses of many dozens, who are kept in a close clump by those who remain for the purpose, the rest of the parents being free to leave them and share the duty of providing food for the whole.

Before these crêches are formed, I think no parent feeds any chicks but its own, though it may pass the whole length of the rookery on the way from the water to its nest; and later, the old birds appear to remain faithful to their own crêches, because although they are seen to be pestered by wandering and starving chicks, piping shrilly and plaintively for food, it is rare to see them yield their loads of food to the poor little beggars, many of whom, growing weaker, daily fall a prey to the ever-watchful skuas. In fact, if each colony of parents did not work solely for its own crêche, it is obvious that the chicks up the heights and at the back of the rookery would come off second best, and many of them starve, whereas these are just as well nourished as those nearer the water.

It is worth remarking here that until the crêches are formed, parents, as a rule, rigidly exclude the offspring of other birds from their nests, and I have seen little chicks who had lost themselves, mortally pecked by strange mothers whose protection they sought.

9.—DEPARTURE FROM THE ROOKERY.

One morning Priestley came into the hut and told me that the penguins were "drilling on the sea-ice," and that I had better come out and look at them. I went with him to the ice-foot, and this is what we saw.

Many thousands of Adélies were on the sea-ice between the ice-foot and the open-water leads, then some quarter of a mile distant. Near the ice-foot they were congregating into little bodies of a few dozen, whilst farther out near the water, massed bands, some thousands strong, stood silent and motionless. Both the small and the large bands kept an almost rectangular formation, whilst in each band all the birds faced the same way, though different bands faced in different directions.

As we watched, it became evident that something very unusual was going on. First, from one of the small bands a single bird suddenly appeared, ran a few yards in the direction of another small band, and then stopped. In the flash of a moment the entire band from which he came executed the movement "left turn," this bringing them all into a position facing him. So well ordered was the movement that we could scarcely believe our eyes. Then from the small band our single bird had approached, another single bird ran out, upon which his own party did exactly as the first had done, so that the two stood facing one another, some fifteen yards apart. Then spontaneously the two bands marched straight towards one another, and joined to form one body.

After this, we saw the same procedure being enacted in many other places, the penguins coming down from the rookery and forming small bands which massed together. Then the augmented body would join another augmented body, forming a still larger one, which then joined another, and so on, until a great mass of birds stood together in rows, all facing in one direction like a regiment of soldiers. One of these masses stood not far from us, a compact rectangular mass.

They stood thus for many minutes, quite motionless and silent, when suddenly, as before, a single bird darted out from among the crowd and ran a few yards toward the open water, when, as if it had received a word of command, every bird faced left. Then the whole regiment marched for the water, keeping its formation almost unchanged, till it arrived at the edge of the ice, where it halted, and subsequently entered the water in batches.

This procedure continued for many hours, the penguins that day observing this extraordinary behaviour, the most astonishing part of which lay in the accuracy of their drill-like movements, so that we might have been watching a lot of soldiers executing movements on a field day. Probably the sudden motions of these bodies of birds was brought about by a sound uttered by the single bird which acted as leader, though we did not hear this.

The actual reason for their departure from their usual customs is beyond my knowledge. There was nothing to be seen to account for it, but the penguins evidently obeyed some instinct which affected them all on this and two subsequent occasions when the same thing took place. The only suggestion I have to offer is that at some remote period the Adélies used to mass together in great numbers as the time for their migration approached, and that this phenomenon was some sort of reversion to bygone habits; but against this theory is the fact that the scenes were enacted long before any thought of leaving the rookery could have possessed them.

Having now given an account of the habits of Adélie Penguins during their breeding season, when they are found at their rookeries, there remains the question of their habitat during the winter, when they leave the Antarctic shores for the Pack.

Unfortunately, only a rough idea can be formed on this subject, as so few data are to hand, and the movements of the pack ice itself are so little known. For the following information concerning the limits of this mass on and about the meridian of Cape Adare (170° 10′ E.), I am indebted to Commander Harry L. L. Pennell, R.N., who commanded the "Terra Nova" from 1910 to 1913, and probably that part of the subject which more nearly concerns the penguins of Cape Adare rookery will be found in Table A, whilst for the benefit of zoologists of future expeditions, who may be carrying these studies further, I append Table B.

The birds from Cape Crozier Rookery (77° 30′ S., 169° 30′ E.) must have some 400 miles further to travel when they go north in the autumn than those at Cape Adare.

TABLE A.

Mean Date.	Northern Limit of Pack.	Miles from C. Adare.	Southern Limit of Pack.	Miles of Pack N. and S.	Remarks.
Feb. 3, 1839 . .	68° S.	190	?	?	Balleny
Jan. 1, 1841 . .	66° 30′	280	69°	150	Ross
Feb. 1, 1895 . .	66° 15′	300	69° 45′	210	Kristensen
Feb. 10, 1899 . .	66° 0′	315	69° 0′	...	Borchgrevink
Feb. 27, 1904 . .	?	...	70° 30′	?	Scott
Feb. 15, 1910 . .	*nil*	...	*nil*	...	"Terra Nova"
Mar. 13, 1912 . .	*nil*	...	*nil*	...	"Terra Nova"
Jan. 30, 1913 . .	*nil*	...	*nil*	...	"Terra Nova"

NOTE.—Ross, Kristensen, Scott, Shackleton and Pennell, all, however, found Pack late in the season while trying to work west along the coast when only some 45 to 75 miles north of Cape Adare, and all were turned by this Pack.

According to Commander Pennell it appears probable that there is a great hang of Pack in the sea west of Cape Adare and south of the Balleny Islands, and most probably it is here that the Adélies repair when they leave the Cape Adare rookery in the autumn. I think, however, it is safe to conclude that they seek the northernmost limits of the Pack during the winter, as these would offer the most favourable conditions.

TABLE B.

Date.	Longitude.	Northern Limit.	Extends N. and S.	Minutes of Latitude Northern Limit is N. of Cape Adare.
			Miles.	
Jan. 3, 1902 . . .	178° E.	67° S.	140	250 ("Discovery")
Dec. 31, 1902 . . .	180°	66° 30′	60	280 ("Morning")
	Second belt	69°	30	130 ("Morning")
Dec. 20, 1908 . . .	178° W.	66° 30′	60	270 ("Nimrod")
Dec. 9, 1910 . . .	178° W.	64° 45′	300	390 ("Terra Nova")
Dec. 27, 1911 . . .	177° W.	65° 20′	160	360 ("Terra Nova")
Jan. 12, 1840 . . .	166° E.	64° 30′	...	400 (Wilkes)
Mar. 8, 1911 . . .	162° E.	64° 30′	270	400 ("Terra Nova")

THE "ECSTATIC" ATTITUDE.

Both cocks and hens at times are seen to take up a very curious position, holding their bodies absolutely erect, their necks being stretched perpendicularly to their utmost length. On assuming this attitude, they raise their flippers horizontally, and with eyes half closed, make a guttural, croaking sound for a few seconds, whilst a

LIST OF THE PLATES.

PLATE I.—A long line of Adélie Penguins approaching their breeding-ground.
,, II.—Walking and "tobogganing" over sea-ice to the Rookery.
,, III.—The proposal: the female on the right in her scoop.
,, IV.—Two cocks squaring up for battle.
,, V.—Nests made of stones.
,, VI.—Nests of stones: some large and some small.
,, VII.—Floods.
,, VIII.—Method of feeding the young.
,, IX.—McCormick's Skuas fighting over Seal-blubber.
,, X.—Adélie Penguins on the ice-foot.
,, XI.—Diving flat into shallow water.
,, XII.— ,, ,, ,, ,,
,, XIII.—Adélie Penguins "porpoising."
,, XIV.—Leaping from the water: one bird jumped 4 feet high and 10 feet long.
,, XV.—Jumping from the water on to slippery ice.
,, XVI.—Adélie Penguins on the ice-foot.
,, XVII.—A knot of Adélie Penguins on the ice-foot.
,, XVIII.—Sea-leopard lurking beneath the overhanging ledges of the ice-foot.
,, XIX.—A couple with their chicks.
,, XX.—Adélie Penguin with chick 12 days old.
,, XXI.—Adélie Penguins and chick.

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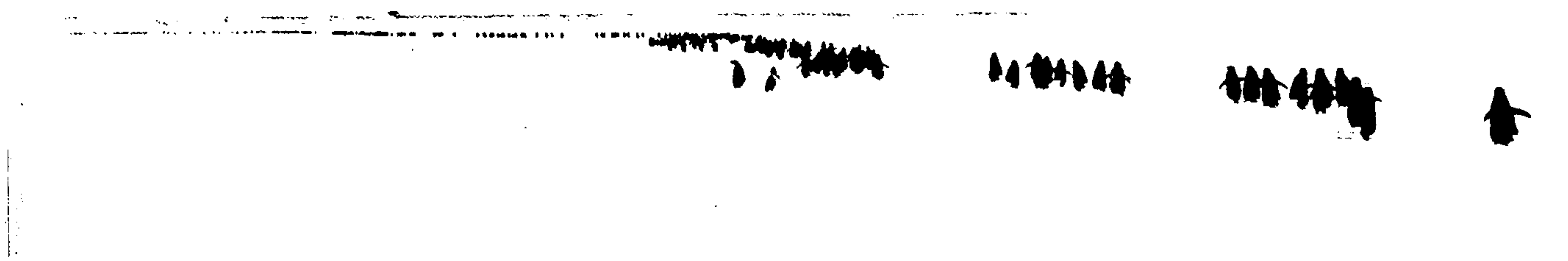
Adélie Penguin, Pl. I.



A long line of Adélie Penguins approaching their breeding-ground.

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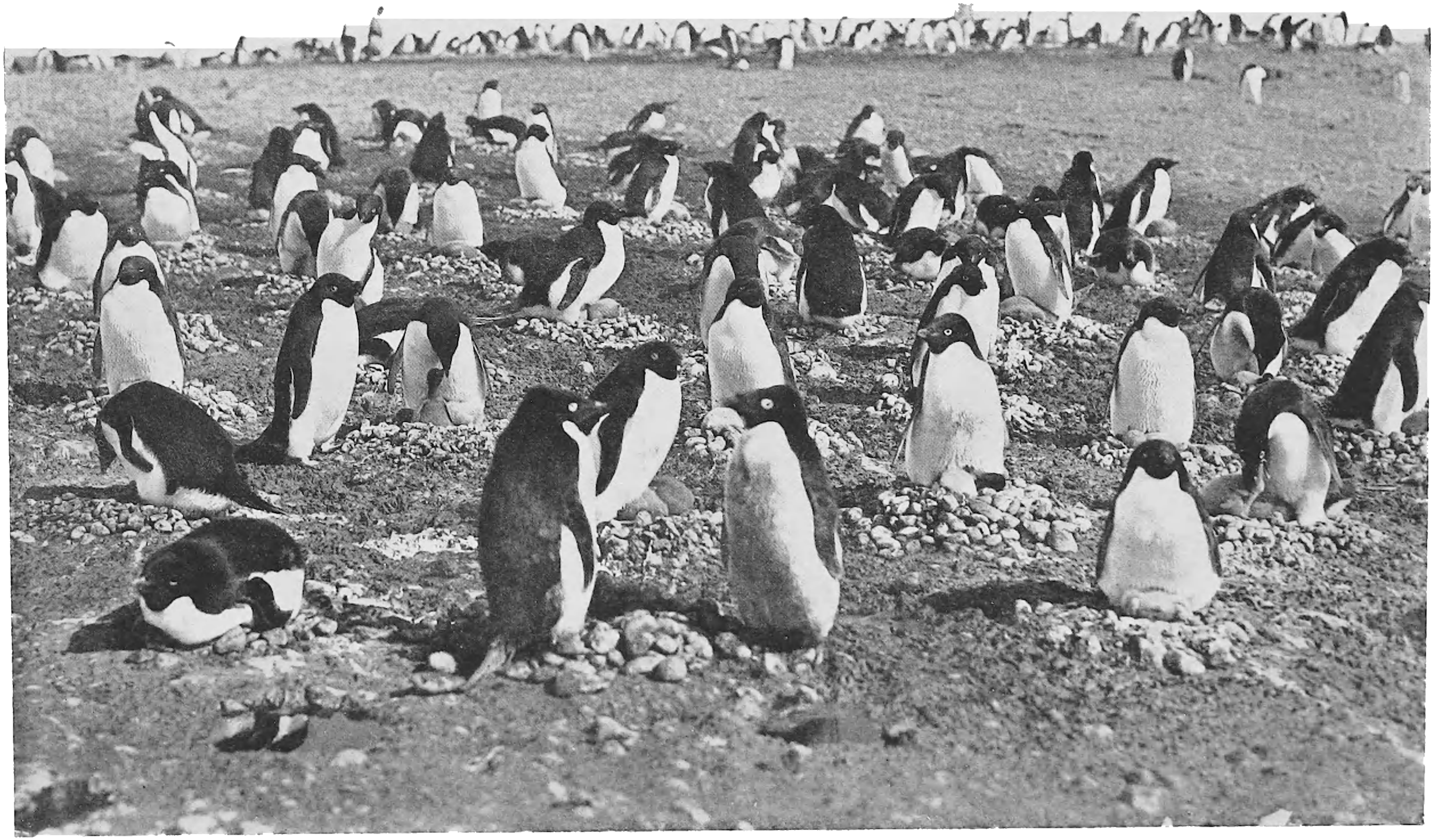
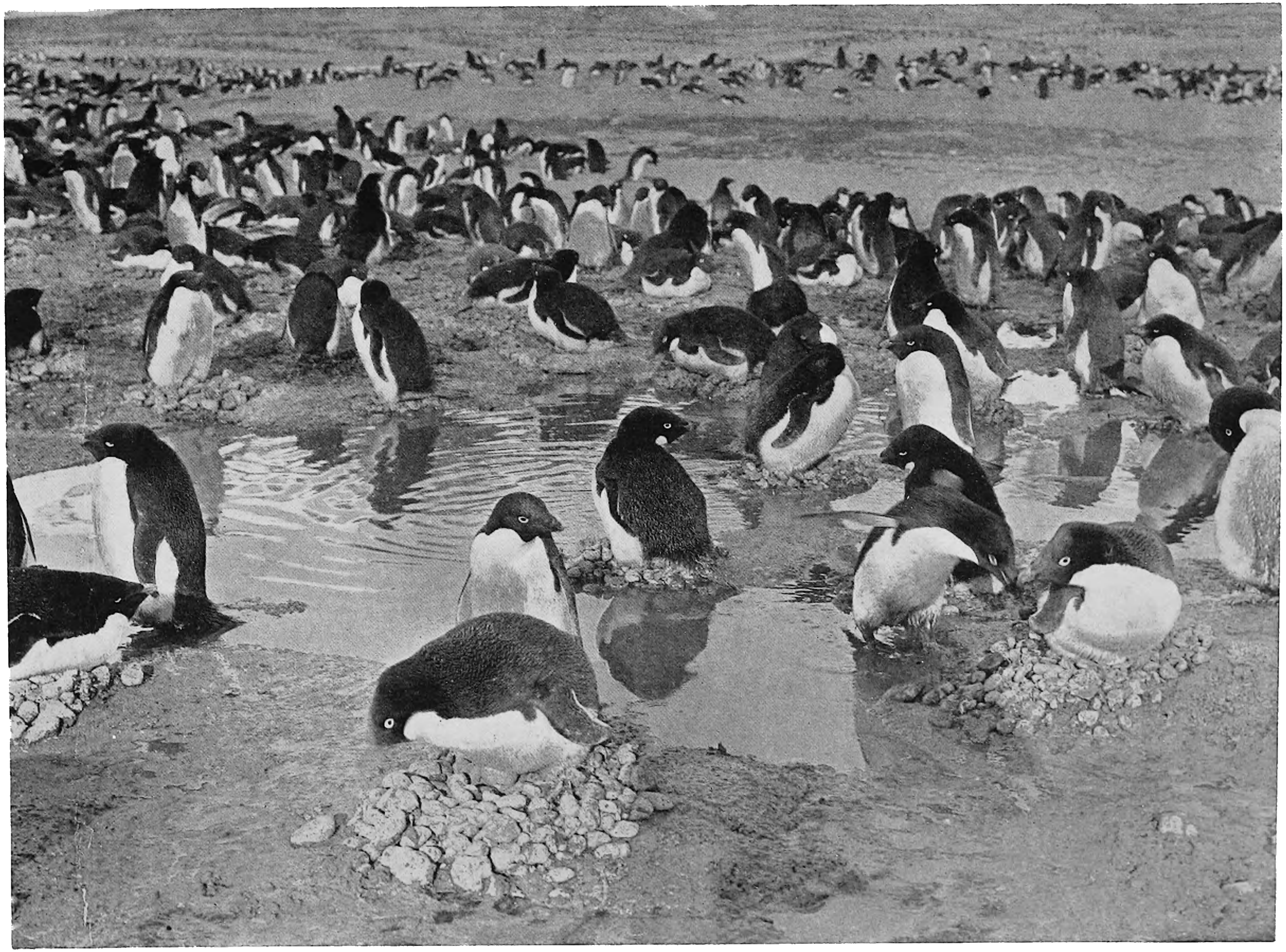
Adélie Penguin, Pl. III



Adélie Penguin, Pl.



Floods.

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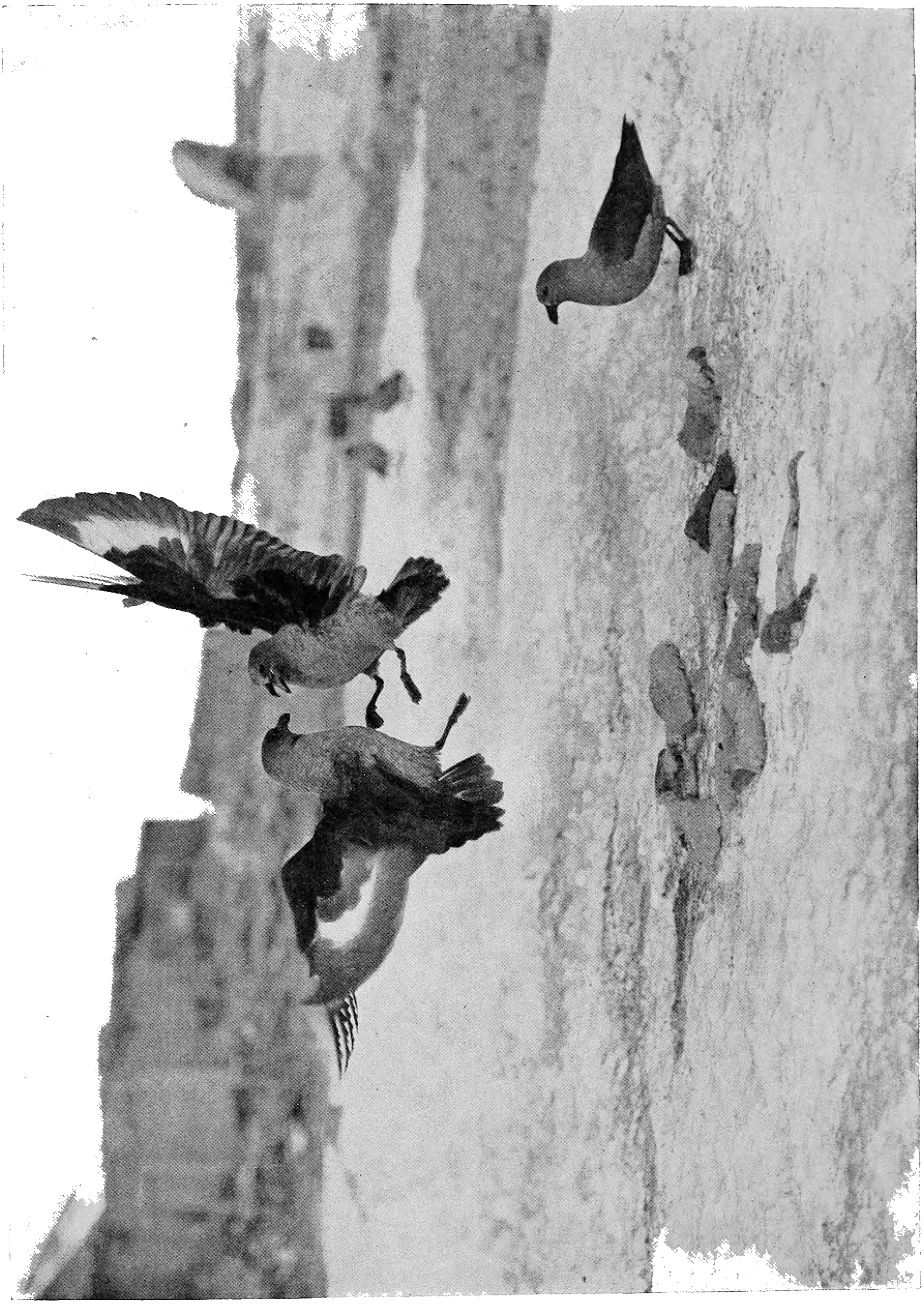
Adélie Penguin, Pl. VII.



McCormick's Skuas fighting over Seal-blubber.

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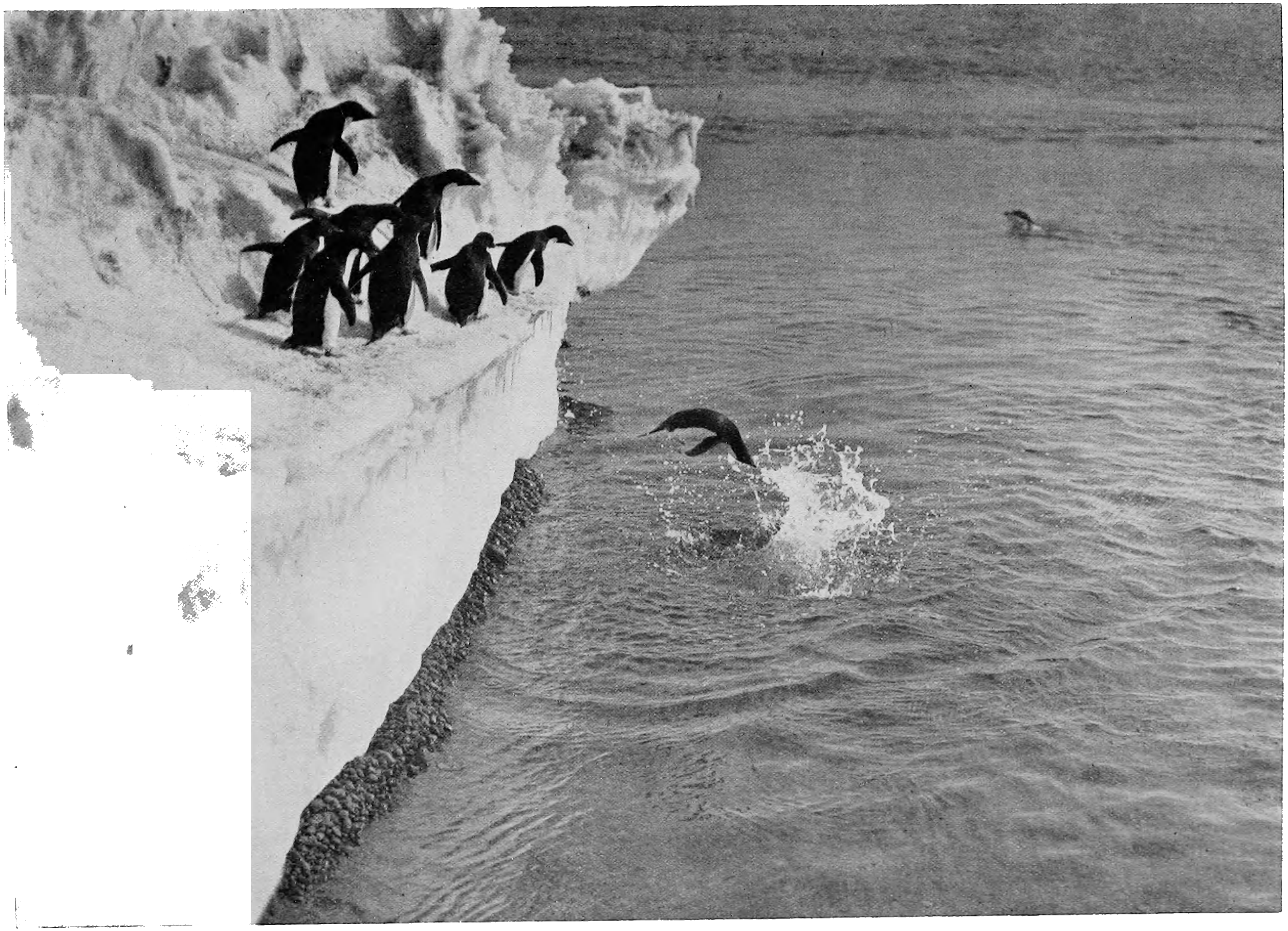

shallow water.

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Adélie Penguin, Pl. XI.

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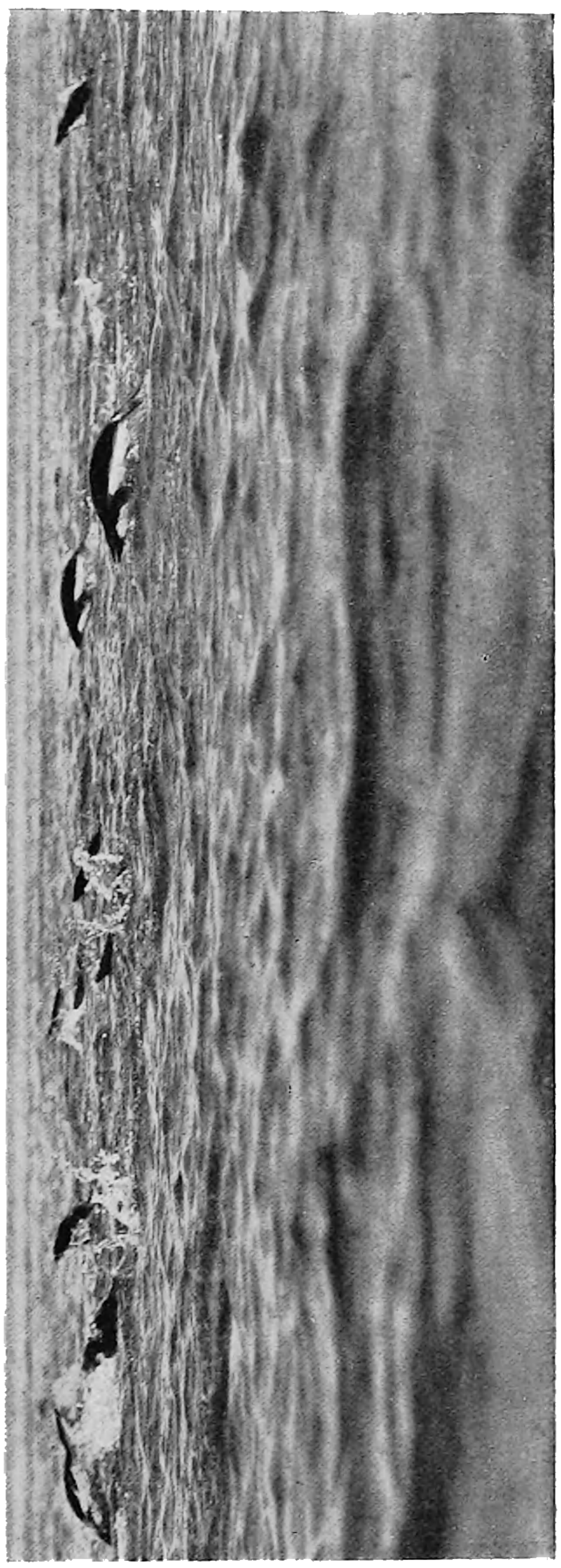

Adélie Penguins "porpoising."

Jumping from the water on to slippery ice.

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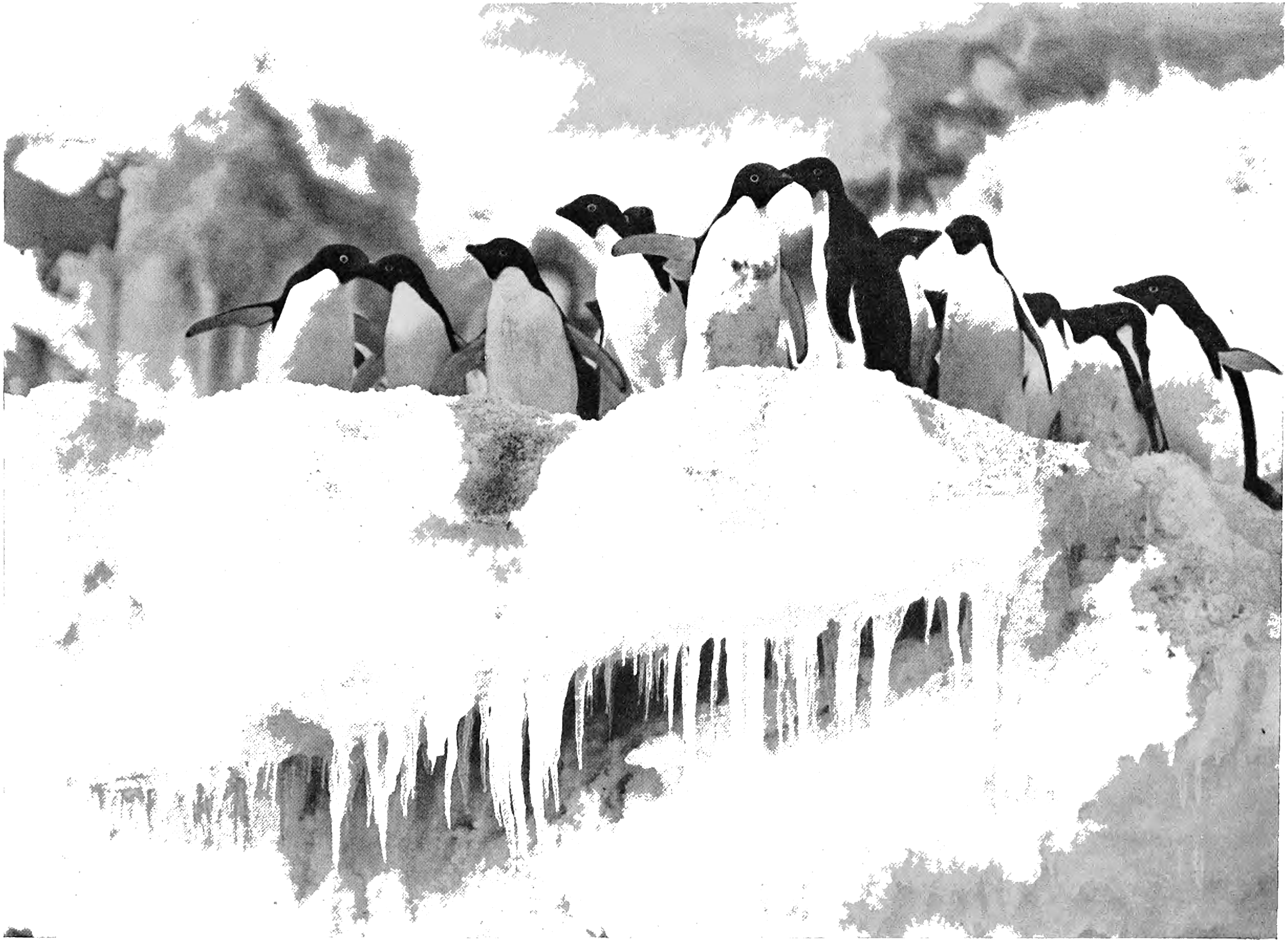

A knot of Adélie Penguins on the ice-foot.

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Adélie Penguin, Pl. XVII.

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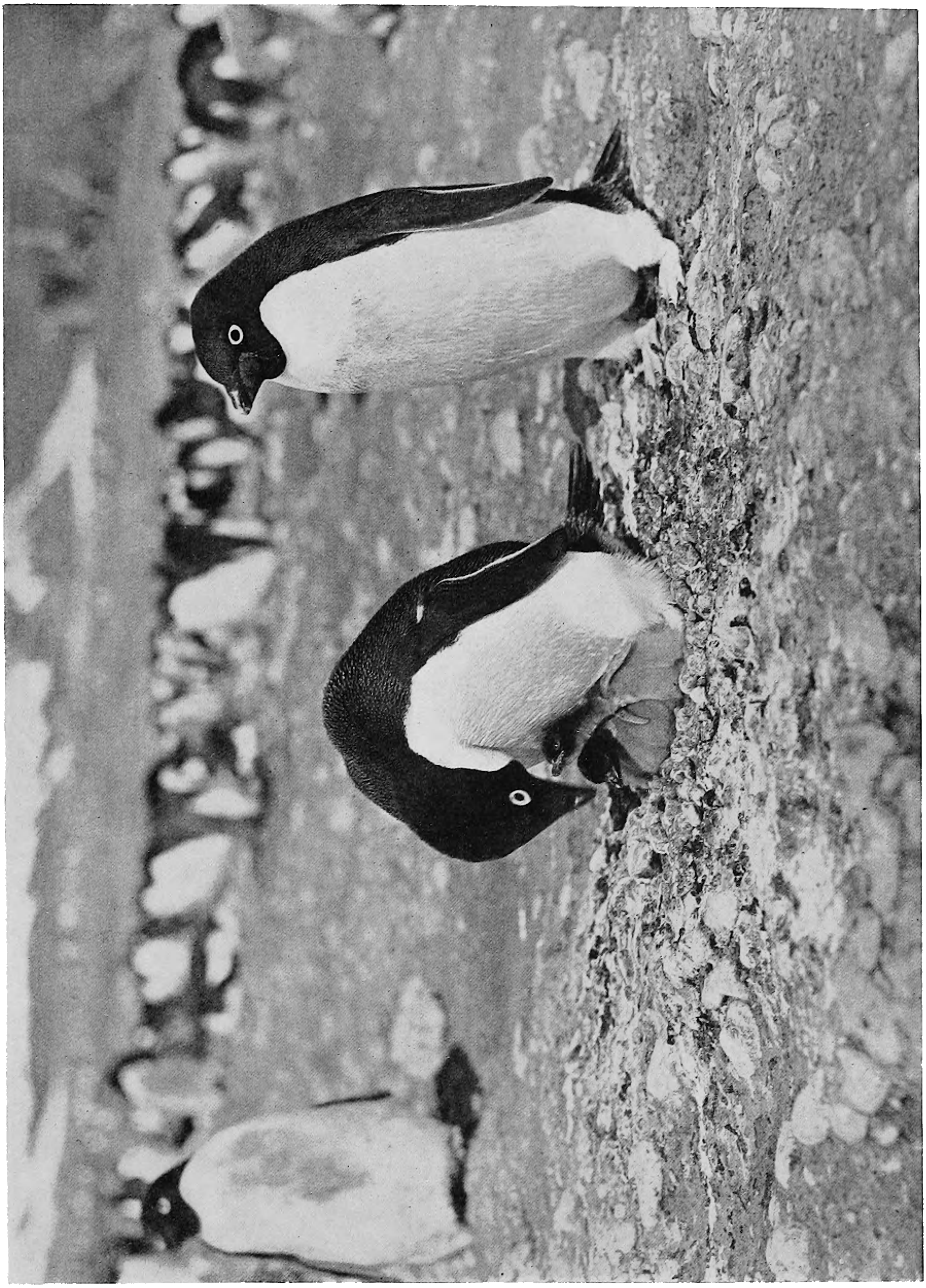
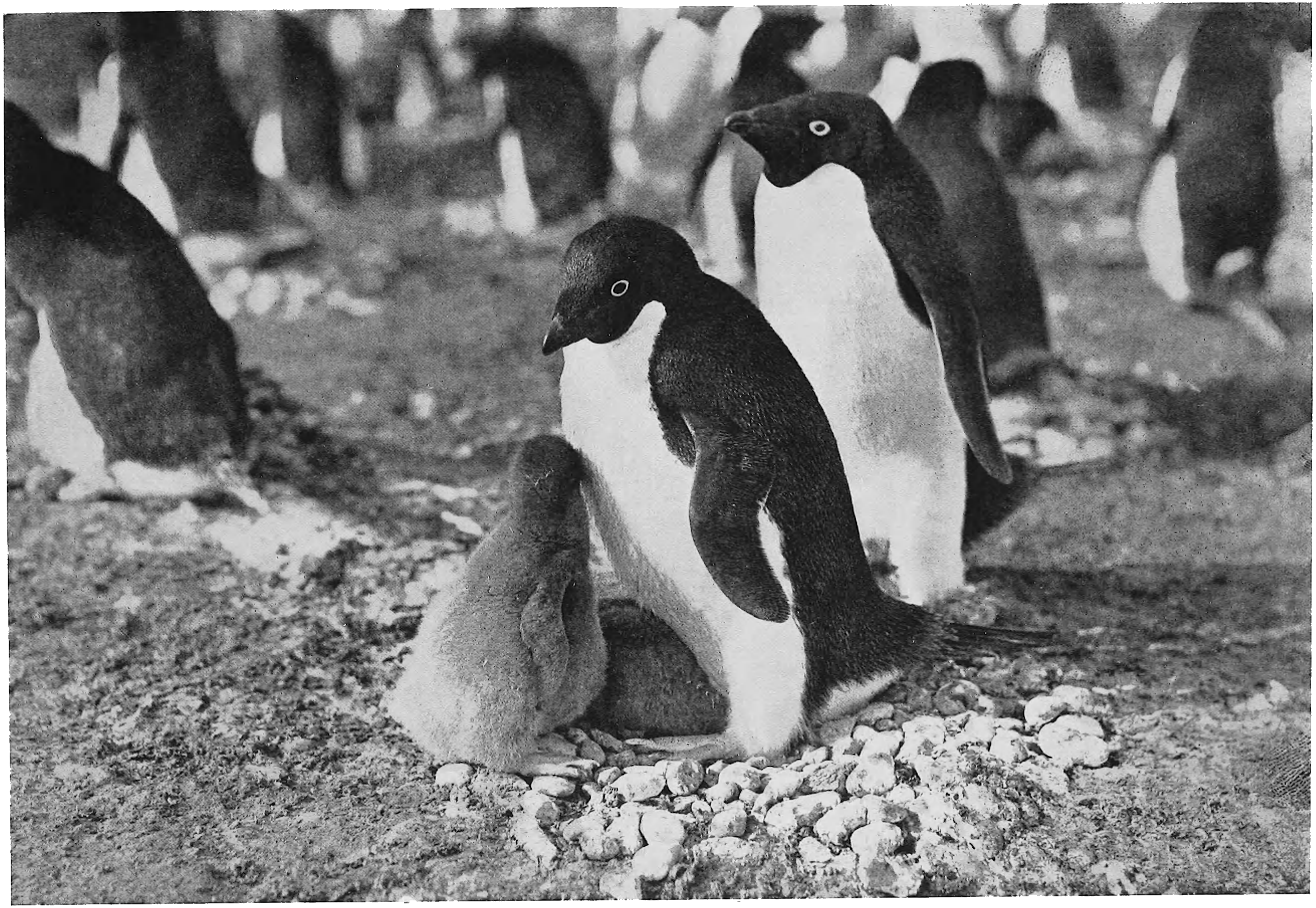


A couple with their chicks.



Adélie Penguins and chick.

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Adélie Penguin, Pl. XXI.

CETACEA.

BY D. G. LILLIE, M.A.

(*Biologist to the Expedition*).

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I.—INTRODUCTION.

A careful watch was kept for Cetaceans on board the "Terra Nova" during all her voyages; and although we did not succeed in capturing any specimens of this group, accurate records and notes were taken of nearly every whale and dolphin which we saw. Great care was exercised to determine the species, as far as this was possible from an examination of the animals as they swam in the sea.

In writing this Report I have had access to the notes made by the late Dr. E. A.

Wilson and by Commander H. L. L. Pennell, R.N., and other officers of the "Terra Nova." The zeal shown by the Officers of the Watch and the whole ship's company to notify the biologist whenever a Cetacean was sighted, deserves to be highly commended; indeed, it must be confessed that the cries of "Whale" were often more numerous than the responses on the part of the biologist.

During the winters of 1911 and 1912 I spent several months at whaling stations near the Bay of Islands, New Zealand; and was thus able to examine three species of large whales in detail. Opportunities were taken of talking to the whalers; and some information was thereby obtained, concerning the distribution and migration of whales in the Southern seas. This memoir contains a record of the Cetacea seen by us on board the "Terra Nova"; and also some anatomical and other notes on the species examined in New Zealand, together with any new information which I have been able to collect with regard to the Cetacea of the Southern Hemisphere.

I have to thank Messrs. Spurling & Son, of Tasmania, for their permission to republish the photograph shown in Plate IV., fig. 1. Professor W. B. Benham, F.R.S., of Dunedin, N.Z., has kindly allowed me to make use of four previously unpublished photographs in Plates IV. and V. I am indebted to Dr. W. G. Ridewood for the photograph of the embryo Humpback Whale in Plate IV., fig. 4. The photographs in Plate VI. were taken by Paymaster F. R. H. Drake, R.N., a member of the Expedition, and to him I tender my best thanks. My sincere thanks are due to the Editor, Dr. S. F. Harmer, for helping me in many ways during the preparation of this Report.

II.—DESCRIPTIONS OF SPECIES.

MYSTACOCETI.

BALAENIDAE.

1. *Balaena glacialis*,* Bonnaterre.

No individuals of this species were observed by the "Terra Nova." It would seem to be doubtful if this whale ever penetrates into the ice-covered seas of the Antarctic, although it still appears to be fairly plentiful in sub-antarctic regions.

This species is caught by the whalers at the South Shetlands, usually towards the end of the season, about February and March. At South Georgia it is taken all through the season, although March was said to be the best month. It is found off Campbell Island, to the south of New Zealand, throughout the year. Thirteen Southern Right whales were captured at the last-mentioned locality by Mr. Cook

* Or *Balaena australis*, Desmoulins. Collett, R., "Norges Pattedyr," Kristiania, 1912, p. 545. Bull, H. J., "The Cruise of the 'Antarctic,'" 1896, p. 214. Racovitza, E., "Résultats du voyage du S.Y. 'Belgica,' 1897–99, Zoologie, Cétacés," 1903, p. 19. Wilson, E. A., National Antarctic Exped., 1901–4, Nat. Hist. Reports, Vol. II., 1907, Mammalia, p. 1. Liouville, J., Documents Scientifiques, Deuxième Expéd. Charcot, 1908–1910, Cétacés, 1913, pp. 5–27. Turner, Sir W., Proc. Roy. Soc. Edinb., XXXV., 1914, Pt. I. (No. 2, p. 18).

shores of the North Atlantic, and of the North-Eastern Pacific, are probably all members of the one species, *M. nodosa*, Bonn. As far as our present knowledge goes, it would appear that this widely distributed species is the sole representative of the genus *Megaptera*. It is of interest to note that the same world-wide identity seems to occur also in the case of the four generally admitted species of the genus *Balaenoptera*, although a fifth species of this genus, *B. brydei*, recently described, has at present only been recorded from the seas off the coast of South Africa.*

SIZE.

It was very difficult to obtain exact measurements of whales at the floating factories, as the carcases were flensed and cut up in the water and taken on board the ship in pieces. When the whales were lying in the sea, previous to the dissecting operations, they were generally partially submerged, which prevented accurate measurement of their length from being made. Careful measurements were collected, however, in the case of the seven specimens seen at the shore station

TABLE I.—*Megaptera nodosa*, Bonnaterre.

Length of Males.	Length of Females.
Feet.	Feet.
42	35
30¾	40
37	43†
31	42
34	—
Average length of Males— 35 feet	Average length of Females— 40 feet

at Whangamumu during October, 1911. This compensated to some extent for my inability to obtain more than two length-measurements from the many individuals which I examined at the floating factories.

The average length of these nine whales was 38 feet, which is rather too short to be typical of all the Humpbacks captured off the Bay of Islands in the season of 1912. The largest individual of this species seen during my stay was about 51 feet long; and I feel certain that, if it had been possible to measure the lengths of a larger number, the average would not have been far short of 40 feet.

The length-measurements obtained are given in Table I., and it will be noticed

* Olsen, Ørjan, Proc. Zool. Soc., 1913, pp. 1073–1090, Pls. CIX.–CXIII.

† Giving suck to calf when shot.

that the average length of the females is greater than that of the males. The measurements were made in a straight line from the tip of the snout to the notch between the tail-flukes.

Mr. A. H. Cocks' estimate of the average lengths of 94 Humpbacks, taken off the Northern Coasts of Norway and Russia in the years 1885 and 1886, is $35\frac{1}{6}$ feet in the case of the males, and $40\frac{1}{3}$ feet for the females.* From this it will be seen that the Southern members of the species are almost identical in size with their *confrères* in the Northern Hemisphere.

Body Form.

In general appearance, the New Zealand Humpback (Plates I. and II.) agreed exactly with the photographs and descriptions of Northern types.†

Proportional measurements, taken in the case of four adults and a large foetus, are shown in Table II.

Table II.—*Megaptera nodosa*, Bonnaterre.

Measurement.	Male.		Male.		Male.		Female.		Female Foetus.	
	ft.	ins.	ft.	ins.	ft.	ins.	ft.	ins.	ft.	ins.
Total length	30	8	31	–	34	–	42	–	13	6
Tip of snout to eye	..		..		..		..		2	10
Tip of snout to angle of mouth	8	8	..		..		..		..	
Eye to ear	1	1	..		..		..		..	
Nostrils in front of eyes	1	7	..		..		..		..	
Tip of snout to anterior end of umbilicus	16	3	17	10	19	6	25	–	7	8
Length of umbilicus	–	8	–	8	1	1	1	3	–	4
Posterior end of umbilicus to anterior end of the urinogenital groove	2	2	2	2	2	3	3	3	–	11
Length of urinogenital groove	1	–	1	–	1	4	2	9	–	11
Posterior end of urinogenital groove to anterior end of anus	2	8	2	2	1	5	1	–	–	10
Length of anus	–	4	–	4	–	4	–	6	–	1
Posterior end of anus to anterior edge of tail-flukes	4	4	4	6	5	5	5	–	1	6
Greatest breadth of tail-flukes	3	4	3	4	2	8	3	5	1	4
Length of one tail-fluke	..		..		..		5	6	1	9
Length of pectoral fin (axil to tip)	10	–	..		10	9	..		4	–
Greatest width of pectoral fin	2	2	..		..		..		1	–
Eye to anterior edge of pectoral fin	1	1	..		..		..		..	
Posterior end of dorsal fin to notch of flukes	..		8	3	..		..		..	
Height of dorsal fin	..		..		..		..		–	4
Width of body between axils of pectoral fins	..		..		..		..		3	4

In Table III. some of these measurements have been reduced to percentages of the total length, for comparison with similar measurements, in European and American specimens, given by True.‡

* Cocks, A. H., *The Zoologist*, 1887, Vol. XL, p. 213.

† Struthers, J., *Journal of Anatomy and Physiology*, 1887, pp. 109–125. True, F. W., "Whalebone Whales of the Western North Atlantic," Smithsonian Contributions to Knowledge, 1904, Vol. XXXIII., pp. 211–231, Pls. 37–41. Haldane, R. C., Annals of Scottish Nat. Hist., April 1905, p. 66, Pl. III.

‡ True, F. W., loc. cit., p. 223.

TABLE III.—*Megaptera nodosa*, Bonnaterre. European, American, and New Zealand.

	Bay of Islands, New Zealand, 1911.	Bay of Islands, New Zealand, 1911.	Bay of Islands, New Zealand, 1911.	Bay of Islands, New Zealand, 1911.	Bay of Islands, New Zealand, 1912.	Finmark (Sars, 80).	Snook's Arm, Newfoundland, No. 2, 9, True.	Snook's Arm, Newfoundland, No. 6, 9, True.	Snook's Arm, Newfoundland, No. 5, 9, True.	Iceland, 1867 (Hallas, 1868).	Vardö, Finmark, 1884 (Cocks, 1885).
Sex	♂	♂	♂	♀	♀ Foetus	♀	♀	♀	♂	♂	♂
	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "
Total length . .	30 8	31 0	34 0	42 0	13 6	46 7[1]	46 6	45 5	42 2	51 6[3]	44 0[4]
Notch of flukes to anus . .	% 25·0	% 25·2	% 23·7	% 20·0	% 20·9	% 25.8[2]	% 24·5	% 24·0	% 22·9	% —	% —
Notch of flukes to navel . .	45·1	43·5	39·4	37·8	41·3	44·4[2]	42·3	41·8	42.4	—	—
Length of pectoral fins (axil to tip) .	32·6	—	31·6	—	29·6	31·0	—	28·1	28·9	29·1	31·3[4]

[1] Straight, from lower jaw. [2] From figure. [3] Danish measure. [4] Approximate.

The cut-water, mentioned by Struthers as occurring beneath the chin in the Tay whale, was a very constant feature in the New Zealand specimens. The number of nodes or bosses on the anterior margins of the pectoral fins were counted in several individuals, and each fin was found to have two larger and seven lesser nodes, as in Northern *Megaptera*.

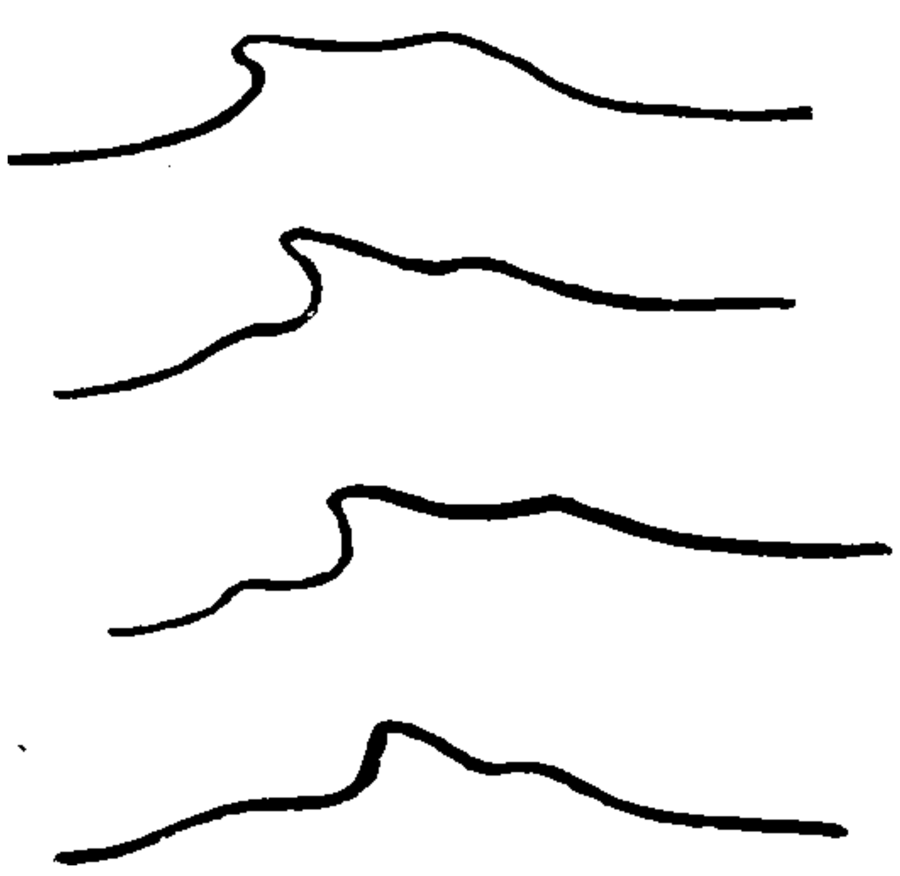

FIG. 1.—Outline diagram of some variations in the shape of the dorsal fin in the New Zealand Humpback whale (*Megaptera nodosa*, Bonn.).

The shape of the dorsal fin varied a good deal,* as is shown in text-fig. 1; but in each case a basal portion could be distinguished which was surmounted by the fin proper. The variations in the outline of the dorsal fin were quite independent of the variations in the amount of pigmentation. The same type of fin was found in individuals which varied greatly in colour.

Behind the dorsal fin, in most of the specimens, the dorsal ridge of the tail was crenulated, as described by Andrews in *Rhachianectes glaucus*.†

COLOUR.

In the case of thirty individuals the colour was carefully noted, and it was found that every gradation occurred in the amount of black and white, as shown in text-fig. 2, Nos. 1–4.

* Cabrera, A., "Fauna Ibérica. Mamiferos," Madrid, 1914, Cetacea, p. 398.

† Andrews, R. C., "Monographs of the Pacific Cetacea," Mem. American Mus. Nat. Hist., N.S. Vol. I., Pt. V., 1914, p. 259.

that these whales may possibly get whiter with age; but this idea was refuted by the fact that some of the whitest whales, seen at the Bay of Islands, were very small and showed signs of immaturity. Moreover, an unborn foetus ($13\frac{1}{2}$ feet in length) was found to possess exactly the same coloration as the mother. They were both coloured as in text-fig. 2, No. 2.

All the specimens examined were black on the dorsal surface, and most of them had some white on the ventral surface. Two were almost entirely black all over. The regular way in which the dorsal pigmented area encroached upon the white ventral region was very marked in the various individuals: the three points of black in the posterior half of the animal, which were barely indicated in No. 1 type (text-fig. 2) became more pronounced in No. 2, and in No. 3 formed bands round the abdomen; in No. 4 they coalesced and spread out over the entire ventral surface, with the exception of two spots below the dorsal fin and a small area below the mandible.

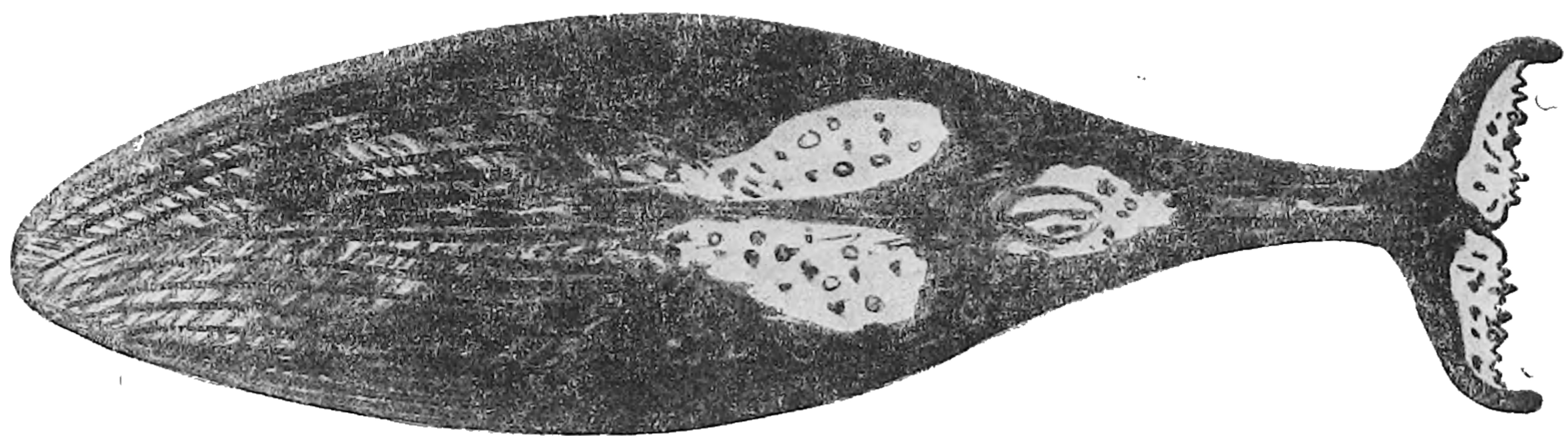

FIG. 3.—Ventral surface of a New Zealand Humpback whose pigmentation is between Nos. 3 and 4 in text-fig. 2.

The mode of spreading of the pigment on the ventral surface is shown in text-fig. 3, which represents the type between Nos. 3 and 4 (text-fig. 2). Over the lighter areas the pigment occurred in oblique lines of flecking, which converged on either side towards the mid-ventral line. All the individuals, including the foetus $13\frac{1}{2}$ feet in length, were dappled like grey horses. The dapple-markings, which were particularly noticeable on the shoulders, pectoral fins, flanks and tail, consisted of white spots, rings and streaks on the black pigmented areas, and the same marks in black on the white areas. These markings are shown in text-fig. 4, A; they were quite distinct from the scars made by rocks and barnacles.

In the whiter individuals there were often patches of grey on the white ventral surface, and especially at the junction of black and white areas in the neighbourhood of the dapple markings. The grey colour was due to a diminution in the amount of black pigment in the Malpighian layer of the epidermis.

The interior of the mouth had a grey appearance, with the exception of the narrow strip of pink palate which made a keel-like parting between the greyish-white hairs of the ranges of baleen-plates.

The tongue was of a darker grey colour than the hairs of the baleen-plates.

External Parasites.

Barnacles.—All the specimens examined had barnacles growing upon them, and the mode of distribution of these parasites over the body of each whale was found to be remarkably constant. The ventral surface appeared to be the favourite place for barnacles, although a few were occasionally found on the dorsal surface of the head. The back was generally quite free from parasites. A thick patch of barnacles always occurred on the anterior, ventral surface of the throat, in the middle line, just behind the chin. A smaller patch was generally to be found in the region of the genitalia. Besides these areas, barnacles seemed to show a preference for projecting knobs; the bosses on the anterior margins of the pectoral fins were nearly always crowned with barnacles, also the extreme tips of the pectoral fins and tail-flukes; occasionally a barnacle was found surmounting one of the hair-tubercles on the snout. It was noticed that barnacles nearly always occupied pigmented areas of the whales' skin; very few were found on a white surface.

The extremely characteristic patch of barnacles behind the chin was always situated on an equally characteristic patch of grey or black skin, and the number of individuals constituting the patch varied with the size of this pigmented area.* (*See* Pls. I. and II., figs. 2 and 7.) Only two species of barnacles were found on the Humpbacks: *Coronula diadema* and *Conchoderma auritum.* The former was always fastened directly to the skin of the whale, while *Conchoderma* only grew upon the shells of *Coronula.* As many as fourteen individuals of *Conchoderma* were found on one *Coronula.* Barnacle-scars were often to be seen on the skin of these whales. Each scar marked the spot from which a *Coronula* had been removed, either by the host rubbing itself against a rock, or by some predatory fish. These marks, formed by the base of the *Coronula* shell, were very easily distinguished from other scars, as they consisted of a sunken dome-shaped area, surrounded by a circular depression. The surface of the dome was impressed by some 18 small furrows, which radiated from a ring near its apex. (Text-fig. 4, C and D, b.)

Whale-lice.—Every specimen was infested with *Paracyamus boopis.* These "lice" were found all over the body of each whale, sticking into the epidermis by their sickle-shaped claws. They were most plentiful among the barnacles and in the throat-grooves on the ventral surface, in which places the young "lice" appeared to seek shelter.

Dr. Calman tells me that the Cyamids have no free-swimming stage, and therefore they probably pass from whale to whale by actual contact, during copulation and lactation. When the young and adult "lice" were removed from a whale and put into a glass vessel containing sea-water, they sank to the bottom and caught hold of one another with their claws in their endeavours to get a foot-hold in a soft surface.

* Shown in one of True's plates, loc. cit., Pl. XXXVIII., Fig. 1.

They were quite unable to swim. Whale-lice should be of value in helping to determine the specific identity of their hosts. It was of interest to find that the New Zealand Humpbacks were infested with a Northern form of *Paracyamus*.

Scars.

Wounds, in all stages of healing, occurred irregularly over the surface of the skin, though they were perhaps more often found at the sides of the animal and on the head. The fresh scars were like little pits, usually about three inches long, two inches broad, and $1\frac{1}{2}$ inches deep. They presented the appearance of having been cut out with a sharp instrument, and the piece of skin and blubber entirely removed.

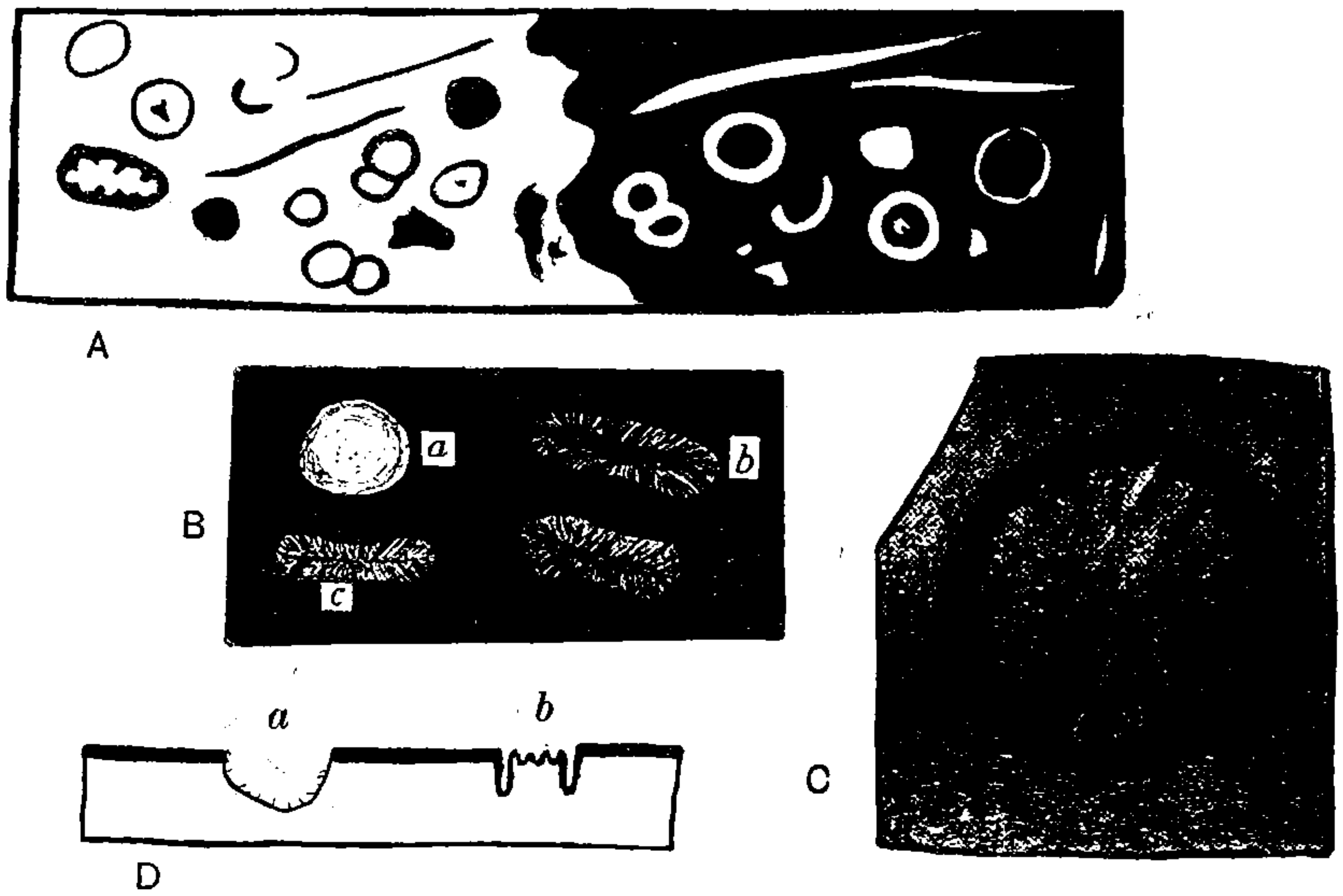

Fig. 4.

A—Dapple-markings on skin of New Zealand Humpback whale.
B—Marks on skin due to wounds: *a*, open scar; *b*, scar partially healed; *c*, scar completely healed.
C—Barnacle-scar.
D—Section of blubber to show: *a*, open wound caused by rock; *b*, barnacle-scar.

The cut ends of the fibres and blood-vessels, which penetrated the dermis or blubber, could be seen on the walls of the cavity.

The open sores were frequently infested with *Paracyamus boopis*. The healed scars had a characteristic oblong shape (text-fig. 4, B, c). When such scars occurred on pigmented areas of the skin they were usually lighter in colour than the surrounding epidermis. They could not, however, be mistaken for the white dapple-markings referred to above, since they had a very characteristic rayed appearance. These wounds were, almost certainly, made by the whale coming in contact with sharp ledges of rock while swimming near the coast. Off the coast of New Zealand on several occasions I have seen these shore-loving whales swim through narrow channels between isolated rocks, and play in their vicinity. It would be very difficult for the

the beak, arranged approximately in two alternate series of four: an outer row on the extreme edge of the beak, and an inner row situated a short distance away from the edge; making in all about twenty-seven tubercles on the upper jaw. On either side of the lower jaw there were about eight hair-tubercles, also arranged in two more or less alternating rows of four. On each side of the blunt extremity of the mandible, pointing directly forwards, there was a cluster of two or three larger tubercles and a few smaller ones. These clusters contained the largest of all the hair-tubercles, and constituted the foremost part of the animal.

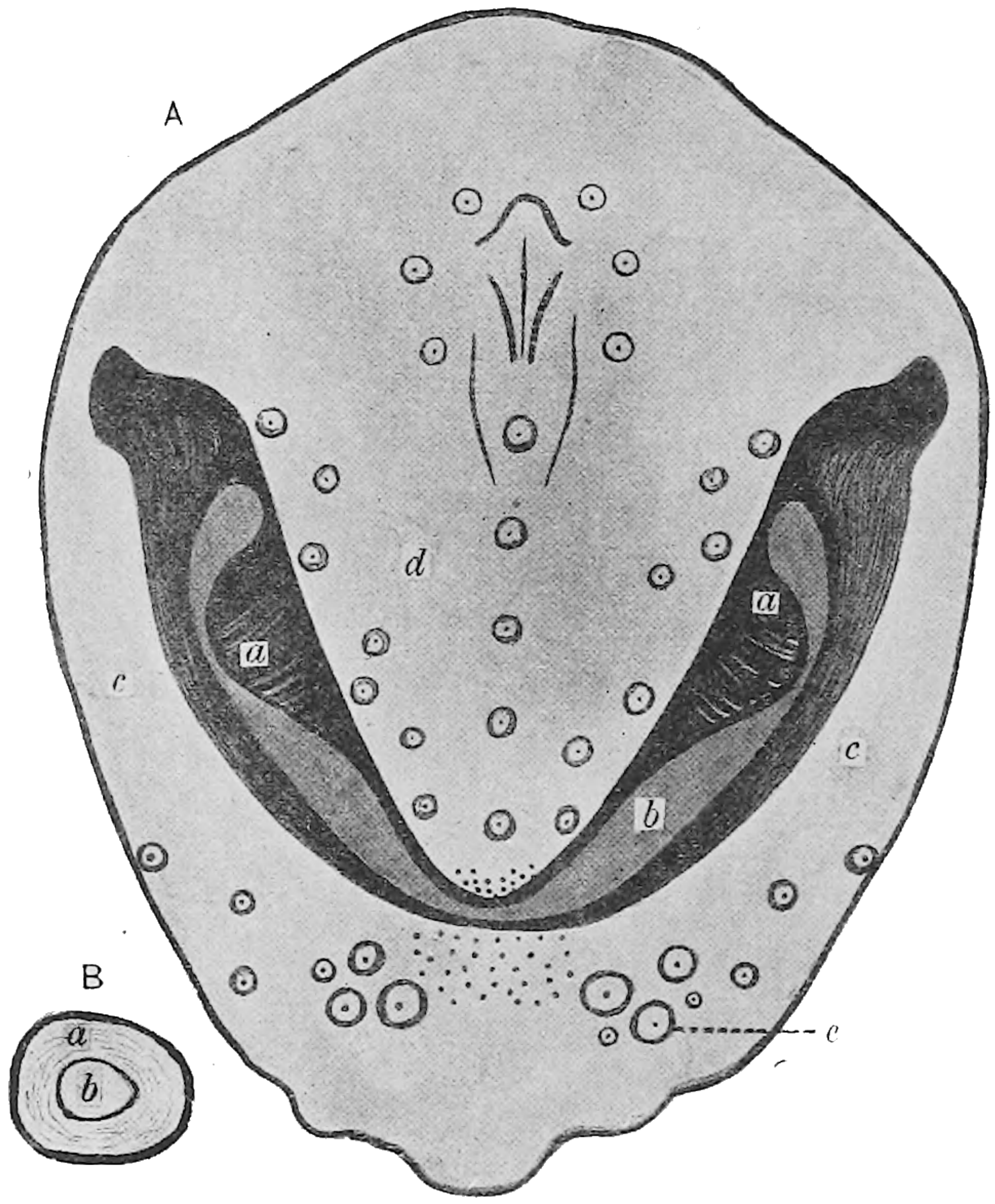

FIG. 5.

A—Anterior view of the mouth of a Humpback, to show the movement of the rami of the lower jaw (semi-diagrammatic): *a*, free ends of the baleen-plates; *b*, tongue seen through the space between the lips; *c*, rami of mandible in the position which they occupy when the mouth is open; *d*, upper jaw; *e*, hair-tubercle.

B—Transverse section of the symphysis between the rami of the lower jaw: *a*, white fibrous tissue; *b*, central pulpy substance.

There were, altogether, about twenty-eight tubercles on the lower jaw. The number and character of the tubercles corresponded very closely with those described as occurring on the Northern *Megaptera*.*

The lengths of the hairs when withdrawn from their follicles were, on an average, about 32 mm. The longest observed was 45 mm. The free portion of

True, F. W., "Whalebone Whales of the Western North Atlantic," Smithsonian Contributions to Knowledge, 1904, Vol. XXXIII., p. 225.

each hair which projected beyond the surface of the tubercle was about 10 mm. Some of the hairs situated at the tip of the snout, and which were without tubercles, only had 5 mm. of their length projecting from the surface of the skin. The height of the tubercles varied from half an inch to two inches.

These hairs have been shown to possess a sensitive function,* and in all probability they serve to indicate to Whalebone Whales the presence of the small plankton animals upon which these whales feed. The sensitive feeler, or barbel, which occurs beneath the chin of certain fishes, which feed upon plankton, has probably a similar function to that of the vibrissae in the Mystacoceti.

Jacobson's Organ.

The remains of the ventral ends of Stenson's duct could be seen in several specimens. They consisted of two shallow depressions on the ventral surface of the tip of the snout, very similar to those of *Balaenoptera musculus*, Linn.†

Throat-Grooves.

About twenty-four furrows were counted between the pectoral fins in several individuals, and they were found to agree in number and character with those of Northern members of this species.‡

The pink coloration which was noticed by the present writer,§ a few years ago, in the throat-grooves of two species of *Balaenoptera* was also observed in some of the New Zealand Humpbacks. Careful investigation showed that it was caused by an effusion of blood, which evidently takes place after the death of the animal, as pointed out by Mr. Burfield.‖ There is, therefore, no truth in the surmise that the grooves may serve to aerate the blood.

Their function is to give elasticity to the floor of the mouth, for the purpose of increasing the capacity of the mouth-cavity. Since the grooves extend backwards to the navel, it would seem possible that they also serve to increase the power of expansion of the lungs. On account of the reduced condition of the sternum and the mobility of the ribs, the dilatation of the thorax takes place laterally, and would be greatly facilitated by the extra elasticity imparted to its ventral wall by the furrows. It was of interest to note that the large superficial muscles, which

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* Japha, A., 1904, Zool. Jahrbücher Abt. f. Anat. und Ont., Bd. XXIV., pp. 1–40. Rawitz, B., Internat. Monatschrift f. Anat. und Physiol., 1906, Bd. XXIII., Hefte 1–3.

† Kükenthal, W., "Vergl.-anatom. u. Entwick. Unt. an Walthiere," in Denkschr. med. naturw. Gesellsch. Jena, Bd. III, Theil 2, 1893, pp. 321, 349. Lillie, D. G., Proc. Zool. Soc., 1910, 2, p. 774. Burfield, S. T., Report on Belmullet Station, British Ass. Rep., Dundee, 1912, p. 177.

‡ True, F. W., "Whalebone Whales of the Western North Atlantic," Smithsonian Contributions to Knowledge, 1904, Vol. XXXIII., p. 224. Struthers, J., *Journ. Anat. and Physiol.*, 1888, Vol. XXII., p. 118.

§ Lillie, D. G., Proc. Zool. Soc., 1910, 2, p. 784.

‖ Burfield, S. T., Report on Belmullet Station, British Ass. Rep., Dundee, 1912, p. 176.

occur beneath the blubber of the throat-groove region in *Balaenoptera*, were also present in *Megaptera*.

When the coat of blubber was removed from the carcase of a whale, the more superficial muscles had a tendency to come away with the blubber. These muscles were confined to the ventral anterior three-quarters of the animal, in the regions occupied by the throat-grooves and the mammary glands. (*See* text-fig. 7.)

There appeared to be two pairs of superficial muscles in the throat-groove region; the anterior pair may possibly be the mylohyoid, and the posterior pair may represent the pectoralis major. Delage,* who described these muscles in *Balaenoptera physalus* Linn., regarded the anterior pair as modified superficial muscles of the neck. He mentioned that the fibres of the muscles were arranged more or less longitudinally in *B. physalus*, but in *Megaptera* they were oblique.

The probable function of the superficial muscle in the mandibular region is to diminish the mouth-cavity, after each mouthful, by the contraction of its floor.

Delage suggested that the function of the posterior superficial muscles might be to compress the air in the lungs, after each act of inspiration, in order to render the animal heavy enough to sink without effort. The Right Whales and the Sperm Whale float on the surface of the sea after they are shot, whereas the Balaenopteridae tend to sink. The latter family have ventral grooves and an associated system of muscles, which are absent in the former types. It is possible that the contraction of the ventral superficial muscles, after death, presses the air out of the lungs, and so causes the Balaenopteridae to sink. The elasticity of the ventral body-wall in these whales would allow of a great expansion of the lungs after inspiration,† which would make the animal so light that "sounding" would be difficult, unless it could alter its density at will by means of the muscles of the ventral grooves. The superior mechanism for increased lung-capacity and the regulation of density which seems to be possessed by the Balaenopteridae, lend some support to the widespread belief that they are capable of remaining under water for a longer period than other whales.

I made further inquiries of whalers as to the length of time it was customary for the Balaenopteridae to remain below water, and was given to understand that the Humpback rarely remained under water for more than a quarter of an hour between each two acts of respiration. Seven minutes was considered to be the normal interval between each two breaths in this species.

The belief, which is held by some whalers,‡ that the larger *Balaenoptera* can remain below the surface for twelve hours, was discredited by those whom I met in New Zealand. The latter were of opinion that the *Balaenoptera* were never in the

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* Delage, Y., Arch. Zool. Exp., 2 Sér., Tome III. 3 bis, 1885, pp. 29–38.

† Andrews, R. C., "Monographs of the Pacific Cetacea," Mem. Amer. Mus. Nat. Hist., New Series, Vol. 1, Pt. V., 1914, p. 256.

‡ Lillie, D. G., Proc. Zool. Soc., 1910, p. 790.

This alteration was brought about by the raising and lowering of the convexity of each ramus, simultaneously, and respectively with the shutting and opening of the mouth. The movement of the rami necessarily involves the elasticity of the symphysis, which joins the two rami together at their anterior extremities. The structure of the symphysis, upon examination, was found to be almost identical with that of the intervertebral cartilages.

It has been suggested that a whale swims by means of movements of the tail-flukes, somewhat after the manner of a steamer which is forced through the water by its propeller. If this were true it would imply that the flukes of the tail had independent muscular movements of their own. Now this is surely impossible, since the flukes are entirely composed of white fibrous tissue and blubber, and contain no trace of muscular tissue or tendons.

Moreover, I have often watched the tail-flukes of the Piked Whale and of various dolphins in the act of swimming, and have seen no other movement in the flukes than that which takes place in the caudal fin of fishes. In the Cetacea it would seem that the tail as a whole moves up and down when the animal is progressing, and the motion appears to be very similar to that which takes place in the tail of a fish, except that in the latter the movement is from side to side.

For this reason, the backbone of a whale has to be especially flexible at the posterior end, in order to allow the powerful tail, which is the principal organ of propulsion, to have free play. Consequently the vertebrae have imitated, as it were, those of fishes, in substituting large intervertebral discs for the interlocking, bony processes of ordinary land vertebrates. These discs consist of a broad ring of white fibrous tissue surrounding a central core of jelly-like pulpy substance, the nucleus pulposus.

Precisely the same structure occurs in the symphysis of the lower jaw (text-fig. 5, B). The thick ring of tough, elastic tissue surrounding a ball of jelly forms an admirable hinge, and permits the necessary movement of the rami when the whale opens and shuts its mouth. The amount of hinge-movement required in this case is about equal to that of the intervertebral discs of the lumbar region.

A similar symphysis occurs in the mandible of *Balaenoptera*; and the above-mentioned movement of the rami is probably characteristic of Whalebone Whales in general.

The reason for this movement of the lower jaw is undoubtedly to allow of an increase in the straining surface of the baleen. As shown in text-fig. 5, A, a, the plates of baleen curve outward at their distal ends, and project beyond the margin of the upper jaw to the extent of about a foot. By this means some eight square feet are added to the straining area in a full-sized Humpback.

The outward movement of the convexity of the rami enables the mandible to clear the projecting baleen-plates, when the mouth is opened and closed.

Mammary Glands.

The mammae of *Megaptera* were found to agree very closely with the descriptions of these organs in other members of the Balaenopteridae given by previous observers;* so that it will only be necessary here to mention a few points which do not appear to have been hitherto recorded. There were two furrows, about 1½ feet long and 3 inches deep, situated one on either side of the urinogenital opening, both of which contained a nipple.

Near each nipple-groove, in the female, there was usually a smaller furrow without a nipple. This accessory groove either occurred on the outer side of each nipple-groove or between the latter and the vulva. (*See* text-fig. 6, A.)

In several dead females the nipples were protruded beyond the general level of

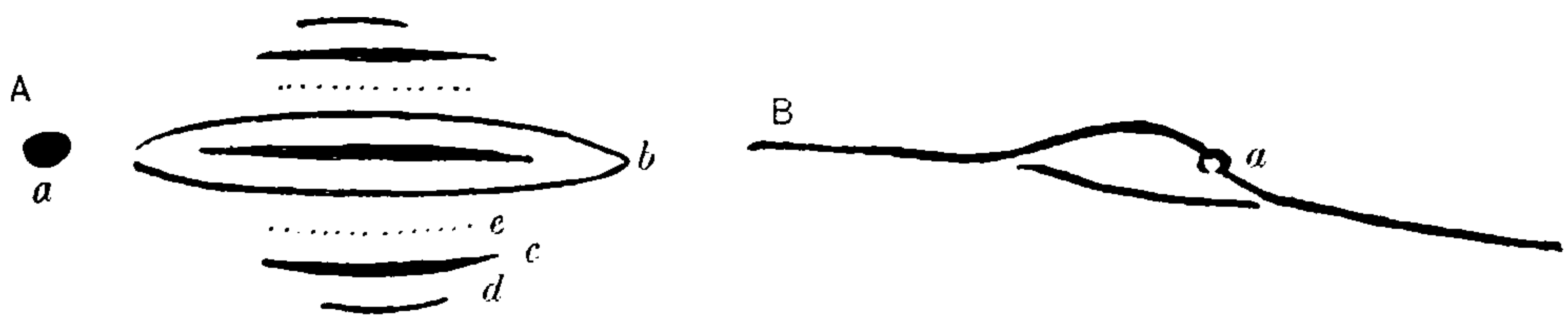

Fig. 6.—A—Diagram to show the position of the nipple-grooves in the Humpback: *a*, anus; *b*, vulva; *c*, nipple-groove; *d*, secondary furrow; *e*, alternative position of latter. B—Lateral view of walls of nipple-groove everted: *a*, nipple.

the ventral surface of the whale, by the eversion of the walls of the nipple-grooves. (*See* text-fig. 6, B.)

When everted, the walls of each furrow formed a dome-shaped swelling, with the nipple on its posterior side. The latter was thus raised about 3 inches above the general level of the surface of the body. When unprotruded it was nearly 3 inches beneath the surface.

I am unable to say whether this protruded condition of the teats was a natural occurrence, or was produced by abnormal causes after death. It was of interest, however, to note that it could occur, and could undoubtedly facilitate the process of lactation. That it was a natural condition of the teats is suggested by the latter function, and by the presence of erectile tissue around the nipple-region. Moreover, the looseness of the skin in this locality, together with the secondary furrows, would allow of the necessary expansion of the nipple-grooves for the protrusion of their walls.

An elongated compressor muscle covered the posterior two-thirds of each mammary gland.

The anterior bundles of this muscle arose in the superficial fascia between the two breasts, and passed across each gland in an oblique direction to their insertions in the

* Hunter, J., Phil. Trans. Roy. Soc., 1787, p. 75, Pl. xxi. Turner, W., Trans. Roy. Soc. Edinb., Vol. XXVI., 1870, pp. 197–251. True, F. W., "Whalebone Whales of the Western North Atlantic," Smithsonian Contributions to Knowledge, 1904, Vol. XXXIII., Pl. 20.

superficial fascia on the outer side of each breast. The posterior bundles arose at a point immediately below and in front of the nipple, and were inserted laterally, as in the case of the anterior bundles (text-figs. 7, e, 8, A). Each mammary gland consisted of a flattened oblong body, which passed from the nipple in an anterior and slightly dorsal direction. (*See* text-fig. 8, A).

In a female 40 feet in length, which was suckling a calf when killed, the gland was 5½ feet long, by 1½ feet broad at its widest part, just in front of the nipple. The

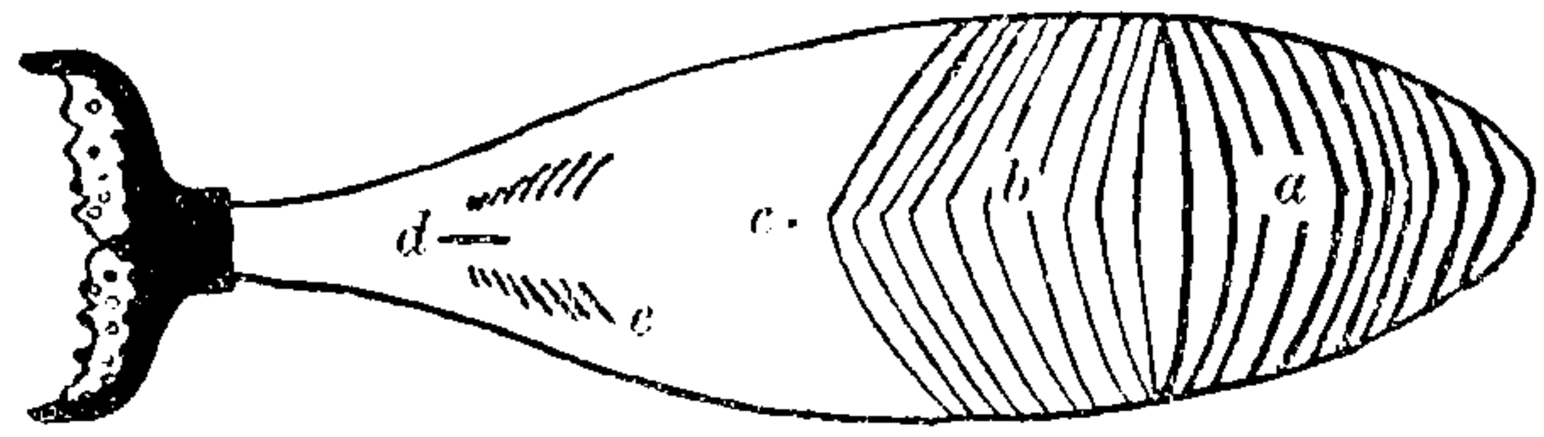

Fig. 7.—Ventral view of a Humpback, with the coat of blubber removed, to show superficial muscles (diagrammatic): *a*, mylohyoid muscle; *b*, pectoralis major; *c*, umbilicus; *d*, vulva; *e*, compressor muscle of left breast.

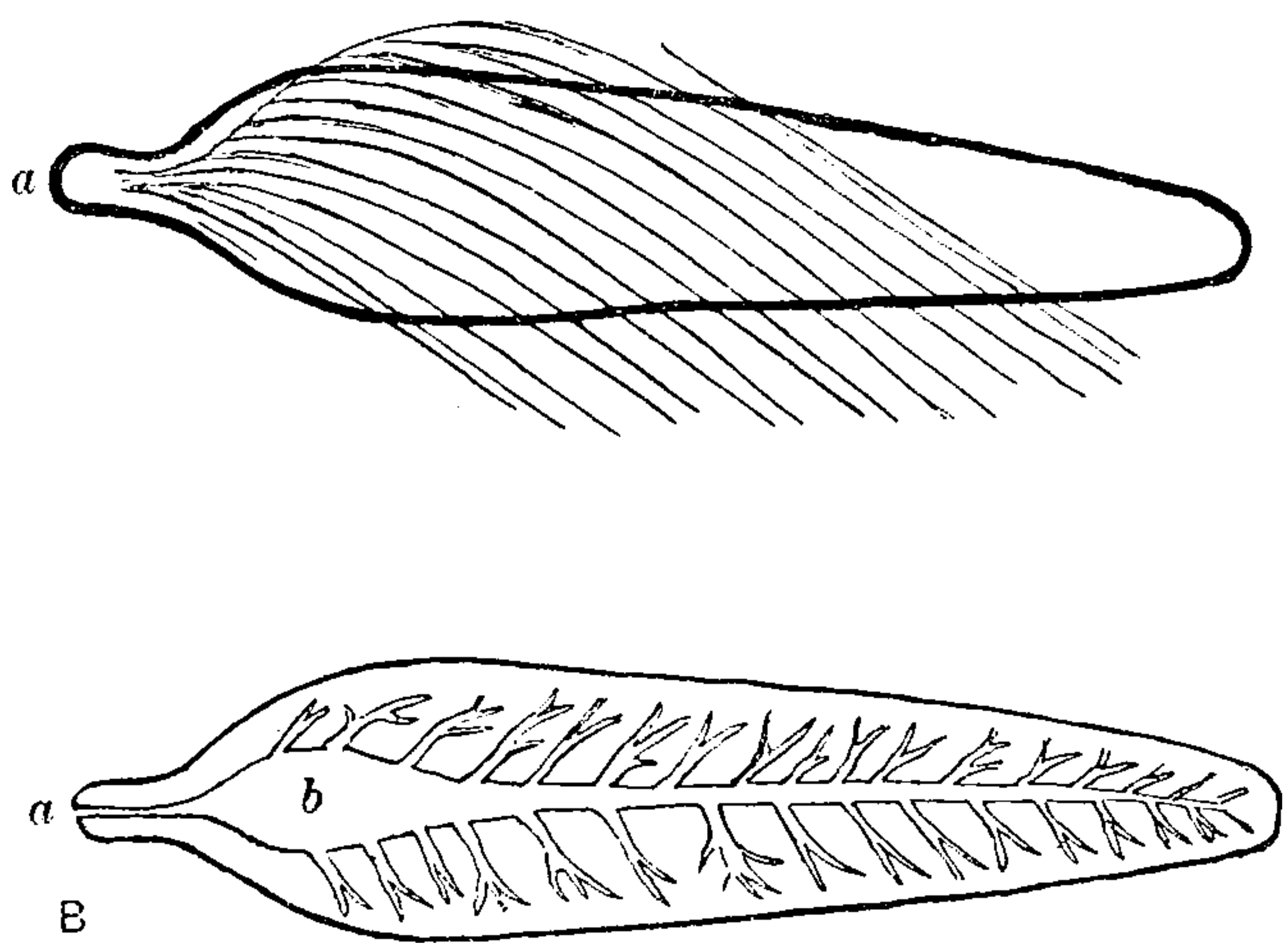

Fig. 8.—A—Ventral view of left mammary gland of a Humpback: the thick line marks outline of gland; compressor muscle indicated with fine lines: *a*, nipple. B—Longitudinal section through gland: *a*, nipple with narrow duct; *b*, wide portion of central canal.

nipple contained the narrow mouth of a relatively wide canal, which traversed the centre of the gland throughout its whole length. In the broad portion of the breast above-mentioned, the canal was dilated into a spacious reservoir. A large number of ducts united with the central canal and ramified in the substance of the gland. (*See* text-figs. 8, B, and 9.) It would appear that the central canal is an elongated false teat.

The milk collects in the reservoir, and by the contraction of the compressor muscle a stream of the fluid is forced through the nipple into the mouth of the calf. The latter is quite unable to draw off the milk from the breast by sucking, after the

The position of the small, slit-like earhole on the surface of the head of this whale has been noted by Struthers.*

From this orifice a narrow tube, about $\frac{1}{10}$ inch in diameter, traversed the blubber, which was about $3\frac{1}{2}$ inches thick in this region of the head. The tube was continued through the underlying tissue for about 2 inches, and gradually decreased in diameter until it ended blindly.

The meatus was here closed up for 3 inches of its course. (*See* text-fig. 10, N.) It then widened out again, somewhat abruptly, to a diameter of rather more than

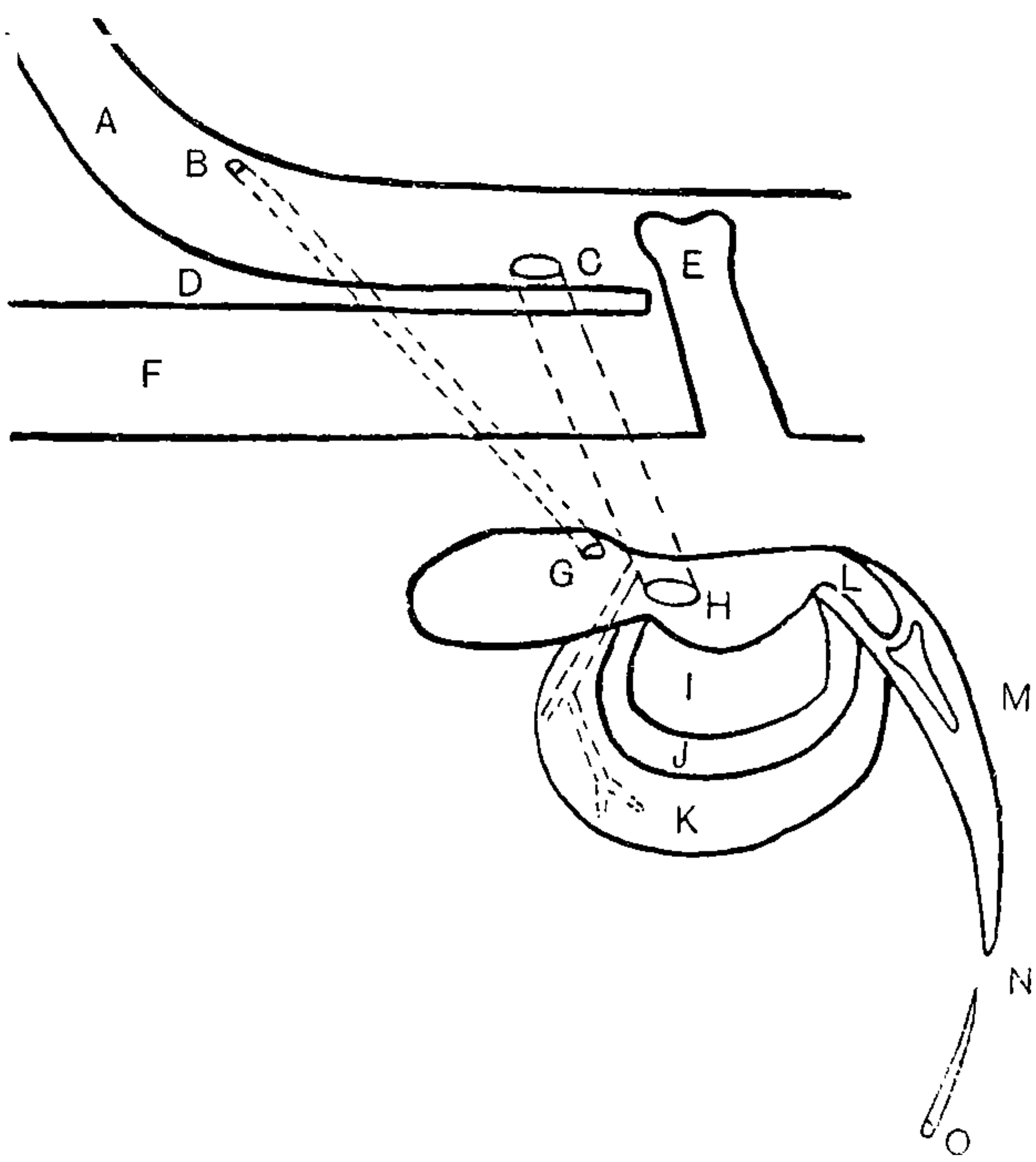

FIG. 10.—Diagram of the outer and middle ear of a Humpback (*Megaptera*). A, passage of nares leading to blowhole; B, opening of pterygoid fossa tube into nasopharynx; C, opening of Eustachian tube into nasopharynx; D, velum palati; E, epiglottis tube; F, pharynx leading to mouth; G, opening of air-passage into pterygoid fossa; H, opening of Eustachian tube into tympanic cavity; I, tympanic bulla; J, coat of yellow elastic tissue and fat; K, spongy layer containing air; L, tympanic membrane; M, wide inner portion of external auditory meatus containing plug of ear-wax; N, portion of meatus closed up; O, narrow portion of meatus opening on surface of head.

an inch, and maintained a fairly uniform size for the remainder of its passage to the tympanic bulla.

The total length of the canal was about 1 foot 9 inches in a Humpback whale 40 feet in length.

The walls of the wide innermost portion of the meatus (text-fig. 10, M) were invariably pressed together. The sole contents of this tube consisted of the finger-like

* Struthers, J., *Journ. Anat. and Physiol.*, 1888, Vol. XXII., p. 122.

external surface of the tympanic membrane and the plug of ear-wax, exactly as they occur in *Balaenoptera.*

Mr. Burfield and Mr. Erik Hamilton noticed that in several of the *Balaenoptera* examined by them off the Irish coast, the meatus was closed up for a part of its course, as described here in the case of the Humpback.

I overlooked this closed area when working at the ear in *Balaenoptera musculus* Linn. and *B. physalus* Linn. a few years ago.* The presence of water in the inner portion of the meatus of one or two of these specimens led me to think that the meatus was open to the exterior throughout its whole length, and was normally full of sea-water. I am now inclined to believe, however, that the occurrence of the water in the meatus was accidental, and due to the whalers playing the hose over my dissections when washing the "flensing slip" during my absence. Sea-water hoses were kept constantly running when whales were being cut up on the "slip."

Carte and Macalister † reported the meatus as open in *Balaenoptera acutorostrata,* Lacépède, and it may be so in that species; but unless the canal is very carefully sectioned throughout its entire length it is easy to overlook the few inches which are closed up.

In *Balaena mysticetus* the meatus has been figured by Gray,‡ and was recorded by him as open, though of a very small diameter in its outer part. The investigation, however, does not appear to have been sufficiently close to preclude the possibility of his having overlooked the closed area.

The plug of ear-wax which occurs in the meatus of the Humpback has been recently figured and described by Sir William Turner.§ It is therefore only necessary to say that plugs similar to the one described by him were found in all the adult specimens; but the plug had not begun to form in the embryo of $13\frac{1}{2}$ feet in length.

With reference to Turner's suggestion that the length of the plug may bear a relationship to the thickness of the external coating of blubber over the head, I would here point out that the plug only occurred in the wide portion of the meatus, close to the tympanic membrane, and was therefore more than a foot away from the coat of blubber, in a Humpback of average size. Moreover, the diameter of that portion of the meatus which traverses the blubber is only $\frac{1}{10}$ inch, whereas the width of the plug is seldom less than $\frac{1}{2}$ inch in its narrowest part.

The tympanic membrane had the same shape as in *Balaenoptera.* In an adult whale, the total length of the sac and ligament was $3\frac{1}{2}$ inches, and the greatest diameter was 1 inch.

The walls of the meatus were compressed and closely surrounded the plug of wax, imprinting upon it the impressions of the ridges and furrows of their inner surfaces.

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* Lillie, D. G., Proc. Zool. Soc., 1910, p. 775.

† Carte and Macalister, Phil. Trans., 1867, p. 252.

‡ Gray, R., *Journ. Anat. and Physiol.*, Vol. XXIII., 1889, p. 300.

§ Turner, Sir W., Proc. Roy. Soc. Edinb., 1913, Vol. XXXIV., Pt. 1 (No. 2), p. 11.

With the exception of the above structures, the inner portion of the canal was empty. The lack of pressure in the meatus enabled the sac-like tympanic membrane to project for 3 inches into its lumen. If the canal had been open to the sea-water, this extreme outward convexity would be very difficult to understand.

The tympanum in *Monodon* and *Phocaena* is concave externally, and the meatus is open. In the following whales the membrane is known to be convex on its outer surface, and it is extremely probable that the meatus is closed in all these cases, as it undoubtedly is in the Humpback; *Balaena mysticetus* and *B. glacialis*; *Balaenoptera musculus*, *B. physalus*, *B. borealis*, and *B. acutorostrata*; *Megaptera nodosa* and *Hyperoodon*. It is possible that this condition of the auditory canal occurs throughout all the larger Cetacea.

The tympanic bulla was examined in several specimens and was found to be identical in shape with that of the Northern *Megaptera*. The species *Megaptera novae zealandiae* was founded by Gray on the ear-bone alone, which was found by him to be shorter and more swollen than in *M. nodosa*.

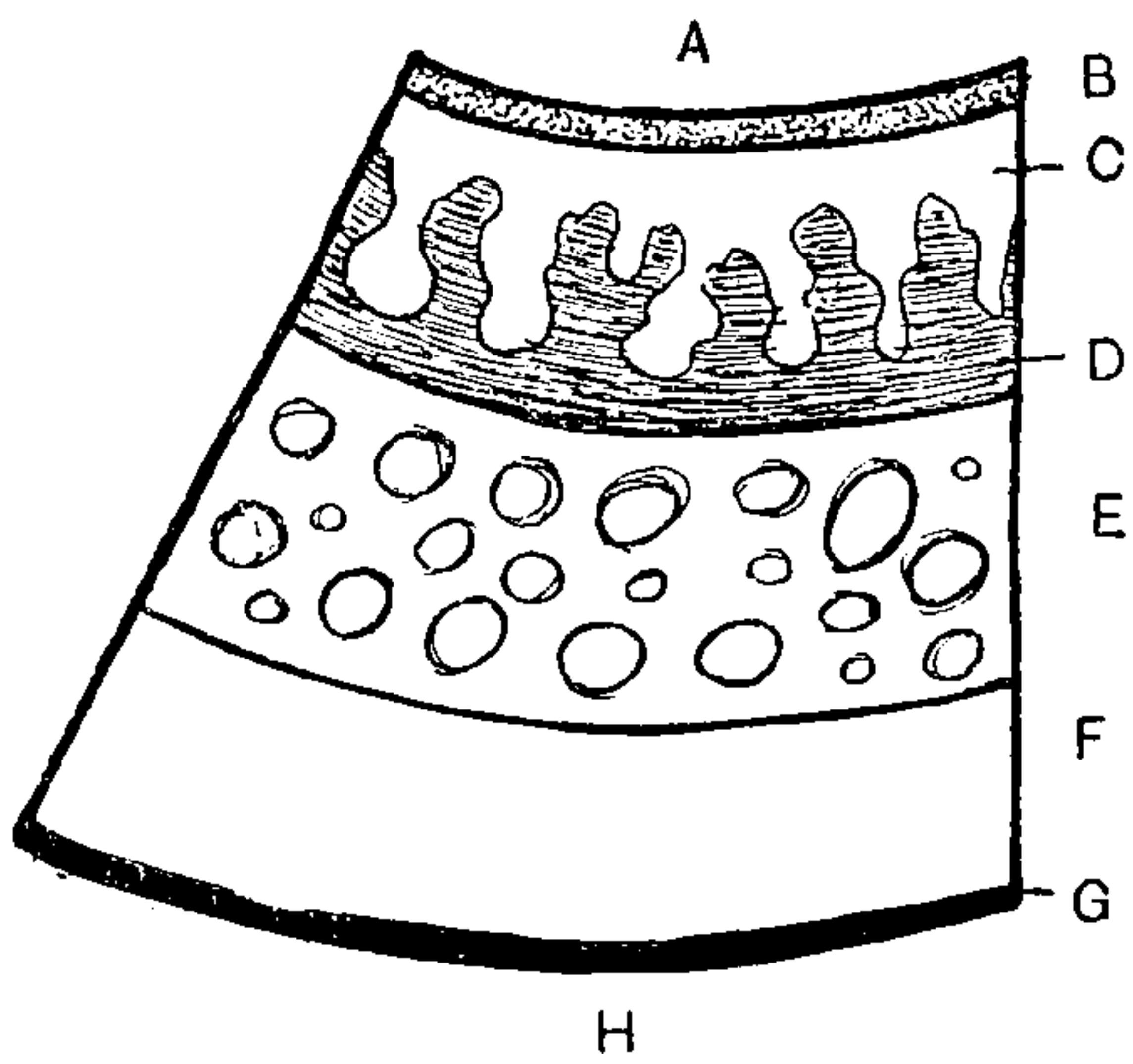

FIG. 11.—Humpback: diagrammatic section through the layers of tissue which surround the tympanic bulla and separate the tympanic cavity from the pharynx: **A**, tympanic cavity; **B**, bony wall of bulla; **C**, fatty tissue; **D**, yellow elastic tissue; **E**, spongy tissue containing air; **F**, muscular layer of pharyngeal wall; **G**, mucous membrane; **H**, cavity of pharynx.

After a careful comparison of the identical bulla from *M. novae zealandiae* which Gray * described, with those of *M. nodosa* Bonn., I have been unable to find any point of difference between the specimens, which could not be amply accounted for by differences of age and individual variation. For instance, the bullae of the 13½ feet foetus were very much more rounded and swollen than those of the adults. (Plate III, figs. 1–3.)

A specimen † of the left tympanic bulla of *M. lalandii*, Fischer was examined and found to be exactly like the bulla of Northern specimens of *M. nodosa*, and those from New Zealand which were obtained by me.

The bulla was surrounded ventrally by two distinct coats of tissue, each of which preserved, more or less, the shape of the tympanic bone.

The inner layer (*see* text-fig. 11, O and D) was about 3 inches thick and lay close against the bulla.

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* Gray, J. E., Catalogue Seals and Whales, Brit. Mus., 1866, p. 128, and Proc. Zool. Soc., 1864, p. 207. The right tympanic and periotic bones described in these papers were presented to the British Museum by Mr. Stuart in 1864 (No. 1468, now labelled *M. lalandii*). Turner, Sir W., "Marine Mammals in University Mus. Edinburgh," 1912, p. 65.

† Specimen in British Museum labelled, "Left Tympanic of *Megaptera lalandii*, New Zealand, 1876. Presented by the Wellington Museum." Turner, W., "'Challenger' Report, Cetacea," pp. 30–31. Hector, Sir J., Trans. New Zealand Inst., 1878, Vol. X., page 335.

correspond in function to the ossified tympanic membrane and the extra-columella expansion in *Plioplatecarpus.* The bony septum formed by the vomer, together with the pterygoid and periotic bones, the bulla and ossicles, would perform the function of the columella in the whale-like reptile.

If neither one nor the other of the above modes of sound-conduction be correct, it is difficult to understand how these whales hear. Yet it is firmly believed by whalers that they are sensible of the report of a gun and similar sounds.

Scapula and Vertebrae.

The shape of the scapula was identical with that of the Northern *Megaptera.** There was no sign of an acromion process on the blade-bone of any of the adults, or on that of the 13½ ft. foetus. (Text-fig. 12.) This point was carefully examined, as the occurrence of an acromion process on the scapula was said to be one of the specific

Fig. 12.—*Megaptera nodosa*, Bonn. Scapula of 13½ feet foetus. Bay of Islands, N.Z.

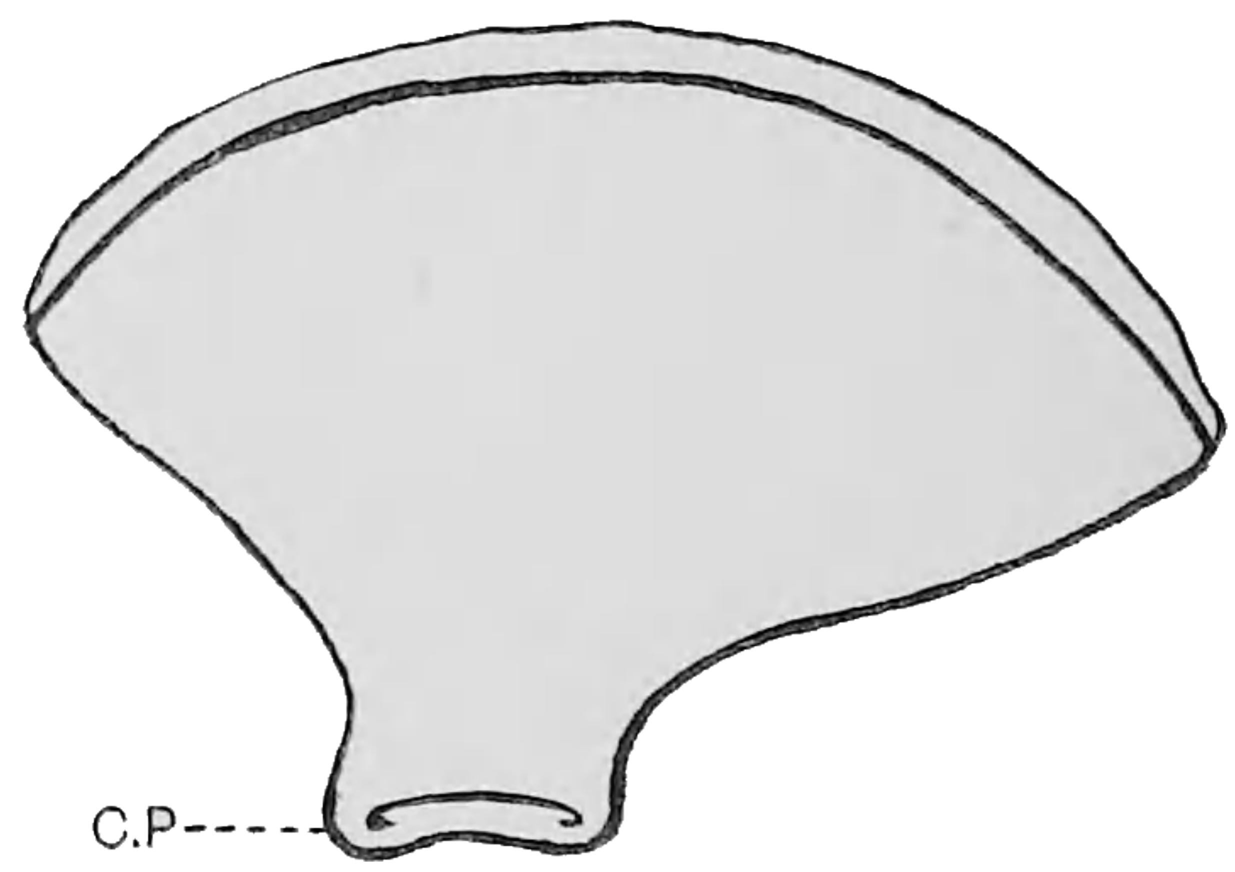

Fig. 13.—Left scapula of New Zealand Humpback whale (adult): **C.P.**, coracoid process.

characters of *M. lalandii* Fischer.† There was a slight trace of the coracoid process. (*See* text-fig. 13.) In other osteological characters the New Zealand Humpback was in agreement with Northern types. The vertebral formula was ascertained in one case and found to be C. 7, D. 14, L. 10, C. about 20. The cervical vertebrae were not united in the young specimen. It is extremely probable that the anterior cervicals in this species become fused in old age.

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* Cabrera, A., "Fauna Ibérica..Mamiferos," Madrid, 1914, Cetacea, p. 398.

† Van Beneden et Gervais, "Ostéographie des Cétacés," p. 133. Turner, W., "Challenger" Reports, Vol. I., p. 30.

Foetuses.

Two foetuses only were obtained. One of these measured $13\frac{1}{2}$ feet in length and was taken from a mother of about 44 feet in length, caught on July 24th, 1912. The measurements of this foetus have been given in Table II. on page 89. It had very nearly completed its uterine existence. The other embryo was taken from a mother of about 48 feet in length and some 60 tons in weight, which was killed off the Bay of Islands, New Zealand, on October 10th, 1912. This specimen (Plate IV., fig. 4) is 61 mm. in total length, and must be one of the smallest embryos known from any Whalebone whale. The general measurements are as follows:

Total length to root of tail	43 mm.
Head-length	25 mm.
Tail-length	18 mm.
Tip of snout to external nares	10 mm.
Length of fore limb (posterior edge, axil to tip)	12 mm.
Length of longest digit	8 mm.
Length of eye (between inner angles of eyelids)	1·5 mm.

Hair-tubercles can be seen on the snout, arranged like those in the adult. There are four along the median line, between the nostrils and the tip of the snout; and a row of nine on each side of the beak, towards the outer edge.

The manus has four digits. The third and fourth digits are much longer than the second and fifth.

The tail-flukes are only just perceptible, when viewed from the dorsal or ventral aspect. It is hoped that a full account of this embryo will be published later.

Food.

A careful examination of the stomach was made in many cases, but very few of the whales had any trace of food in their alimentary canals. This was not altogether a surprise, when one considered the relatively small amount of plankton obtained by the "Terra Nova" in her daily hauls off the north of New Zealand, during the months of July, August, and September, 1911. The only food organisms found in the stomachs were unidentifiable remains of Schizopoda.

Habits.

The Southern Humpbacks, like those of the Northern Hemisphere, are somewhat slower in their movements than species of *Balaenoptera*. They seldom stay under water for more than seven minutes, between each two acts of respiration. They show a distinct partiality for coastal waters; and it was quite a common sight, on the coast of New Zealand, to see a school of three or more of these whales pass through the narrow channel between an isolated rock and the mainland (p. 94). This habit was formerly made use of, during the whaling season, by Mr. Cook of Whangamumu. He placed a wide-mesh net, made of wire rope, across the channel, some 50 yards broad, between a rock and the shore. A look-out was kept from the cliffs; and when a whale became entangled in the net, a boat was immediately despatched to shoot the captive by means of a Hotchkiss gun.

An average of about eight Humpbacks each season was obtained by these means, over a period of nearly twenty years. No other species were taken in the net.

Distribution and Migration in the Southern Hemisphere.

July 29, 1910	22° 17′ S., 28° 16′ W.	School of two.
August 4, 1910	30° 49′ S., 17° 13′ W.	School of five or six travelling S.W.
*October 26, 1910	46° 8′ S., 170° 42′ E.	School of five or six travelling south.
*August 11, 1911	Off the Three Kings Islands, N.Z.	School of three travelling north.
*March 15, 1912	68° 3′ S., 169° 45′ E.	
*January 30, 1913	67° S., 167° 25′ E.	

The above list gives the occasions on which Humpback whales were seen by the "Terra Nova." On the dates marked with an asterisk the whales showed themselves very clearly, so that identification was quite certain. In spite of careful observations, we did not see any of these whales in the Ross Sea; which tends to support the opinion arrived at by M. Racovitza,* that the Humpback does not penetrate into ice-covered seas, although it is very common in Antarctic waters wheresoever they are fairly free from ice. It used to be the whale chiefly taken by the whalers who go every summer to South Georgia, the South Shetlands, and Graham's Land, but it has become less common at some of these localities during the last two or three years. The Humpback is also captured off the east and west coasts of South America, South Africa, New Zealand, Tasmania, Norfolk Island, and Australia.

Excellent opportunities were afforded to me for studying the seasonal migrations of Humpback whales, off the north of New Zealand, during the winters of 1911 and 1912. There seemed to be very good evidence that these whales spend the summer months in the Antarctic Ocean, down to the northern limit of the pack-ice; and that at the beginning of winter they migrate northward into the warm seas, in the neighbourhood of New Zealand and Norfolk Island.

The first whales of the season began to pass the Bay of Islands, on their way northward, about the middle of April. They continued to go towards the north until the end of August. The greatest number passed northward of this locality in May and the early part of June. After the middle of September, at the Bay of Islands, the first members of the long procession were to be seen going southward, on their way back to the Antarctic Ocean. The majority passed south of the Bay during October, and by the middle of December they were all to the south of this place.

The whaling season at the Bay of Islands lasts from May to November. There is a slack time in the middle of the season, from July to September, when all the whales are to the northward. These three months are the busy time for the whalers at Norfolk Island.

* Racovitza, E., "Résultats du voyage du S.Y. 'Belgica,' Zoologie, Cétacés," 1903, pp. 32 and 46.

Southern summer the Humpback whales concentrate in the Antarctic Ocean, where they are found in great numbers off the South Shetlands, South Georgia, and similar localities, between the months of November and March. They turn North in the autumn and radiate outwards, passing up the coasts of the three great continental areas, towards the equator. But as it is scarcely possible to observe the Cetacea in the Antarctic Ocean during the winter, we do not know how many remain there throughout those dark months.

It therefore appears to be possible, as far as the Mystacoceti are concerned, to divide the Southern whaling grounds into three classes. The first class, or best, "fisheries," are in the cold Antarctic seas, where there is plenty of food for Whalebone whales. These grounds can only be worked during the summer months, on account of their high latitude.

The second class areas are off the shores of the great continents, between Lat. 50° S. and the equator. These waters probably owe their favourable character to cold southern currents, such as those which run up the western shores of South America and South Africa; and also to the rivers, which carry ammonia into the sea from the land, and thereby minister to the needs of the Nanno-plankton, upon which the plankton animals feed, which are in their turn the food of the Whalebone whales.

The best season for these grounds appears to be during the winter.*

The third class, or poorest, fields are in the warm, open oceans, where the plankton-supply falls to a minimum. At the present time it does not pay whalers to exploit the open seas for the Mystacoceti.

The foregoing general scheme of what we may perhaps call the quantitative distribution of the Whalebone whales, although it would seem to apply to all members of the group, is perhaps best demonstrated by the case of the Humpback. The coast-loving habits of this whale cause it to be more readily observed than the species of *Balaenoptera*, which tend to keep further out at sea.

As an illustration of the so-called "bad luck" which accrues to whalers who fail to realise the quantitative distribution of whales, I may mention the case of the Company with whom I spent four months. They exploited the warm seas to the north of New Zealand, and employed there a "plant" which was on a scale suitable for a first-class whaling ground, such as South Georgia. The result was they

* The cold currents on the western sides of the continents are due to an up-welling of cold water from the bottom of the oceans. In the tropics, the deeper layers replace the water carried westward by the trade winds as the Equatorial Current. In temperate regions the greatest vertical circulation takes place in the winter, when the surface-temperature is at a minimum, and the denser upper layers sink down and are replaced by the warmer water from below.

The bottom-water is said to be comparatively rich in ammonia from the decomposition of organic remains on the sea floor; and consequently when this water comes to the surface, during the winter months, the plankton reaches a maximum. See "The Depths of the Ocean," by Sir John Murray and Dr. J. Hjort, London, 1912, pp. 371 and 378.

could not get whales enough to make the enterprise pay, and had to leave. New Zealand waters are poor whaling fields, and should only be exploited by small concerns.

These remarks on distribution and migration are put forward tentatively, and can lay no claim whatever to finality. They are based upon such facts as we possess; but a great deal more work will have to be done before we can hope for any certainty as to the movements of all the different whales over the oceans of the world.

4. *Balaenoptera acutorostrata*, Lacépède. (Pl. IV., figs. 2, 3; Pl. V., figs. 1, 2; Pl. VI., figs. 1–6; Pl. VIII., fig. 1.)

December 10, 1910	66° 38′ S., 179° 04′ W.
,, 18, ,,	67° 24′ S., 177° 34′ W.
,, 23, ,,	68° 25′ S., 179° 11′ W.
,, 29, ,,	70° S., 180° W.
January 2, 1911	75° 03′ S., 173° 41′ E.
,, 3, ,,	Off Cape Crozier, Ross Island.
,, 4, ,,	In McMurdo Sound.
,, 26, ,,	Off Glacier Tongue, McMurdo Sound.
,, 31, ,,	78° 30′ S., 170° 35′ W.
February 2, ,,	Off King Edward VII. Land.
,, 3, ,,	— —
,, 4, ,,	Bay of Whales, Great Ice Barrier.
,, 5, ,,	78° 10′ S., 171° 20′ W.
,, 6, ,,	77° 52′ S., 172° 27′ W.
,, 7, ,,	77° 33′ S., 176° 51′ E.
,, 12, ,,	72° 0′ S., 171° 56′ E.
,, 22, ,,	69° 10′ S., 164° 30′ E.
March 2, ,,	67° 25′ S., 160° 40′ E.
,, 3, ,,	67° 22′ S., 160° 31′ E.
,, 7, ,,	65° 0′ S., 161° 22′ E.
January 2, 1912	70° 02′ S., 175° 31′ E.
,, 5, ,,	72° 19′ S., 172° 05′ E.
,, 6, ,,	74° 0′ S., 171° 18′ E.
,, 7, ,,	75° 15′ S., 168° 37′ E.
,, 14, ,,	77° 15′ S., 166° 0′ E.
,, 15, ,,	— —
March 18, ,,	64° 03′ S., 160° 12′ E.
,, 27, ,,	52° 16′ S., 167° 31′ E.
December 29, ,,	69° 51′ S., 166° 17′ W.
,, 31, ,,	71° 23′ S., 166° 3′ W.
January 1, 1913	71° 35′ S., 166° 01′ W.
,, 2, ,,	71° 37′ S., 166° 55′ W.
,, 4, ,,	— —
,, 5, ,,	71° 41′ S., 166° 47′ W.
,, 9, ,,	71° 44′ S., 167° 57′ W.
,, 23, ,,	76° 32′ S., 163° 50′ E.

When sailing in Antarctic waters to the south of Lat. 64° S., scarcely a day passed without our getting a sight of one of these whales. The above list gives the occasions on which members of this species were clearly seen.

This whale was mistaken for *Neobalaena marginata* by Dr. Wilson when on board the "Discovery" in 1901–4. On the "Terra Nova" Expedition, although we knew that *Balaenoptera acutorostrata* had been identified in New Zealand and Antarctic waters,* and we were quite prepared to find it in the Ross Sea, yet there was only one occasion on which these whales showed themselves sufficiently well to put their determination beyond dispute. This was on March 3, 1911, in Lat. 67° 22′ S., Long. 160° 31′ E., when the ship was ploughing her way through thick pack-ice, in which the water was freezing between the fioes, so that the only open spaces for miles around were those made by the slow movement of the ship. We saw several of these whales during the day, making use of the holes in the ice near the ship for the purpose of "blowing." There was scarcely room between the fioes for the whales to come up to "blow" in their usual manner, which consists in rising almost horizontally, and breaking the surface of the water with their backs. On this occasion they pushed their snouts obliquely out of the water, nearly as far as the eye, and after "blowing," withdrew them below the water again. Commander Pennell noted that "several times one rested its head on a floe not 20 feet from the ship, with its nostrils just on the water-line; raising itself a few inches, it would blow and then subside again for a few minutes to its original position with its snout resting on the floe. They took no notice of pieces of coal which were thrown at them by the men on board the ship." (*See* Pl. VI., figs. 1–6.)

They swam close to the surface, in the pool of open water under the stern of the ship, and frequently rolled over in play, so that their external characters could be easily determined.

They were between 20 feet and 30 feet in length. The dorsal fin was shaped as in Pl. V., fig. 2. The throat-grooves numbered about sixty, as far as we could ascertain.

In colour they were greyish black above, and most of them were white throughout on the underside. A few were grey ventrally, with white patches in the middle of the ventral surface. There was considerable variation in the amount of pigment on the lower surface of the body. A characteristic triangular patch of lighter colour occurred on either side of the back, in the region of the dorsal fin. (*See* Pl. VIII., fig. 1.)

In the majority of cases, the pectoral "flippers" had a broad white band on their dorsal surfaces, but in some, the "flippers" were almost entirely white above and below. The posterior dorsal margins of the tail-flukes were white in some cases.

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* Hutton, F. W., and Gray, J. E., Ann. Mag. Nat. Hist., 1874 (4), Vol. XIII. J. von Haast, Trans. New Zealand Inst., 1880, Vol. XIII., p. 169. Bull, H. J., "The Cruise of the 'Antarctic,'" 1896, p. 141. Benham, W. B., Trans. New Zealand Inst., 1901, Vol. XXXIV., p. 151. Racovitza, E., "Résultats du voyage du S.Y. 'Belgica,' 1897–99, Zoologie, Cétacés," 1903, p. 56. Liouville, J., op. cit., p. 111. Stead, D. G., "A Brief Review of the Fisheries of New South Wales," Sydney, 1910. Trivett, J. B., Official Year Book of New South Wales Fisheries, 1912. Published 1914.

The Blue Whale was nearly as common in the Ross Sea as the little Piked Whale. These two whales were often seen together, and they both appeared to be very fond of frequenting the pack-ice.

Some of the Blue Whales which we saw were of very large size, and must have been fully 90 feet in length, or even more. There was no mistaking these whales, with their characteristic dorsal fin situated well aft. (*See* Pl. VII., fig. 1.)

A young immature male of this species was taken off the Bay of Islands, New Zealand, during my visit to the Norwegian whaling station. This specimen was 65 feet long. In general appearance it exactly resembled the individuals of this species which I had examined in the Northern Hemisphere. It was of a bluish grey colour with lighter flecks all over the body, which has been likened to the appearance of galvanised iron. The only white on the animal was on the underside of the flippers. The baleen-plates were entirely black, with coarse, black, curly bristles on their inner edges. The tongue was dark grey, and the palate was black.

This whale is obtained off the South Shetlands, South Georgia, South America, South Africa, New Zealand, and Australia.*

6. *Balaenoptera physalus*,† Linnaeus.

July	17, 1910	4° 07′ N., 21° 26′ W.	March	10, 1912	70° 28′ S., 174° 39′ E. ?
October	6, ,,	41° 46′ S., 121° 39′ E.	December	25, ,,	62° 20′ S., 167° 45′ W.
December	5, ,,	56° 41′ S., 176° 23′ E. ?	March	24, 1913	55° 55′ S., 152° 39′ W.
March	2, 1911	67° 25′ S., 160° 40′ E.	April	13, ,,	52° 03′ S., 63° 46′ W.
January	5, 1912	72° 19′ S., 172° 05′ E. ?	,,	18, ,,	42° 09′ S., 55° 15′ W.
,,	9, ,,	75° 23′ S., 164° 39′ E. ?			

The Common Rorqual, or "Finner," appeared to be very scarce in the Ross Sea. We only saw this whale eleven times during the whole progress of the Expedition, and on some of these occasions the determination was not certain. The doubtful occurrences have been marked in the list with a note of interrogation.

I saw a stranded member of this species at Stewart Island, in March, 1911, and although it was very much decomposed there was no doubt about the determination. One of these whales was caught off the Kermadec Islands in October, 1912; I did not see it, but was assured by the whalers that it was indistinguishable from the "Finners" which they are accustomed to take in the Northern Hemisphere.‡

This whale used to be very common off the Falkland Islands, but it is said to have become scarce there of late years. It is taken off the coasts of South America, South Africa, South Georgia, and the South Shetlands. But it is evidently not fond of ice-covered seas, as has been remarked by M. Racovitza.§

* Racovitza, E., op. cit., p. 54. See also Liouville, J., op. cit., p. 73.

† Or *Balaenoptera musculus*, auctt.

‡ Parker, T. J., Trans. New Zealand Inst., 1884, Vol. XVII., pp. 3–13.

§ Racovitza, E., op. cit., p. 55. See also Liouville, J., op. cit., p. 86.

7. *Balaenoptera borealis*, Lesson. (Pl. VII., fig. 2.)

June 19, 1910	43° 54′ N.,	12° 48′ W.	One, travelling eastward.
August 4, „	30° 49′ S.,	17° 13′ W.	One.
„ 7, „	33° 20′ S.,	8° 2′ W.	One, small size.
September 3, „	33° 57′ S.,	18° 49′ E.	Travelling eastward.
„ 6, „	38° 46′ S.,	25° 42′ E.	—
„ 24, „	39° 21′ S.,	84° 58′ E.	?
October 3, „	42° 17′ S.,	111° 18′ E.	Two adults, one calf.
„ 5, „	41° 49′ S.,	118° 01′ E.	? One.
„ 6, „	41° 46′ S.,	121° 42′ E.	? Three.
„ 21, „	43° 41′ S.,	156° 56′ E.	? Several.
„ 22, „	44° 25′ S.,	160° 3′ E.	One.

We did not see any of these whales in the Antarctic. It is possible, however, that some of the larger specimens of the whales which we identified as *Balaenoptera acutorostrata* may have belonged to this species. We did not see any Antarctic whales which appeared to be between 37 and 55 feet in length. The specimens of *B. acutorostrata* usually varied between 20 and 32 feet in length.

A few whales of about 37 feet were occasionally met with, and we regarded them as being large individuals of *B. acutorostrata.*

On October 3, 1910, we saw two adults and a calf; their identity was beyond any doubt. The two adults were estimated at 50 feet long and the calf was 20 feet long.

Of the specimen seen on October 22, 1910, Dr. Wilson wrote: "I have no doubt in saying it was precisely similar in every respect to the North Sea *B. borealis*, so far as appearance in the water goes." An individual of this species was taken off the Bay of Islands, New Zealand, during my visit to the whaling station. This whale was a young female, 40 feet in length. (*See* Pl. VII., fig. 2.)

It will be noticed that this whale is depicted in the plate as being of a lighter colour than those which are usually described as blue-black. The colour was taken from a fresh specimen. The species of *Balaenoptera*, when freshly killed, are lighter in colour than is generally supposed. The epidermis only becomes dark when the carcase is out of the water and exposed to the sun. The whalebone plates were black, with fine greyish white bristles on their inner edges. The bristles on the posterior third of the ranges were darker grey than in the anterior two-thirds, where some of the bristles were quite white. The delicate, silky nature of the bristles of the baleen-plates is characteristic of this species. The tongue was grey and pink. The palate was pink. This specimen agreed exactly with the descriptions of Northern members of this species.* *Balaenoptera borealis* is taken at the Falkland Islands, South Georgia, South America, South Africa, and New Zealand. It is said to be scarce at the South Shetlands, but it was seen on several occasions by the "Belgica" near Graham

* Collett, R., Proc. Zool. Soc., 1886, p. 243–265, Pls. 25–26.

Land.* Liouville seems to have referred all the small Rorquals seen by him in the Antarctic to this species.†

To sum up with regard to the Balaenopteridae of the Southern Hemisphere. It would appear that all the members of the family which are known in Northern latitudes occur all over the oceans of the Southern Hemisphere. *Balaenoptera musculus* and *B. acutorostrata* penetrate in large numbers to the farthest shores of the ice-covered seas. *B. borealis* does not appear to be quite so common in the ice, while *B. physalus* and *Megaptera nodosa* do not seem to go further south than the outskirts of the pack.

A new Rorqual has recently been described by Olsen‡ and called by him *Balaenoptera brydei.* Up to the present this whale has only been taken off the coast of South Africa. We of the "Terra Nova" did not come across it at all.

ODONTOCETI.

PHYSETERIDAE.

8. *Physeter catodon*, Linnaeus.

Physeter catodon and *P. macrocephalus*, Linn.

The only occasion on which we saw this whale was on March 31, 1912, when we were off the south of New Zealand in Lat. 44° 56′ S., Long. 172° 53′ E.

A school of twelve were seen very clearly. Towards the end of February, 1911, thirty-six bulls and one female were stranded on the beach at Perkins Island. Tasmania. The bulls appear to have been swimming after the cow, who took them into shallow water when the tide was receding, with disastrous results. A photograph of this stranded school was published in the *Otago Witness* for March 15, 1911, and is reproduced here. (Pl. IV., fig. 1.)

ZIPHIIDAE.

9. *Hyperoodon rostratus*, Müller.

March 10, 1911	62° 0′ S., 162° 03′ E.
December 29, 1912 . . .	69° 51′ S., 166° 17′ W.

We saw two specimens of this whale on March 10, 1911, swimming southward together. They were evidently old males, about 30 feet in length, and of a light brown colour with white spots. Although we only saw this whale twice in the Antarctic, there seems to be no doubt that it occurs in these regions.§ The whalers at the South Shetlands regard the "Bottlenose," which they obtain in the far South, as identical with the species which they hunt off the coast of Norway.

* Racovitza, E., op. cit., p. 38.

† Liouville, J., op. cit., p. 110.

‡ Olsen, Ørjan, Proc. Zool. Soc., 1913, pp. 1073–1090, Pls. CIX.–CXIII.

§ Racovitza, E., op. cit., p. 58. Wilson, E. A., op. cit., p. 5, Fig. 3. Liouville, J., op. cit., pp. 140–151, Pl. VI.

February	1, 1911	78° 38′ S., 166° 17′ W.
"	11, "	Off Coulman Island.
September	6, "	34° 25′ S., 172° 10′ E.
January	6, 1912	74° 0′ S., 171° 18′ E.
"	10, "	76° 03′ S., 165° 55′ E.
"	13, "	76° 54′ S., 166° 39′ E.
"	14, "	77° 15′ S., 166° 0′ E.
"	15, "	— —
"	22, "	77° 26′ S., 165° 17′ E.
March	18, "	64° 03′ S., 160° 12′ E.
January	20, 1913	77° 46′ S., 166° 8′ E.
"	21, "	— —
"	27, "	73° 51′ S., 172° 57′ E.

This was undoubtedly the commonest Cetacean in the Ross Sea. "Killer" whales could be seen near the ship almost every day, so we did not attempt to keep a record of every occurrence. The above are only a few of the dates on which this whale was sighted. I have not much to add to the account of this whale given by Wilson,* except that, on this expedition, we obtained evidence that the "Killers" not only hunt along the edge of the fast ice in search of seals, but occasionally break up the ice with their backs, when it is not too thick, in order to dislodge seals which they see lying on the icefield.†

"Killers" were more common off the coast of the Antarctic lands than in the pack-ice, out at sea.

The "High-finned" Whale.

December 19, 1910	67° 54′ S., 178° 28′ W.
February 9, 1911	Off Glacier Tongue, McMurdo Sound.

This whale was first seen by Wilson, when on the "Discovery" Expedition. We saw a school of some twelve, or more, very clearly on February 9, 1911. They were about 30 feet in length, and the majority of them had long, pointed dorsal fins, as figured by Wilson.‡ In one case the concavity of the fin was pointing forwards. A few members of the school had shorter dorsal fins, exactly like those of *Orcinus orca.*

The only points in which these whales appeared to differ from the "Killer" were in the uniform black colour of the back, and in the height of the dorsal fin. The variability in the size and shape of the dorsal fin in *Orcinus orca* is well known.§

On January 22, 1912, we saw a school of what were undoubtedly "Killer" whales swimming near the edge of an ice-flow, on which some Adélie penguins were

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* Wilson, E. A., op. cit., pp. 6–8, Fig. 7.

† "Scott's Last Expedition," Vol. I., pp. 94–96.

‡ Wilson, E. A., op. cit., p. 4, Pl. I.

§ Id., Fig. 7. Flower, Sir W. H., "Recent Memoirs on the Cetacea," published by the Ray Society, 1866, pp. 153–188. Collett, R., "Norges Pattedyr," Kristiania, 1912, 15 & 16 Hefte, p. 711.

standing. The floe was between the ship and the whales. This enabled us to estimate the height of the highest dorsal fin in the school at about 5 feet. It was quite the highest fin which we saw on a "Killer," and it was about the same height as the fins in the school of "High-finned" whales. We saw another school of "Killers" with variable dorsal fins off Coulman Island, on February 11, 1911. The "High-finned" whale seen on December 19, 1910, was among the floes of pack-ice, and Wilson estimated the dorsal fin as being about 4 feet high. My own opinion is that the "High-finned" whale is probably only a variety of *Orcinus orca*, or possibly a new species of that genus.

12. *Globicephala melaena*, Traill.

July 9, 1910 . . .	11° 20′ N., 24° 37′ W., travelling southward.
„ 11, 1911 . . .	42° 06′ S., 175° 13′ E.
August 8, „ . . .	33° 37′ S., 171° 30′ E.
October 2, „ . . .	39° 40′ S., 178° 21′ E.
March 19, 1913 . . .	55° 03′ S., 166° 36′ W.
April 18, „ . . .	42° 09′ S., 55° 15′ W.

We did not see this Cetacean to the south of Lat. 56° S.

13. *Delphinus delphis*, Linnaeus.

June 20, 1910	41° 20′ N., 13° 45′ W.
„ 21, „	38° 37′ N., 14° 43′ W.
July 3, „	22° 3′ N., 23° 18′ W.
„ 16, „	1° 7′ N., 21° 16′ W.

On June 20, 1910, a school of about 100 individuals of this species approached the ship from the eastward and followed her all day. These dolphins agreed very well with the figures of *D. delphis* with the exception of having rather more white on their ventral surfaces, and their pectoral fins seemed to be entirely white.

14. *Tursio peronii*, Lacépède. (Text-fig. 14.)

October 20, 1910	42° 51′ S., 153° 56′ E.
March 30, 1912	47° 04′ S., 171° 33′ E.

On both the above dates a pair of these whales were seen playing under the bows of our ship. They seemed to roll over more than the other dolphins which we saw. On October 20 the *T. peronii* came with a herd of "Dusky Dolphins," but they kept separate. They were larger than *Lagenorhynchus obscurus*. All the four specimens were exactly alike and agreed with Gray's figure,* except that the tail-flukes were quite white above and below. The demarcation between the black and white was very pronounced (text-fig. 14).

* Gray, J. E., "Synopsis of the Whales and Dolphins," 1868, Pl. 15, Fig. 1.

15. *Lagenorhynchus obscurus*, Gray.* (Pl. VIII, figs. 2–4.)

September	3, 1910	35° 57′ S., 18° 49′ E.
October	7, ,,	41° 38′ S., 125° 27′ E.
,,	18, ,,	38° 52′ S., 146° 40′ E.
,,	20, ,,	42° 51′ S., 153° 56′ E.
,,	21, ,,	43° 41′ S., 156° 56′ E.
July	13, ,,	38° 12′ S., 178° 56′ E.
October	1, 1911	37° 49′ S., 178° 39′ E.
,,	4, ,,	41° 51′ S., 175° 16′ E.
,,	5, ,,	Off Kaikoura, N.Z.
,,	6, ,,	,, ,,
December	15, ,,	Off Banks Peninsula, N.Z.
,,	14, 1912	20 miles off Akaroa, N.Z.
February	7, 1913	51° 56′ S., 168° 02′ E.
March	13, ,,	Off Lyttelton Heads, N.Z.

Schools of dolphins which we identified as belonging to this species were seen on the above dates.

This dolphin does not seem to occur further south than about Lat. 58° S. But whenever we were approaching, or leaving, the coast of New Zealand we invariably met

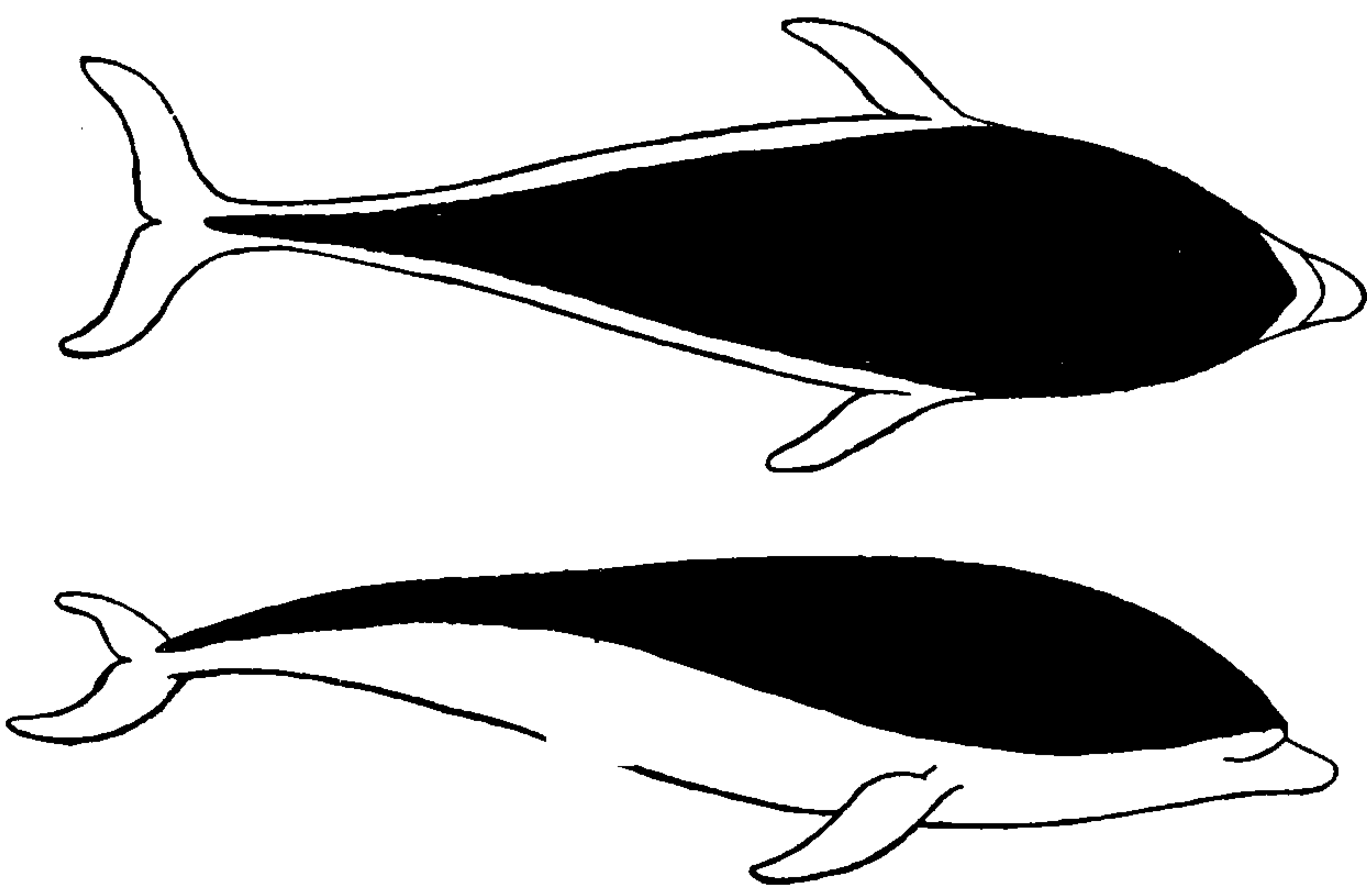

FIG. 14.—*Tursio peronii*, Lacépède.

large schools of the "Dusky Dolphin," which used to follow us and play round the bows of the ship, as though they were seeing us off or welcoming us back to temperate lands.

These dolphins varied a good deal in colour. Three of the most common types of pigmentation, in what appeared to be one species, are given in Plate VIII., figs. 2–4.

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* True, F. W., Bull. U.S. National Mus., No. 36, "Review of the Family Delphinidae," 1889, p. 104, Pl. XXIX. Racovitza, E., op. cit., pp. 59, 111–119. Wilson, E. A., op. cit., p. 8. Waite, E. R., Records of the Canterbury Museum, N.Z., Vol. I., No. 2, 1909, Pl. VI., Fig. 2.

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Cetacea, Plate I.

PLATE I.

The New Zealand Humpback whale, *Megaptera nodosa*, Bonnaterre (adult).

Cetacea, Plate II.

PLATE II.

Megaptera nodosa, Bonn.

FIG. 1.—Dorso-lateral view of an individual of No. 3 type (*see* text-fig. 2). Whangamumu, Bay of Islands, New Zealand.

FIG. 2.—No. 2 type text-fig. 2, showing the patch of pigmented skin, covered with barnacles, behind the chin. Bay of Islands, N.Z.

FIG. 3.—No. 3 type, text-fig. 2. Ventral view. Bay of Islands, N.Z.

FIG. 4.—No. 2 type, text-fig. 2. Bay of Islands, N.Z.

FIG. 5.—No. 1 type, text-fig. 2. Posterior ventral view, showing dapple-markings. Bay of Islands, N.Z.

FIG. 6.—No. 1 type, text-fig. 2. Dorso-lateral view. Bay of Islands, N.Z.

FIG. 7.—No. 1 type, text-fig. 2. Ventral view, showing barnacle-patch behind the chin.

Photographs by Mr. George Hutchinson, of Edinburgh.

Cetacea, Plate III.

PLATE III.

Megaptera nodosa, Bonn.

FIG. 1.—Exterior face of left periotic bone, with tympanic bulla attached. From a foetus, 13½ feet long. *a*, tympanic membrane. Bay of Islands, N.Z.

FIG. 2.—Interior face of the above.

FIG. 3.—Anterior view of the above. *a*, tympanic membrane.

FIG. 4.—Exterior face of right tympanic bulla of adult specimen. Bay of Islands, N.Z.

FIG. 5.—Interior face of the same. *a*, the attached malleus.

Cetacea, Plate IV.

PLATE IV.

FIG. 1.—*Physeter catodon*, Linn. Thirty-six bulls and one female stranded at Perkins Island, Tasmania, in February, 1911. Photograph by Spurling & Son, Tasmania.

FIG. 2.—*Balaenoptera acutorostrata*, Lacépède. Head of calf 10 feet long. Dunedin, N.Z. Photograph by Prof. W. B. Benham, F.R.S.

FIG. 3.—Mouth of the same. Photograph by Prof. W. B. Benham, F.R.S.

FIG. 4.—*Megaptera nodosa*, Bonn. Foetus, slightly enlarged. Bay of Islands, N.Z. Photograph by Dr. W. G. Ridewood.

Cetacea, Plate V.

PLATE V.

Balaenoptera acutorostrata, Lacépède.

FIG. 1.—Calf 10 feet long. Lateral view of head. Dunedin, N.Z. Photograph by Prof. W. B. Benham, F.R.S.
FIG. 2.—Lateral view of the same specimen. " " " " " "

Cetacea, Plate VI.

PLATE VI.

Balaenoptera acutorostrata, Lacépède.

Figs. 1–6.—Various specimens "blowing" in the pack-ice of the Ross Sea on March 3, 1911. Photographs by Paymaster F. R. H. Drake, R.N.

Cetacea, Plate VII.

PLATE VII.

Fig. 1.—*Balaenoptera musculus*, Linn. Immature male, 65 feet in length. Bay of Islands, N.Z.
Fig. 2.—*Balaenoptera borealis*, Lesson. Female, 40 feet. Bay of Islands, N.Z.

Cetacea, Plate VIII.

PLATE VIII.

FIG. 1.—Dorsal view of *Balaenoptera acutorostrata*. Lat. 75° 3′ S., Long. 173° 41′ E., January 2, 1911. From a sketch by the late Dr. E. A. Wilson.

FIGS. 2–5.—*Lagenorhynchus obscurus*, Gray. Colour varieties from the Southern Ocean.

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.

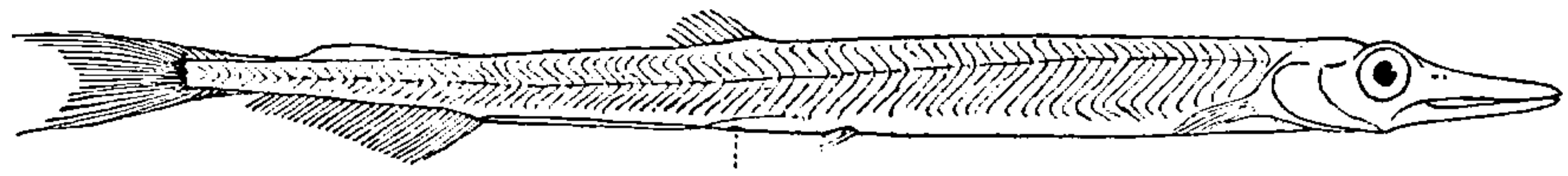

FIG. 1.—*Notolepis coatsii.* Type, actual size.

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

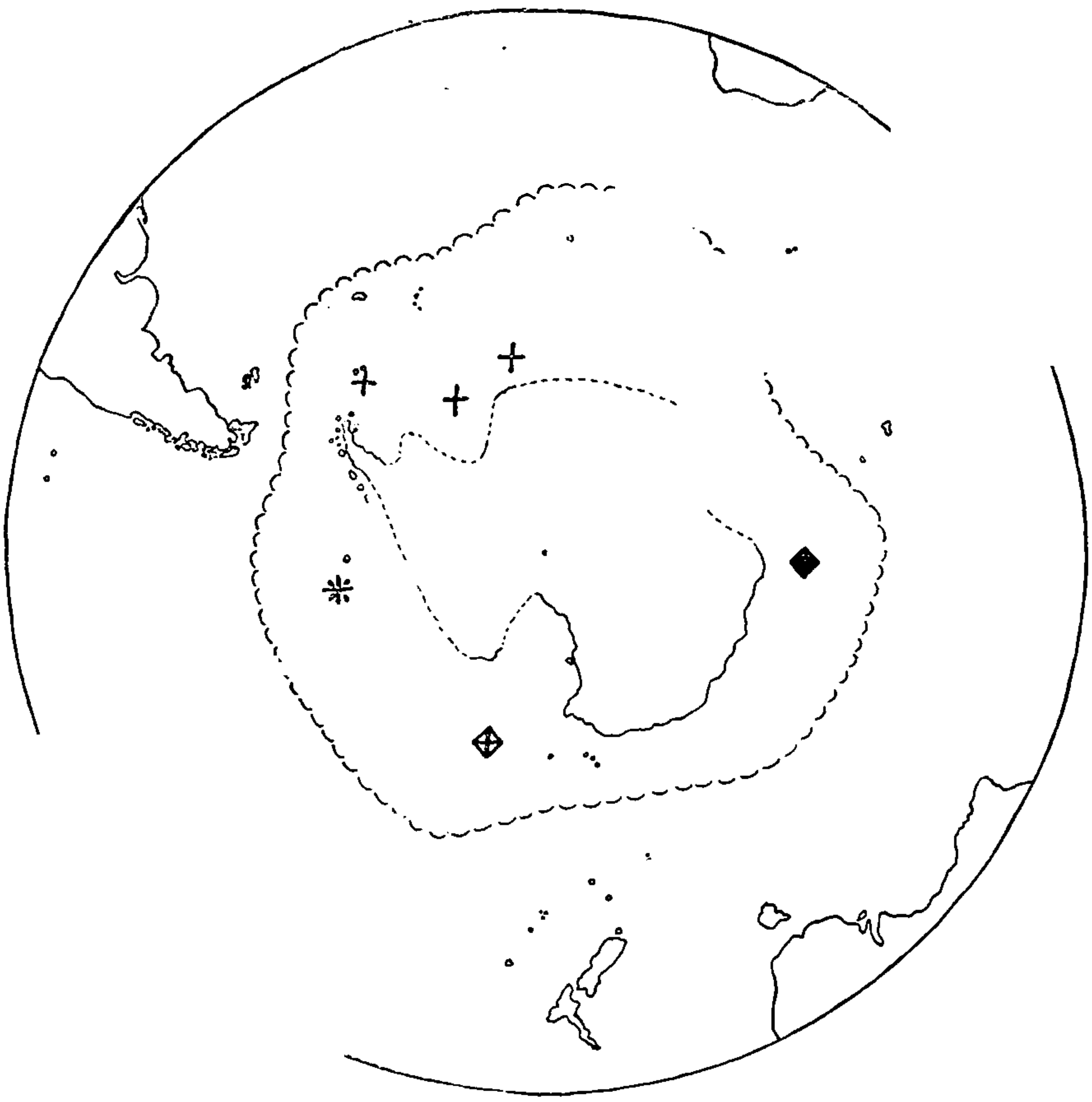

FIG. 2.—Distribution of *Notolepis coatsii.* All recorded captures are from the area bounded by the extreme limit of pack-ice, ⌒ ⌒ ⌒ ⌒ ⌒ ⌒ ⌒. Specimens taken by the "Terra Nova," ⊕; "Pourquoi Pas?" ✱; "Scotia," +; "Challenger," ◆.

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

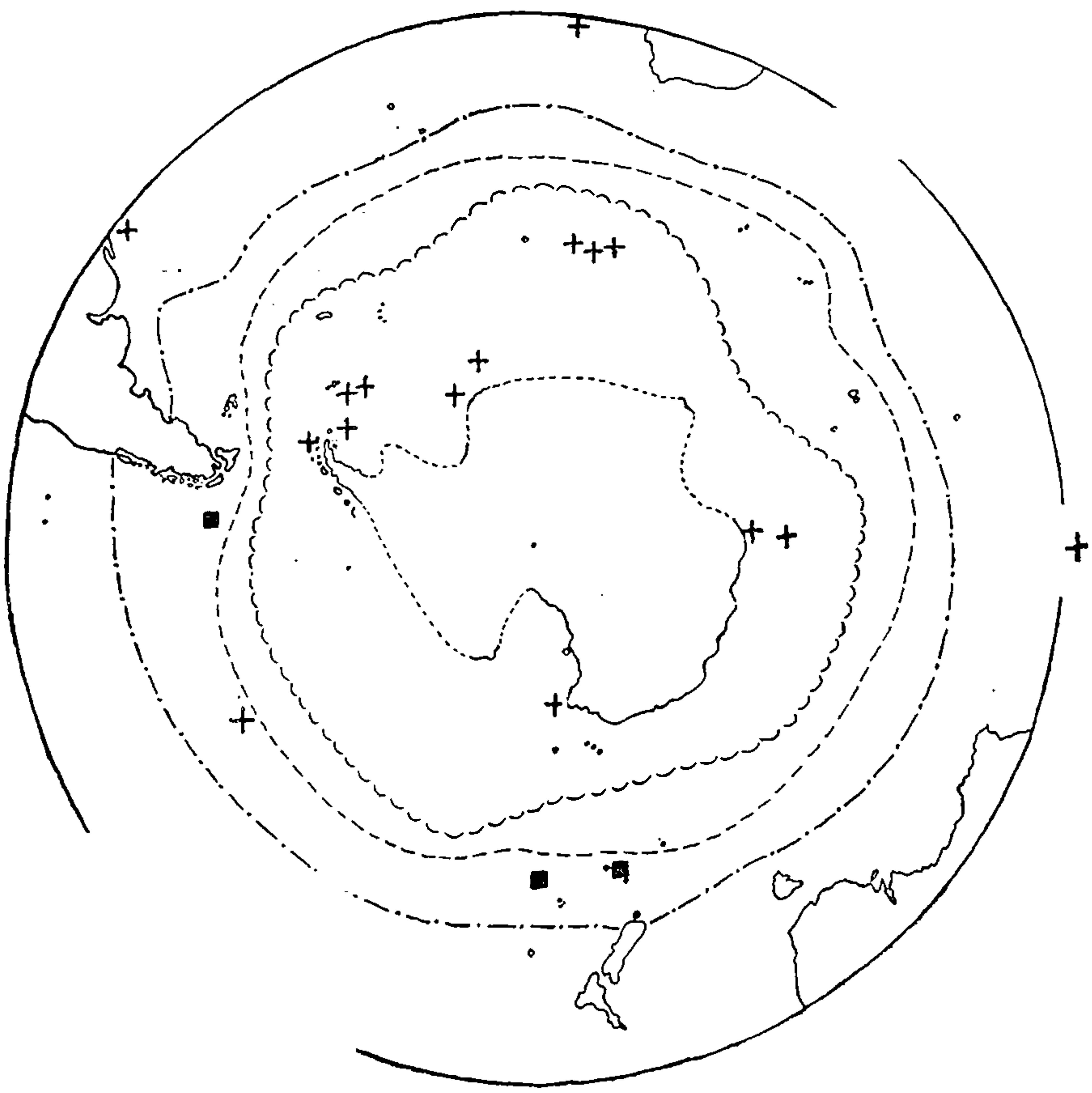

FIG. 3.—Distribution of *Myctophum antarcticum*. Recorded captures of the adult are marked +; larval and post-larval stages taken by the "Terra Nova," ■. The map shows the extreme limit of pack-ice ⌒ ⌒ ⌒ ⌒ ⌒, and the mean annual surface isotherms of 6° C. – – – – – – and 12° C. —·—·—·—·

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.

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. cyaneobrancha*, 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 2½ to 3 mm. in diameter. Lönnberg has recorded nearly ripe females of *A. mirus*, with eggs of 2½ 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.

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 artarcticum* larval and post-larval Notothenioids 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; inter-orbital region broad and flat. Myotomes about 70. Dorsal 22, placed posteriorly. Anal 40, extending forward in advance of dorsal. Protruding terminal portion of

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, Coeco (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. I, 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,

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.

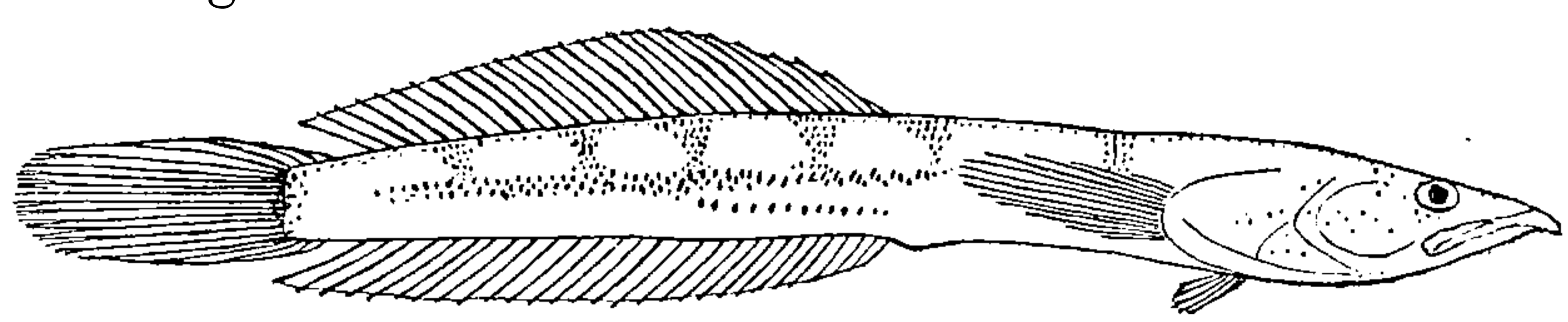

FIG. 4.—*Limnichthys fasciatus* (× 6).

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.

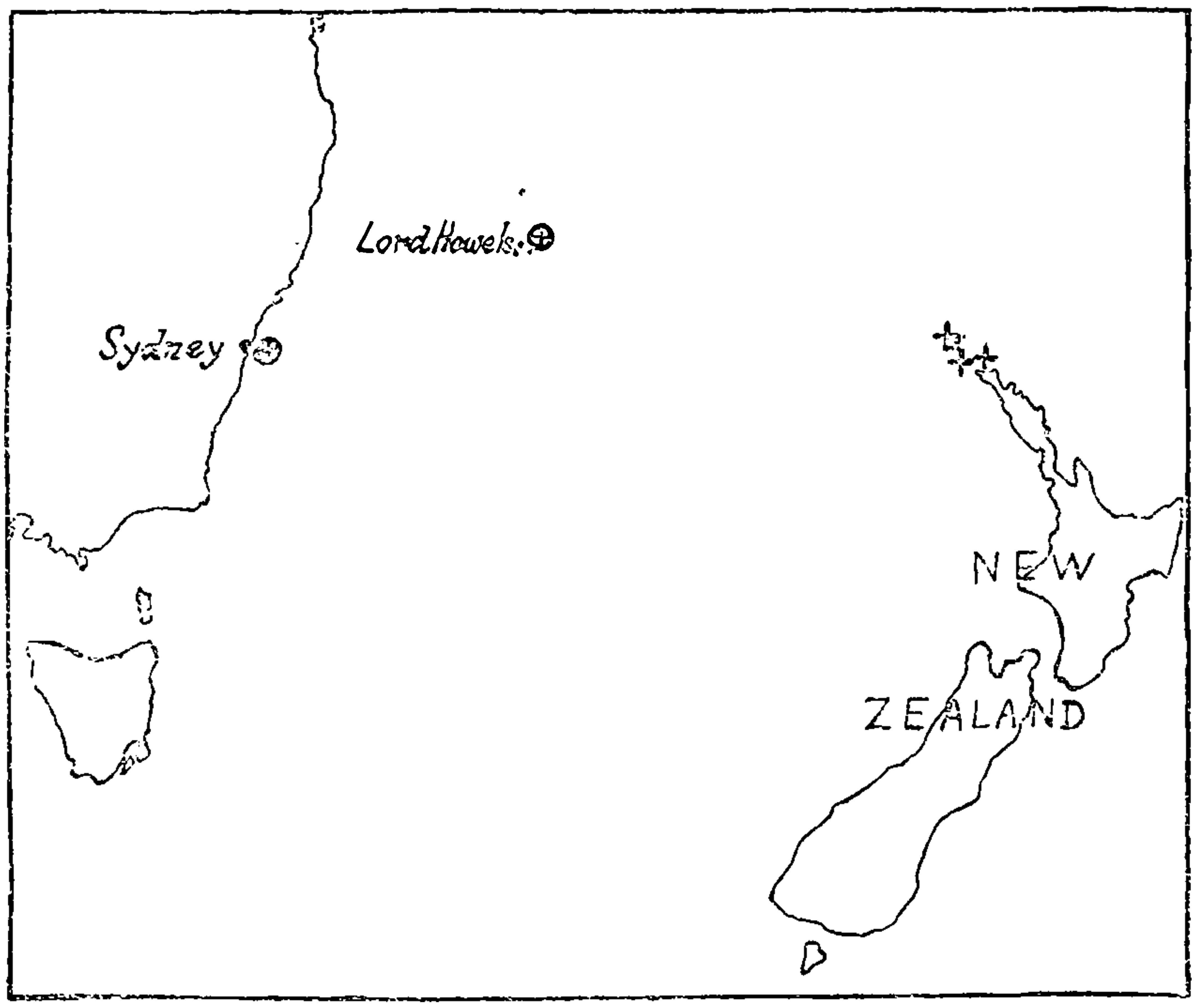

FIG. 5.—Distribution of *Limnichthys fasciatus*.
⊕, Littoral, from rock-pools; +, planktonic.

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

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

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.

laternatum, Myctophum, 135, 139.
Lepidopus caudatus, 134, 144.
Leptocephalus acuticeps, 135, 140.
,, euryurus, 141.
,, hexastigma, 135, 141.
,, muraenae unicoloris, 135, 141.
,, oxycephalus, 140.
,, similis, 141.
Limnichthyidae, 143.
Limnichthys fasciatus, 134, 143, 149.
loennbergii, Artedidraco, 132.
longipinnis, Lampanyctus, 134, 140.
lucetia, Vinciguerria, 135, 137.
macrenteron, Stylophthalmus, 135, 136, 137, 151.
macrocephala, Notothenia, 130, 134, 149.
macropterus, Lampanyctus, 134, 140.
,, Pagetopsis, 132, 151.
maderensis, Lampanyctus, 135, 140.
maoricus, Centrolophus, 134, 144.
marmorata, Pentaroge, 135, 145.
megalepis, Doratonotus, 143.
microdon, Cyclothone, 135, 137.
mollis, Haplophryne, 134, 148.
Monacanthus scaber, 134, 147.
Muraena helena, 141.
,, unicolor, 141.
muraenae unicoloris, Leptocephalus, 135, 141.
Muraenidae, 141.
Myctophidae, 138.
Myctophum, 127.
,, antarcticum, 125, 127, 139, 148.
,, benoiti, 135, 139.
,, coccoi, 134, 139.
,, glaciale, 129.
,, laternatum, 135, 139.
,, punctatum, 127.
Notolepis, 125, 150.
,, coatsii, 125, 138, 148.
Nototheniidae, 130.
Notothenia, 130, 133.
,, coriiceps, 130.
,, cyaneobrancha, 130.
,, gibberifrons, 130.
,, larseni, 130.
,, macrocephala, 130, 134, 149.
,, nudifrons, 130.
,, rossi, 130.
,, sima, 130.
,, tessellata, 130.
nudifrons, Notothenia, 130.
obscurus, Eustomias, 136.
ocellatus, Bothus, 135, 147, 148.
Odacidae, 143.
Odax balteatus, 135, 143, 150, 152.
Omosudis elongatus, 138.
Ophichthyidae, 141.
Ophichthys, 142.
oxycephalus, Leptocephalus, 140.
Pagetopsis macropterus, 132, 151.
Palaeoniscidae, 149.
paradoxus, Stylophthalmus, 135, 136, 137.
Paralepis, 127, 138, 150.
,, speciosus, 135, 138.
Paralichthinae, 146.
Paraliparis antarcticus, 129.
,, terrae-novae, 129.
Pediculati, 147.
Pentaroge marmorata, 135, 145.
Percomorphi, 142.
Pholidophoridae, 149.
Platophrinae, 147.
Platycephalidae, 146, 152.
Platycephalus, 135, 146, 152.
Plectognathi, 147.
Pleuragramma antarcticum, 131, 133, 134.
podas, Bothus, 135, 147.
Pomacentridae, 142.
Pomatomus saltator, 150.
procerus, Lampanyctus, 140.
Prymnothonus, 127, 134, 135, 137, 138, 150.
punctatum, Myctophum, 127.
quadrocellata, Ancylopsetta, 135, 146.
rossi, Notothenia, 130.
rugosus, Chaenichthys, 132.
saltator, Pomatomus, 150.
Sardina neopilchardus, 134, 136.
,, pilchardus, 136.
Sardinella aurita, 136.
,, pseudohispanica, 135, 136.
saurus, Scombresox, 135, 142.
scaber, Monacanthus, 134, 147.
Scaridae, 143.
Scleroparei, 145.
Scombresocidae, 142.
Scombresox forsteri, 134, 142.
,, saurus, 135, 142.
Scorpaena, 135, 145.
Scorpaenidae, 145.
Scorpididae, 142.
Scorpis violaceus, 134, 142.
scorpius, Cottus, 130.
Semionotidae, 149.
sima, Notothenia, 130.
similis, Leptocephalus, 141.
skottsbergii, Artedidraco, 132.
speciosus, Paralepis, 135, 138.
Stomiatidae, 136.
Stromateidae, 144.

Stylophthalmus macrenteron, 135, 136, 151.
„ paradoxus, 135, 136, 137.
Sudidae, 137, 152.
Synentognathi, 142.
Synodontidae, 137, 152.
Synodus synodus, 135, 137, 150
„ varius, 137.
synodus, Synodus, 135, 137, 150.
terrae-novae, Paraliparis, 129.
tessellata, Notothenia, 130.
Thyrsites atun, 134, 144, 150, 151, 152.
Trachypterus, 151.
Trematomus bernacchii, 130, 133.
„ hansoni, 130, 133.
Trichiuridae, 141.
Triglidae, 152.
Tripterygium varium, 134, 145, 150.
unicolor, Muraena, 141.
unifasciatus, Hemirhamphus, 135, 142, 149.
ustus, Cryptotomus, 135, 142, 149.
varius, Synodus, 137.
varium, Tripterygium, 134, 145, 150.
Vinciguerria lucetia, 135, 137.
violaceus, Scorpis, 134, 142.

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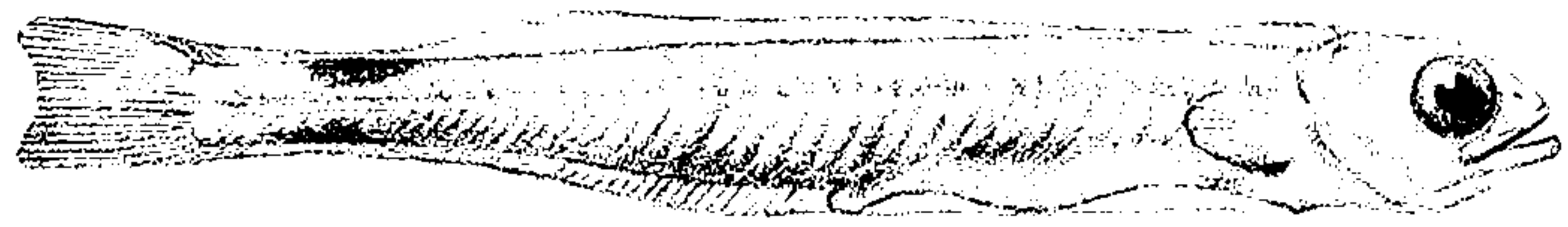
PLATE I.

	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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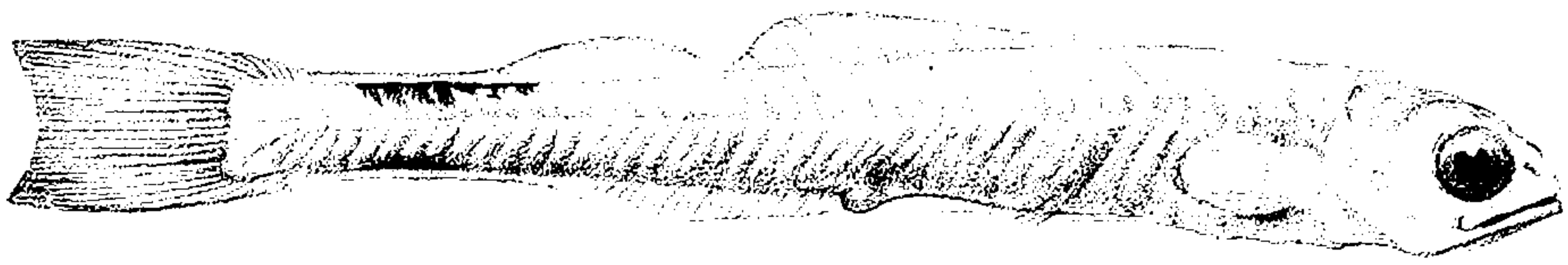

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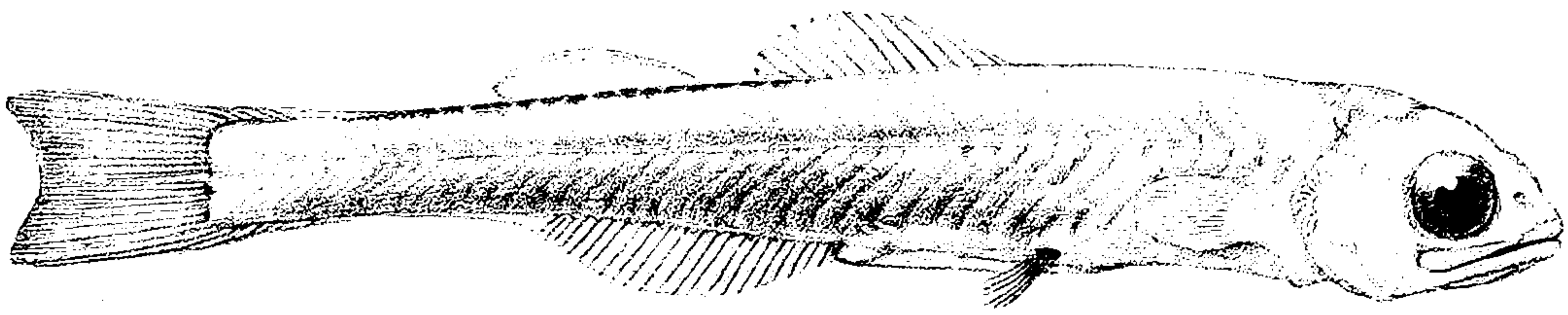

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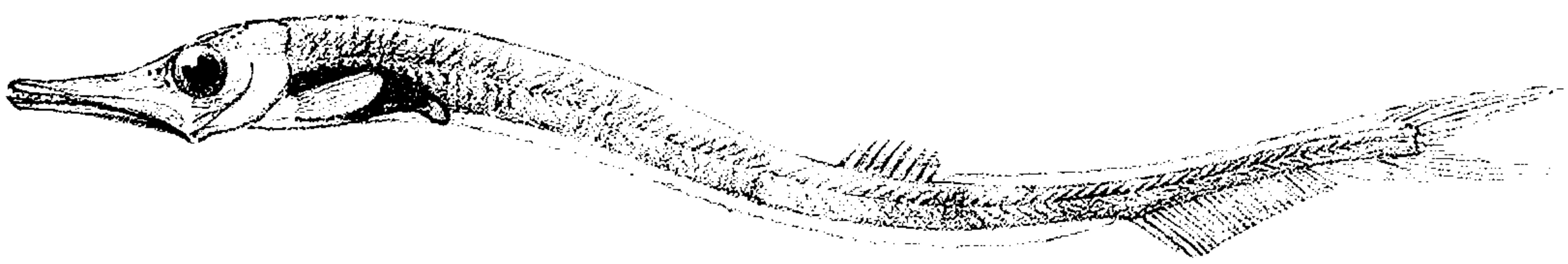

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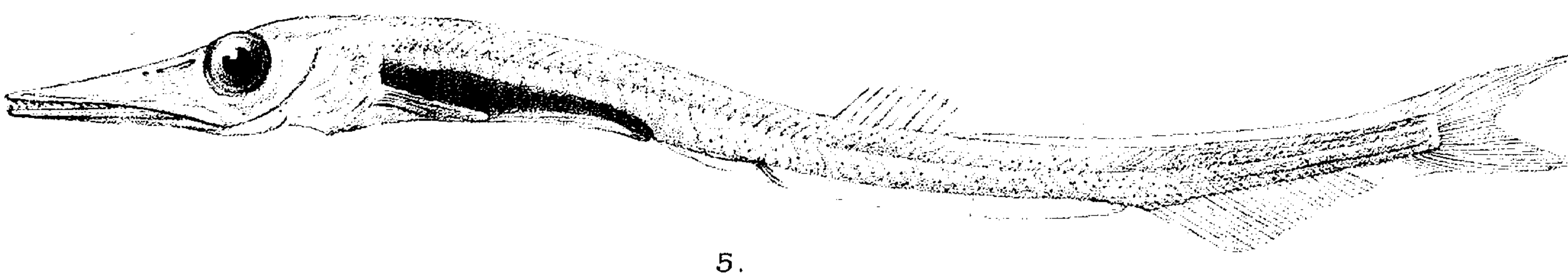

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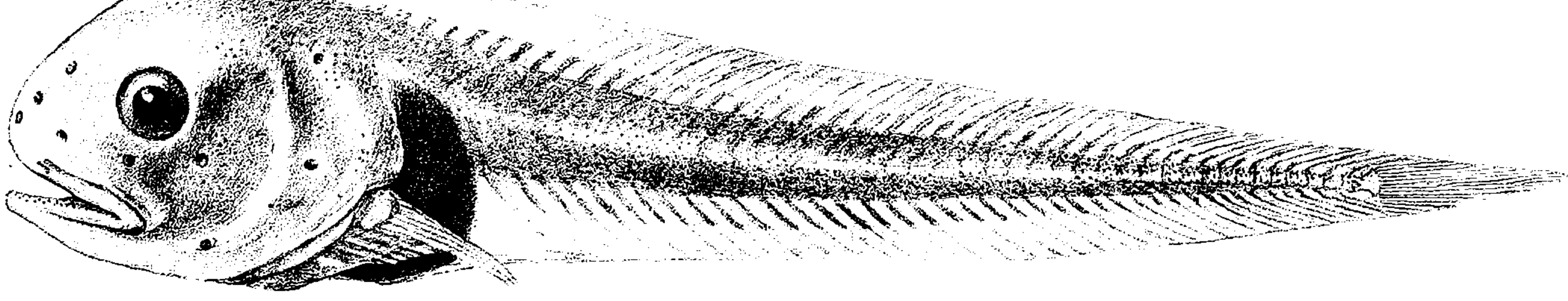


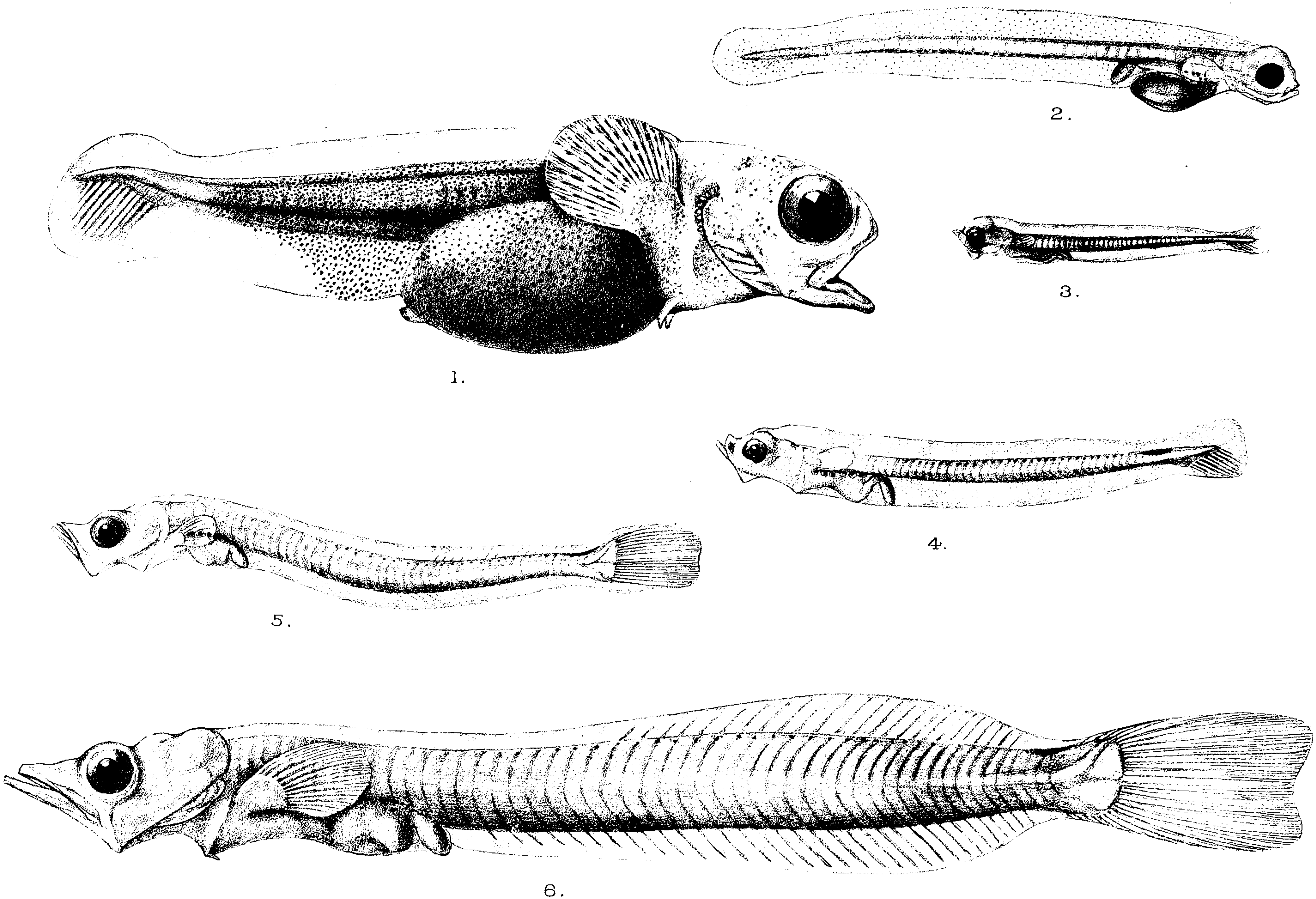
6.

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

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.	



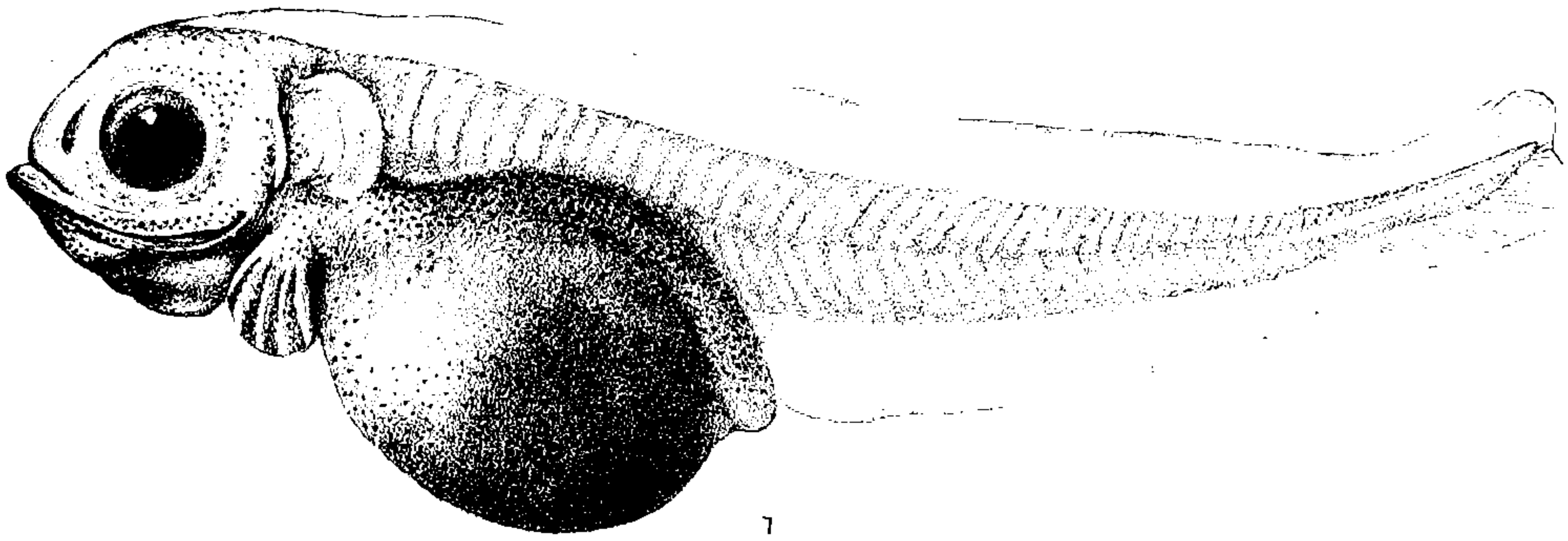
G. M. Woodward del. et lith., Huth imp.

Nototheniidae.

Larval Fishes, Pl. II.

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.	,,



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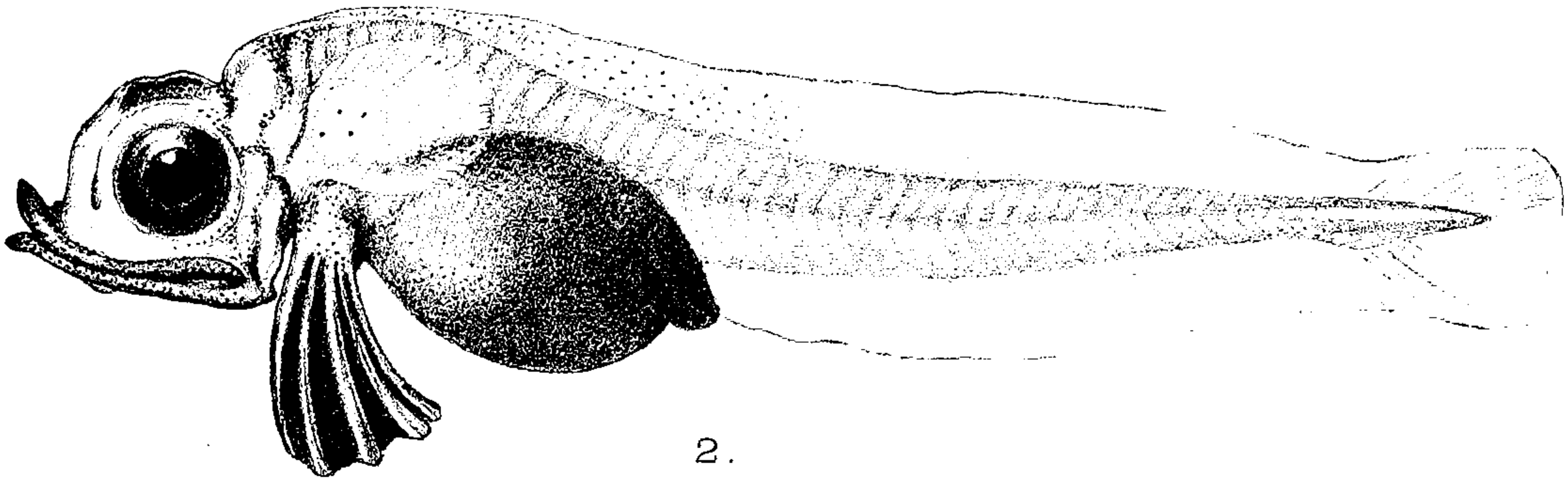

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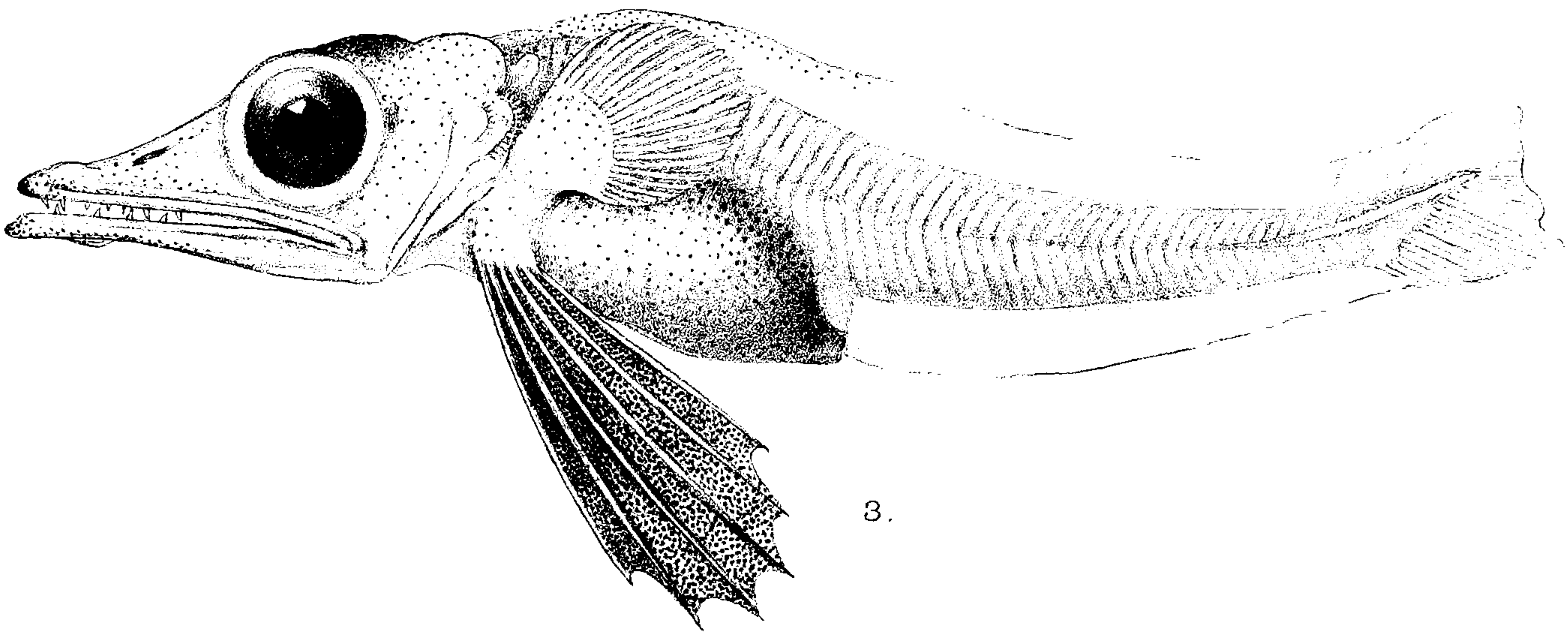

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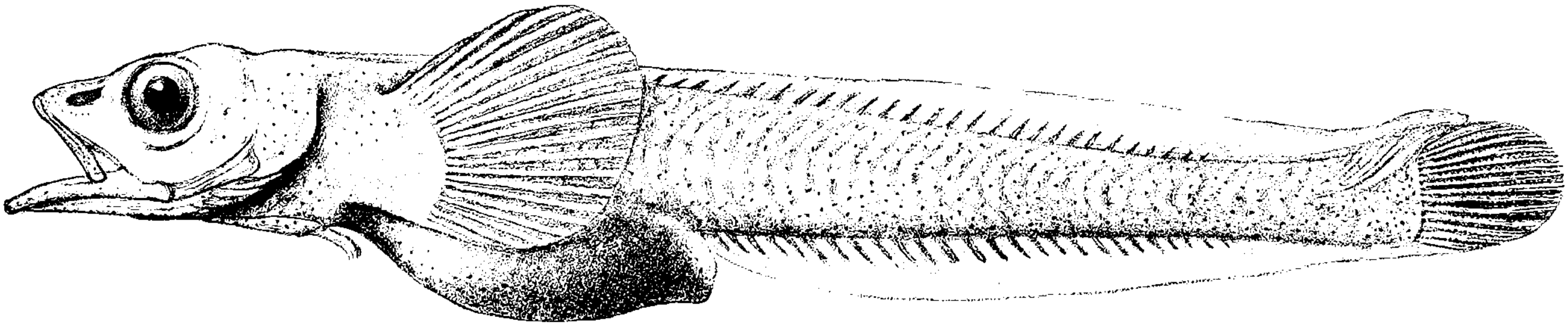

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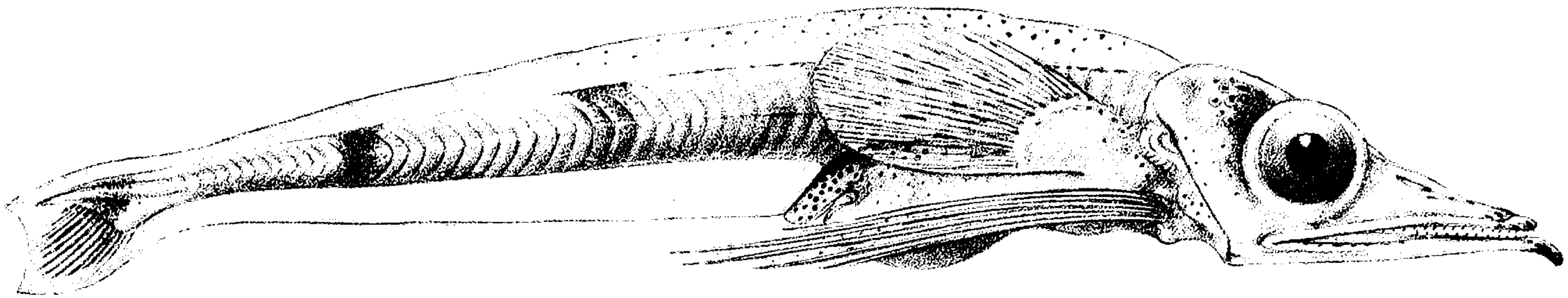
G. M Woodward del. et lith.

Huth imp.

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.	



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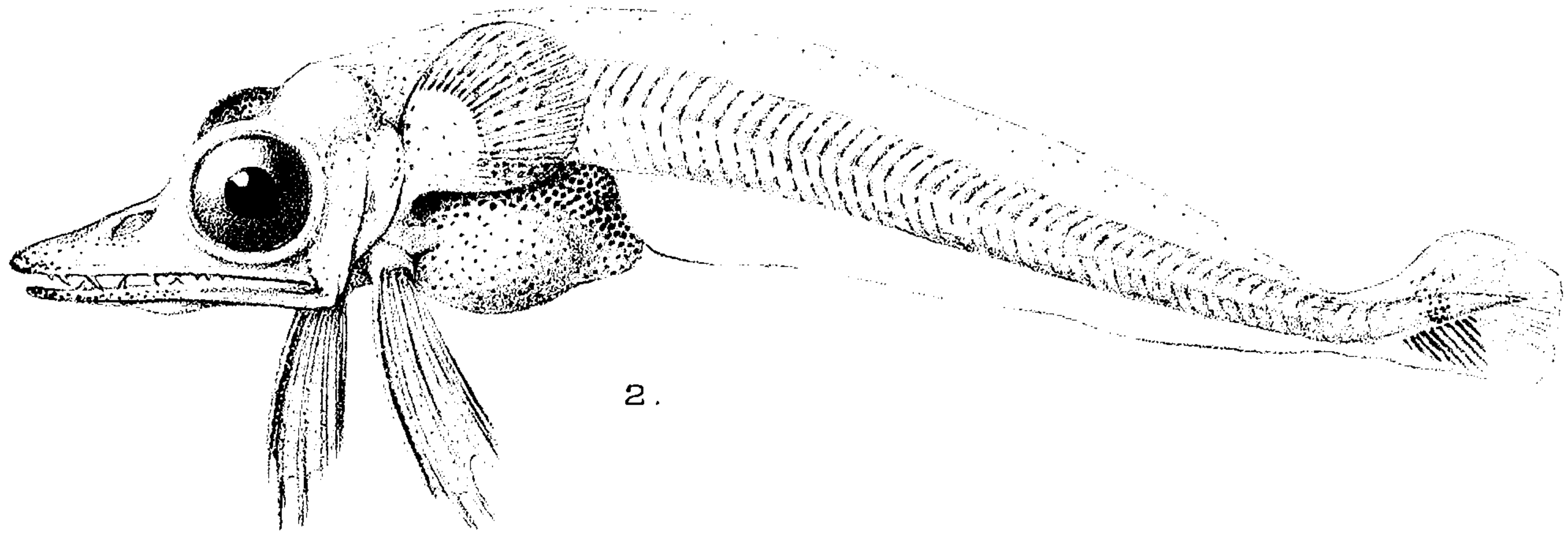

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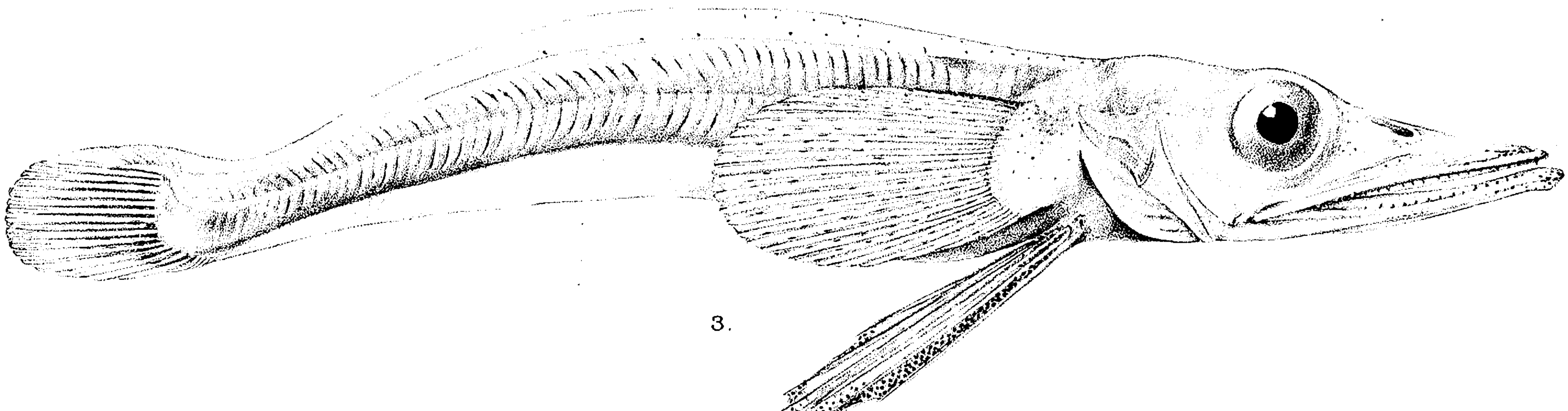
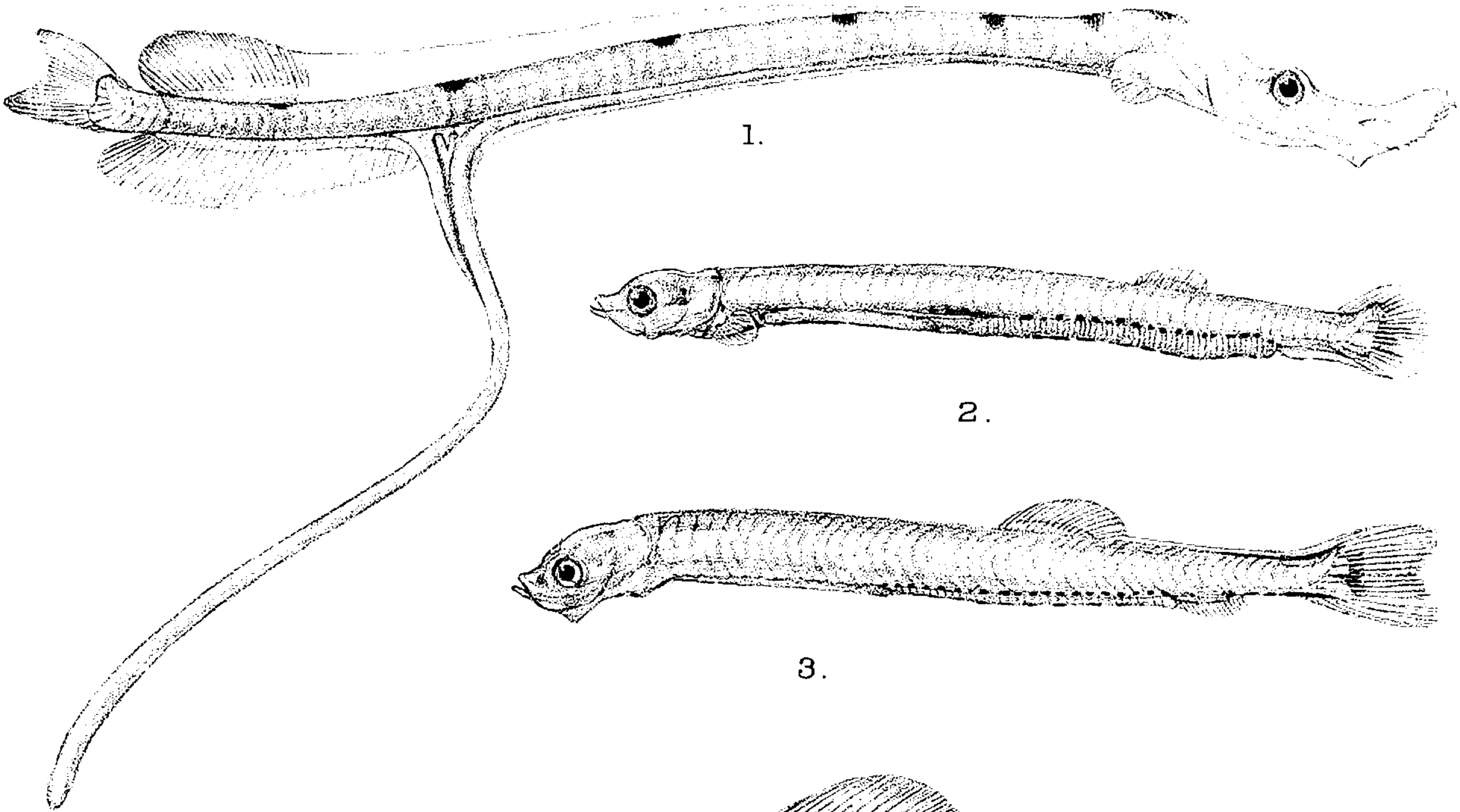


3.

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.	,, ,,



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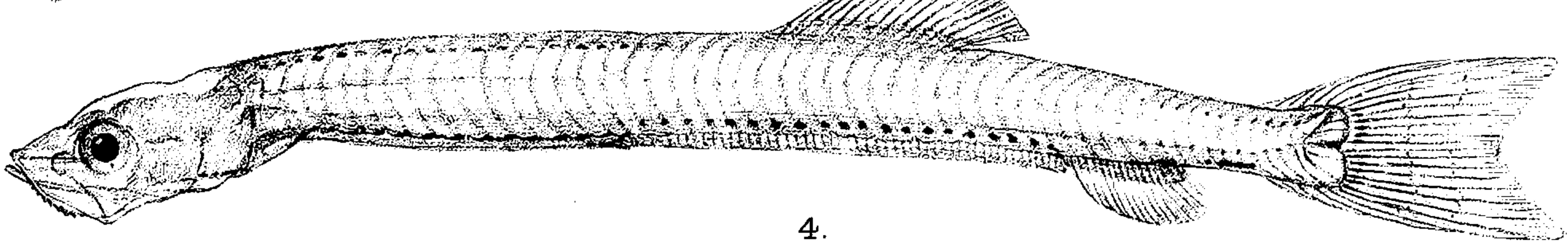

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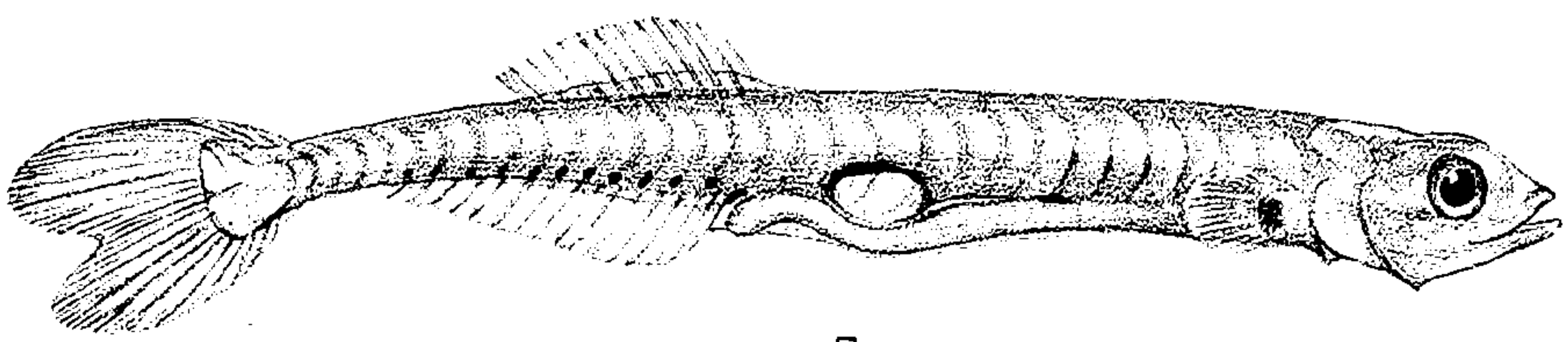

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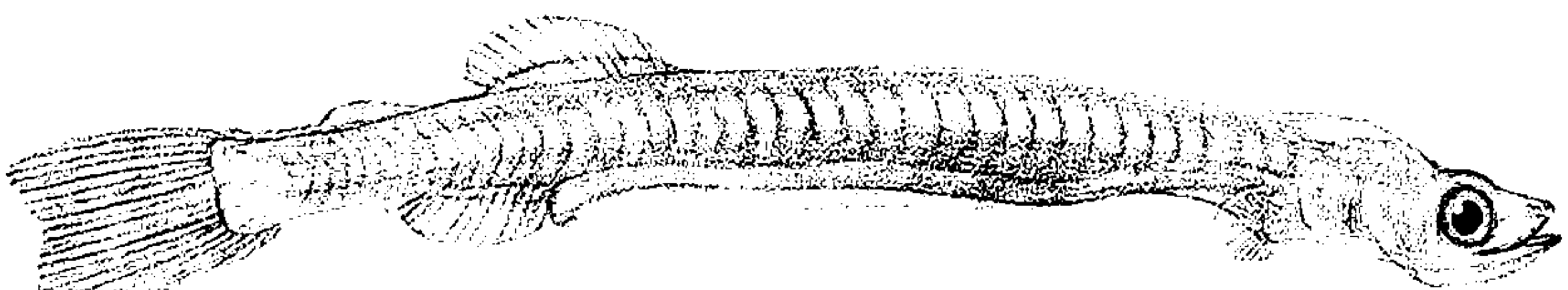

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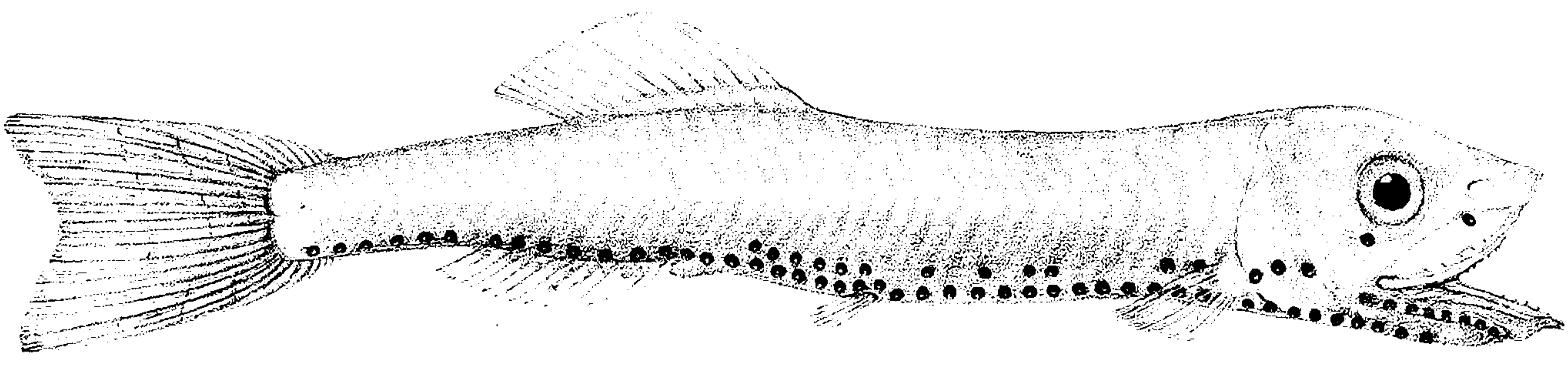

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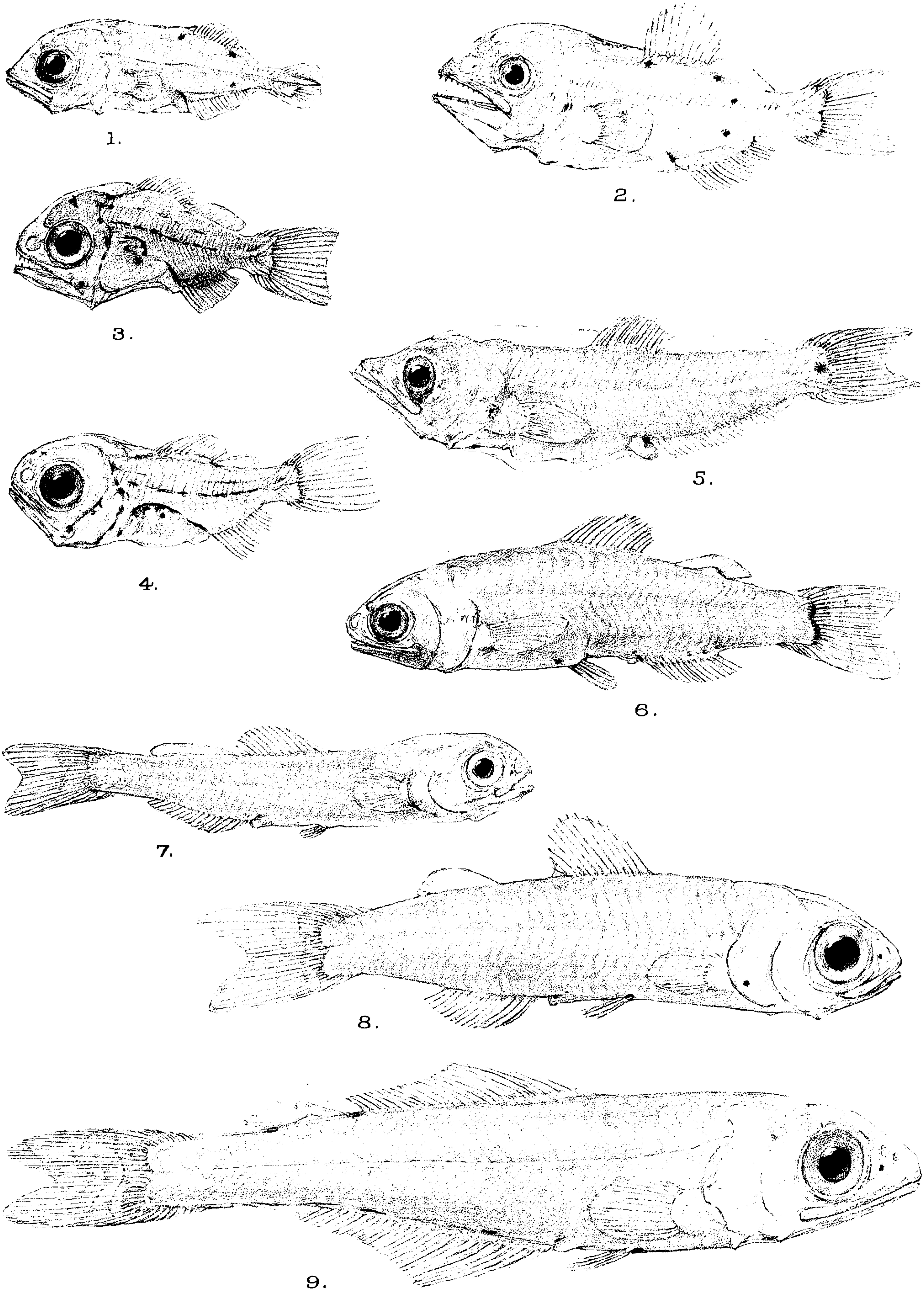
PLATE VI.

	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.



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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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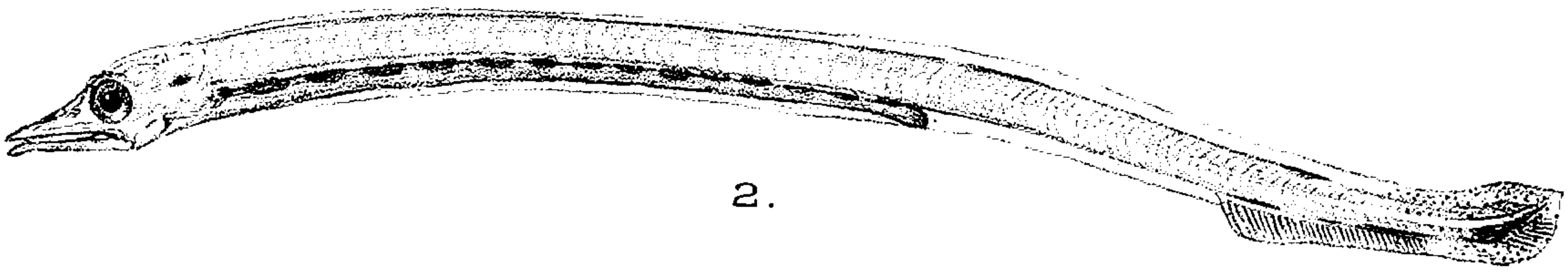

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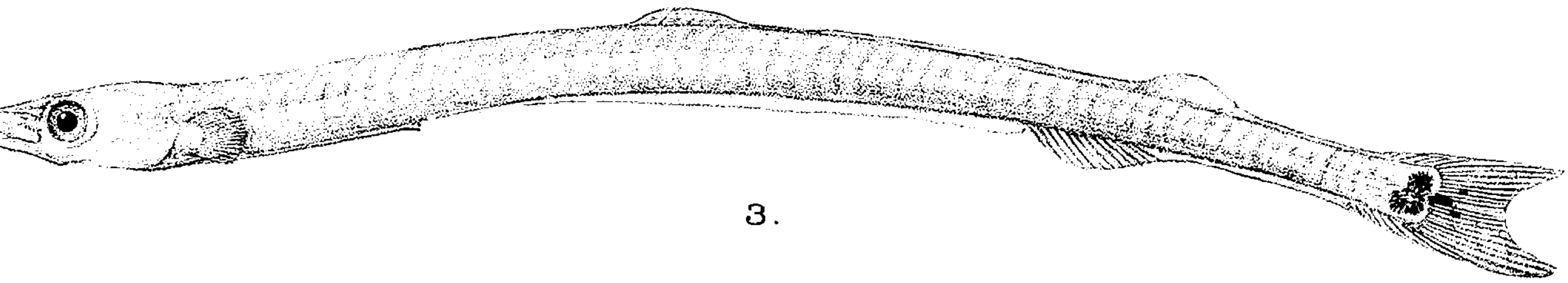

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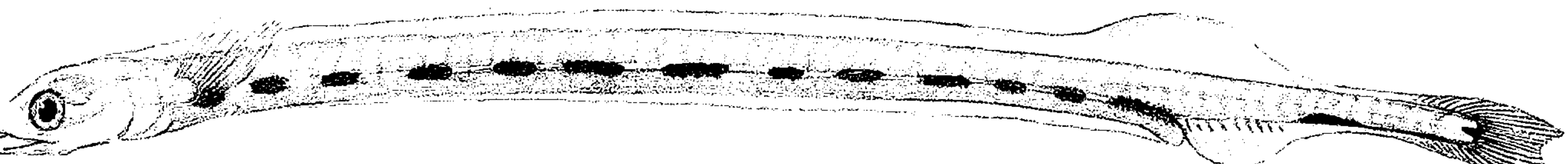

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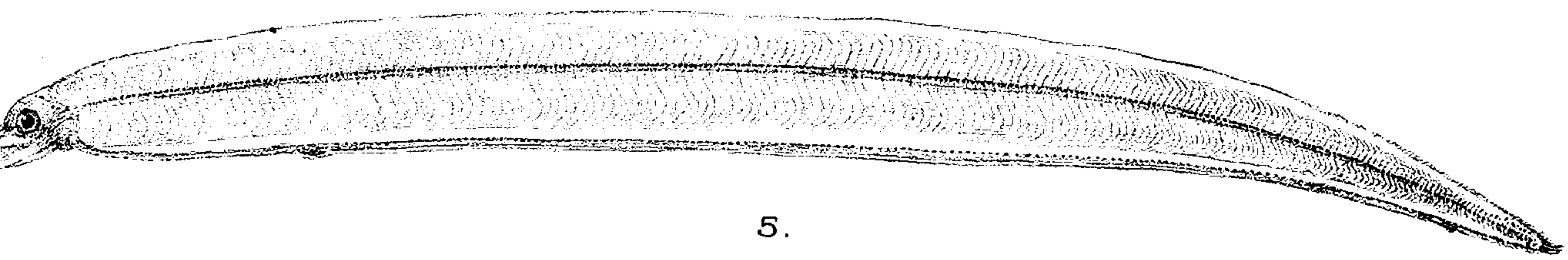

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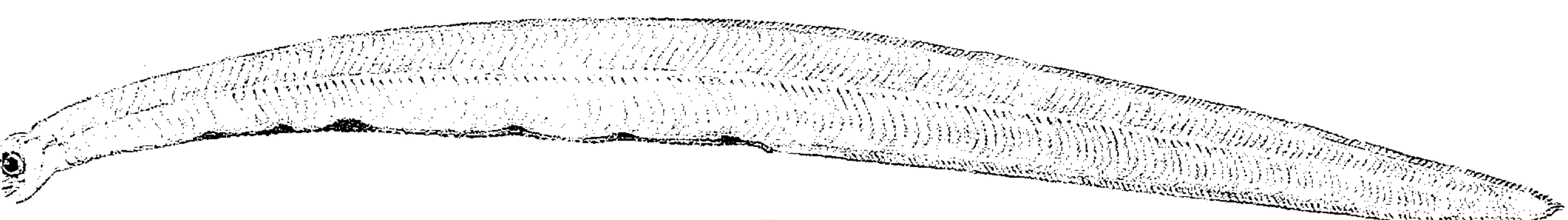

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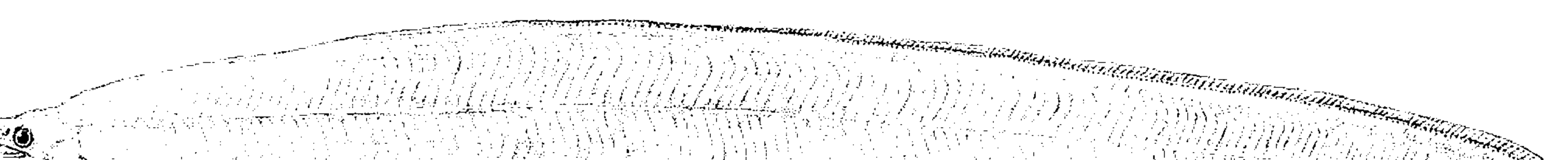
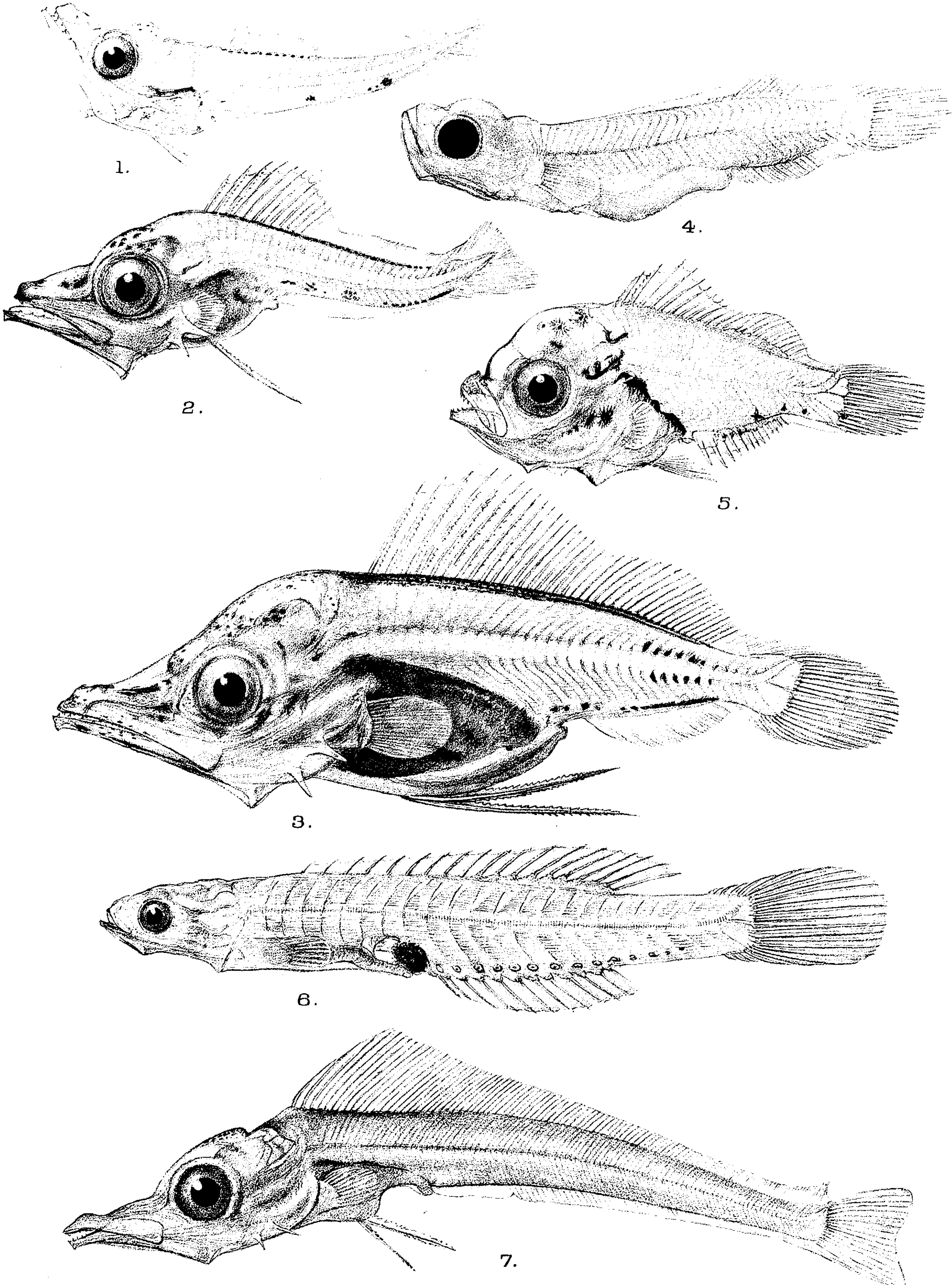


PLATE VIII.

	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.



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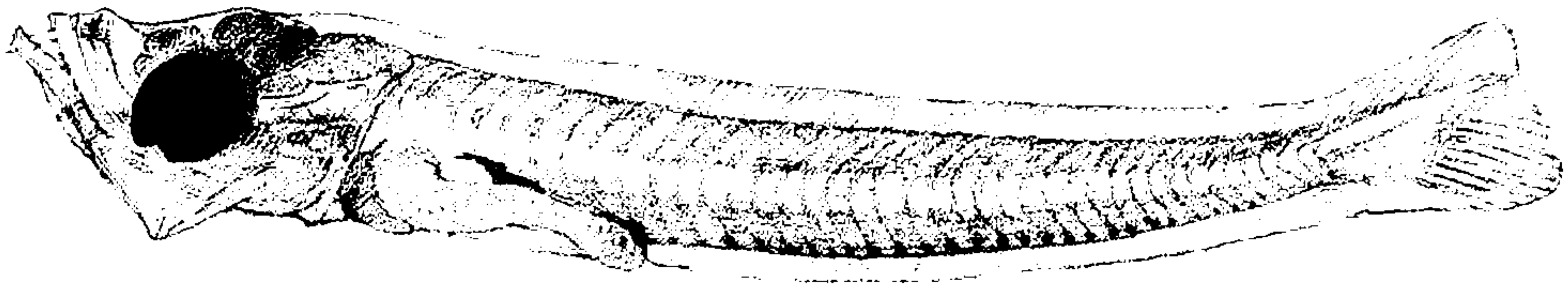
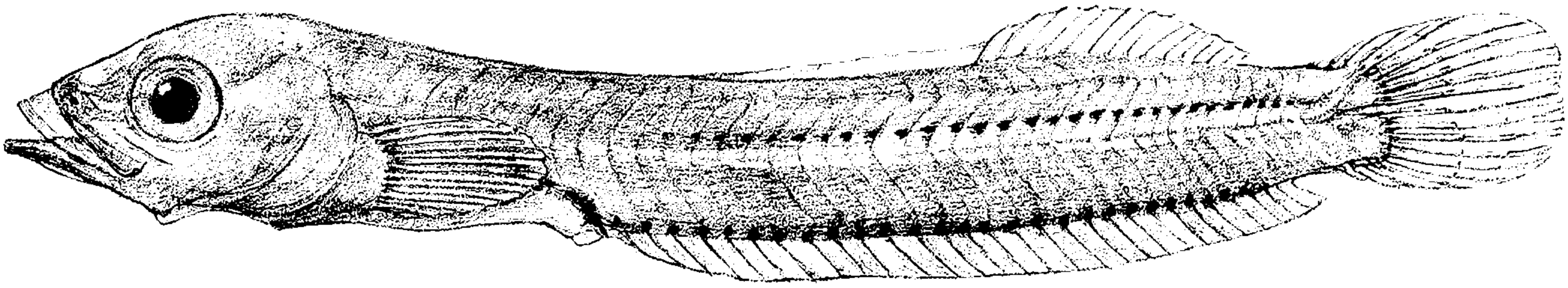
Trichiuroidea and Percoidea.

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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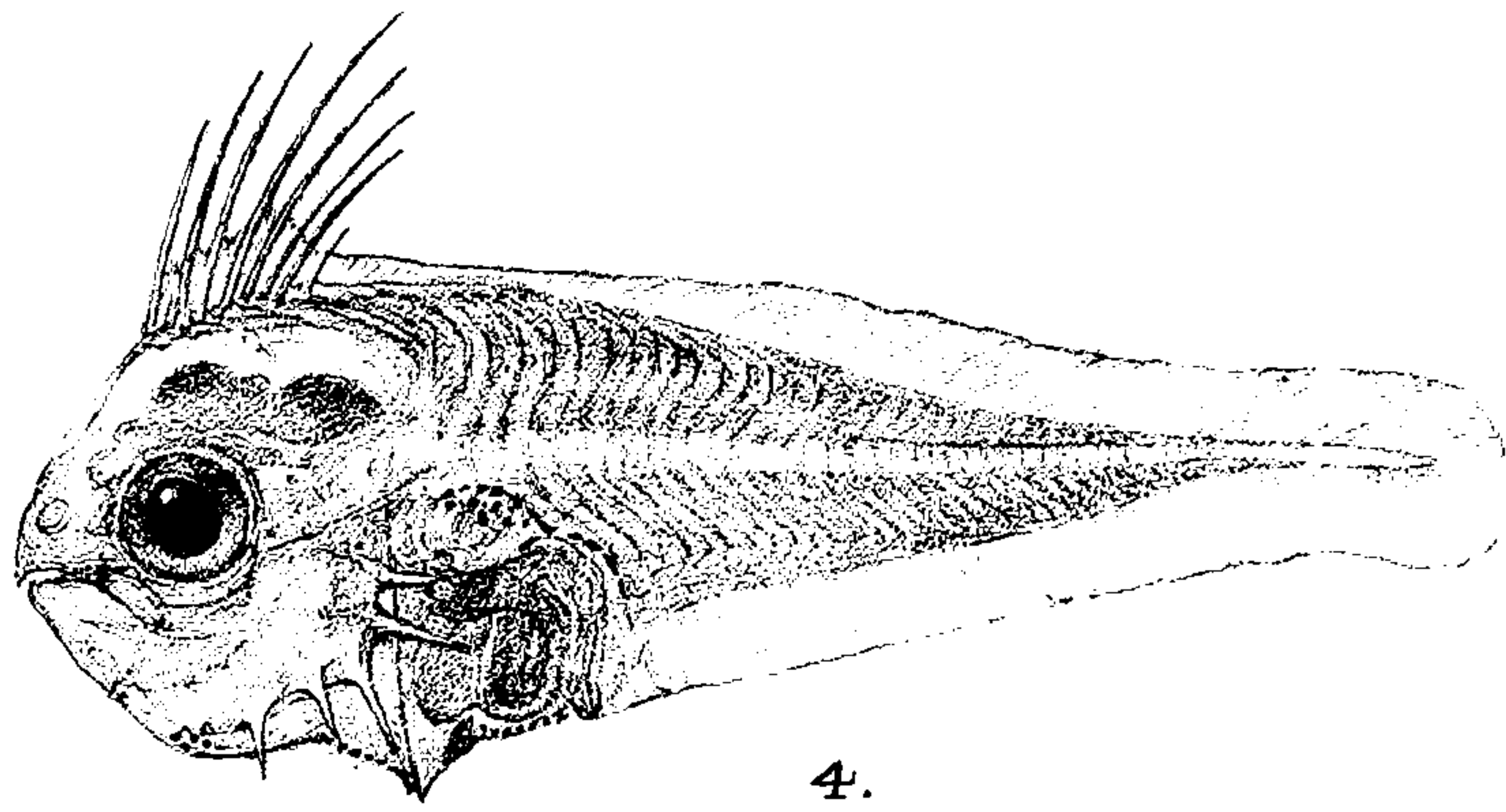

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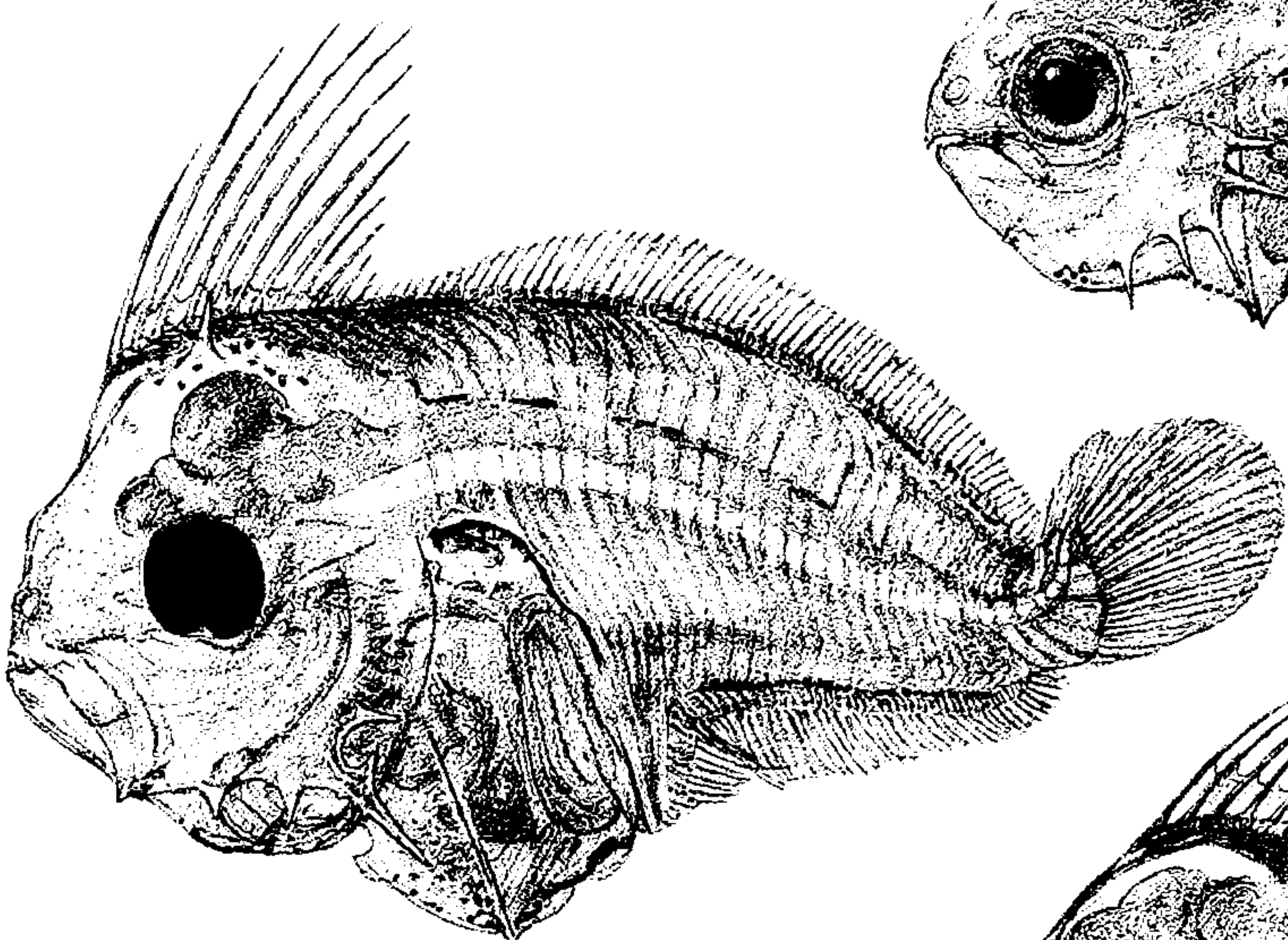

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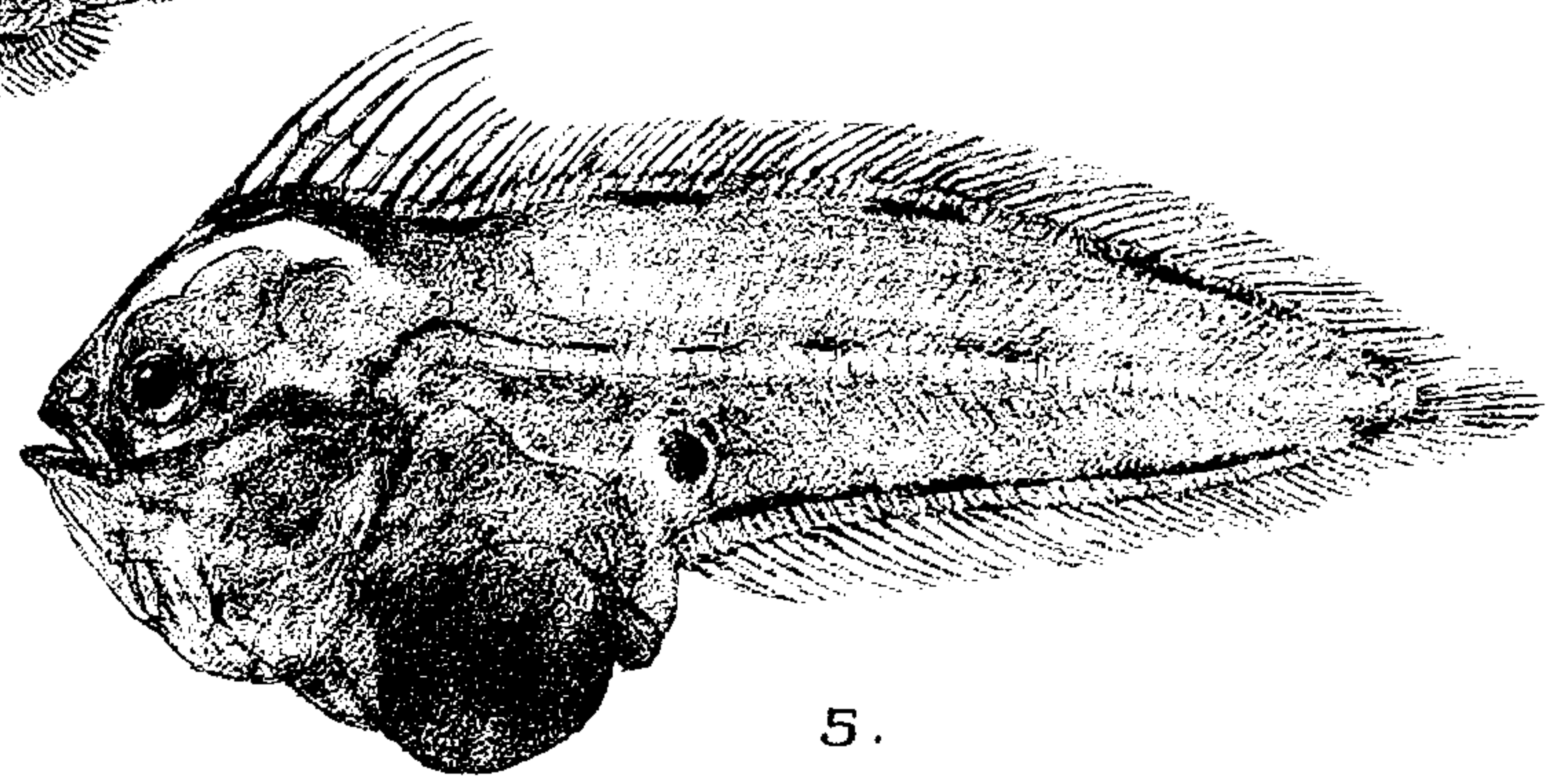

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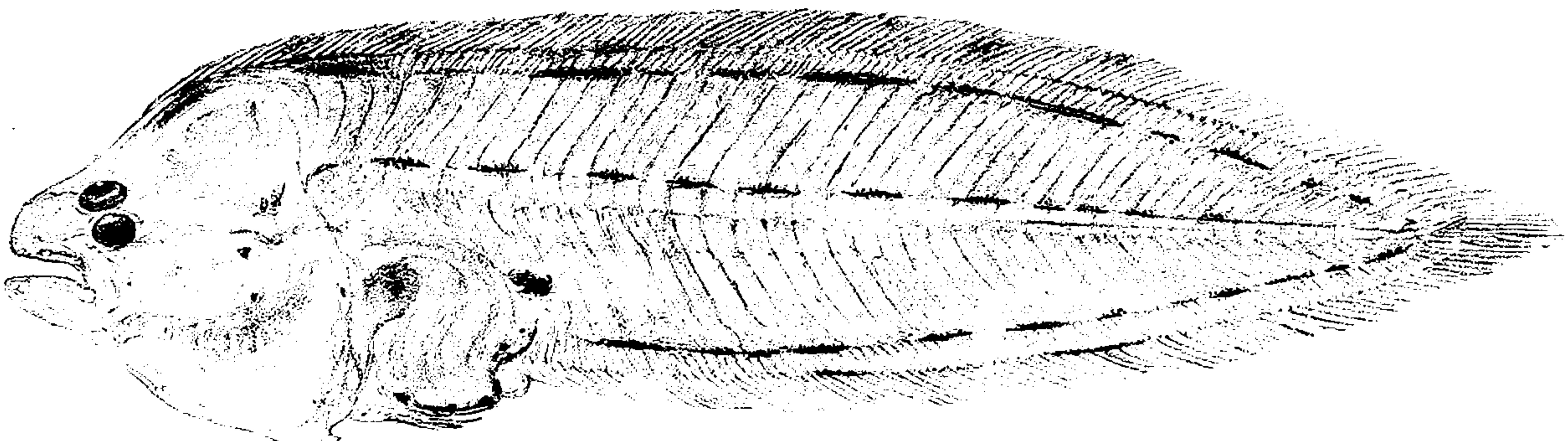

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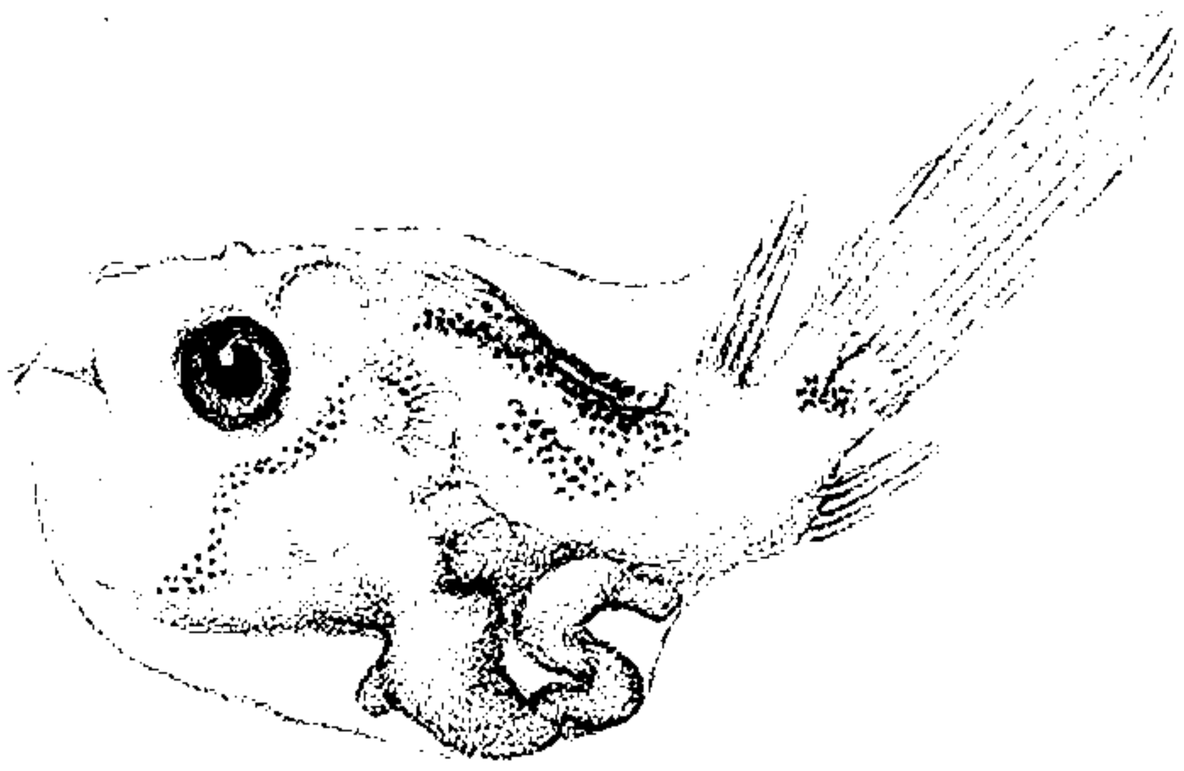
Tripterygium and Heterosomata.

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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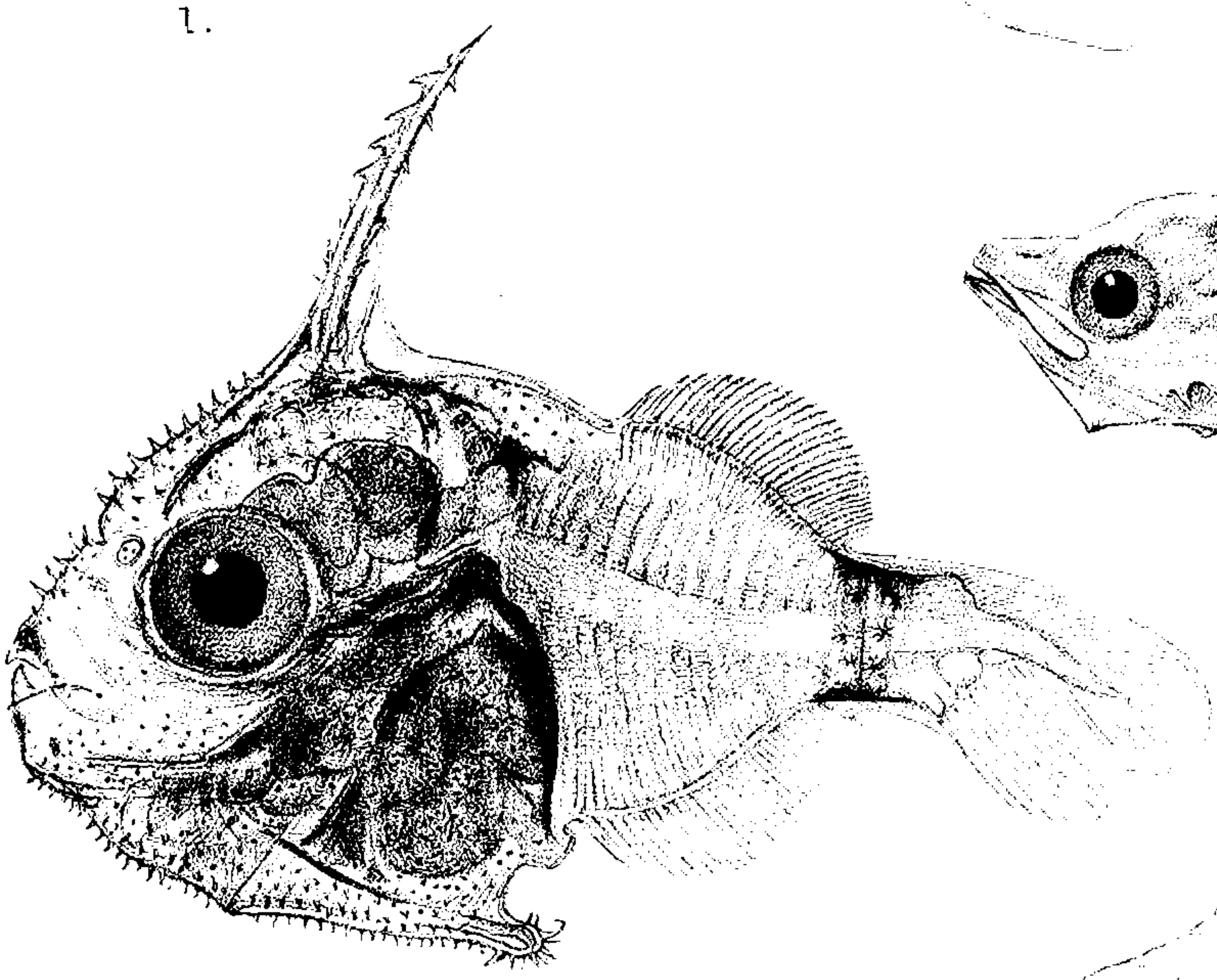

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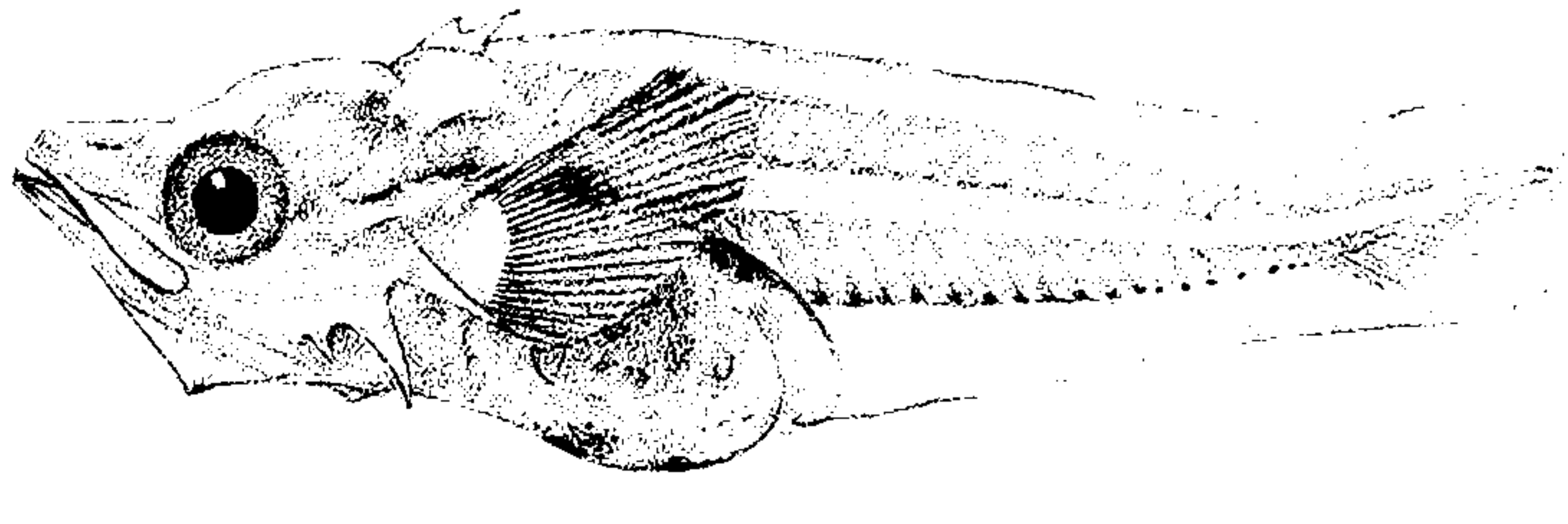

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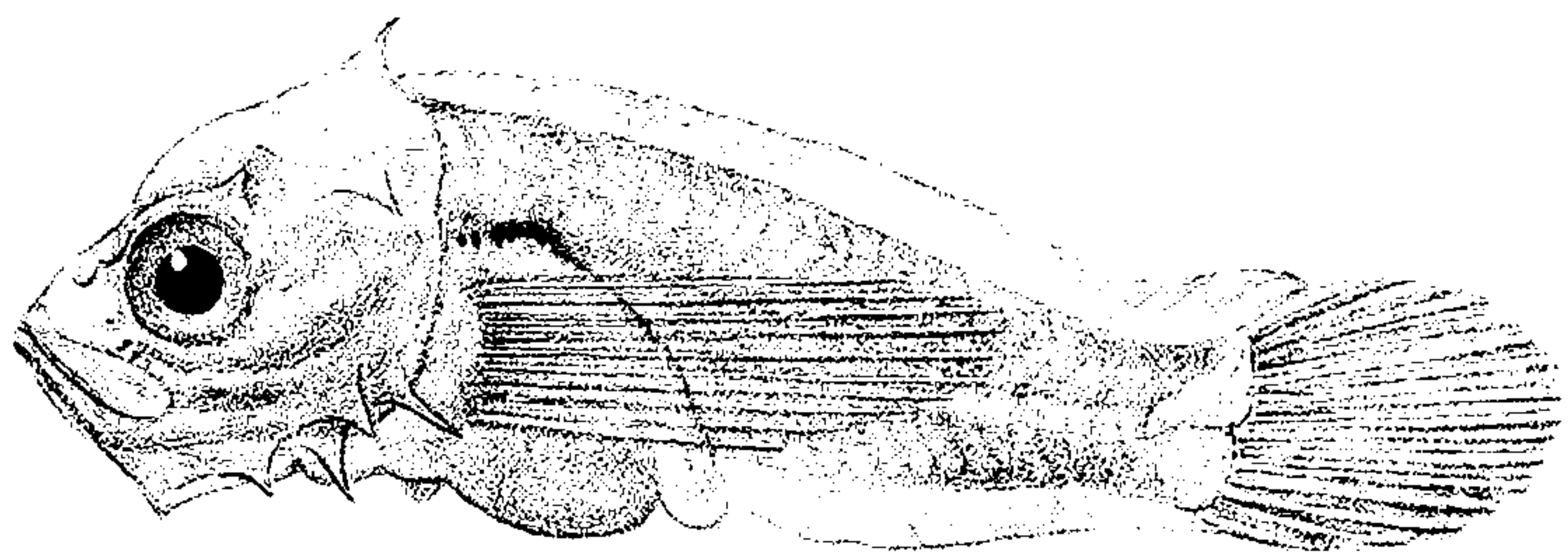

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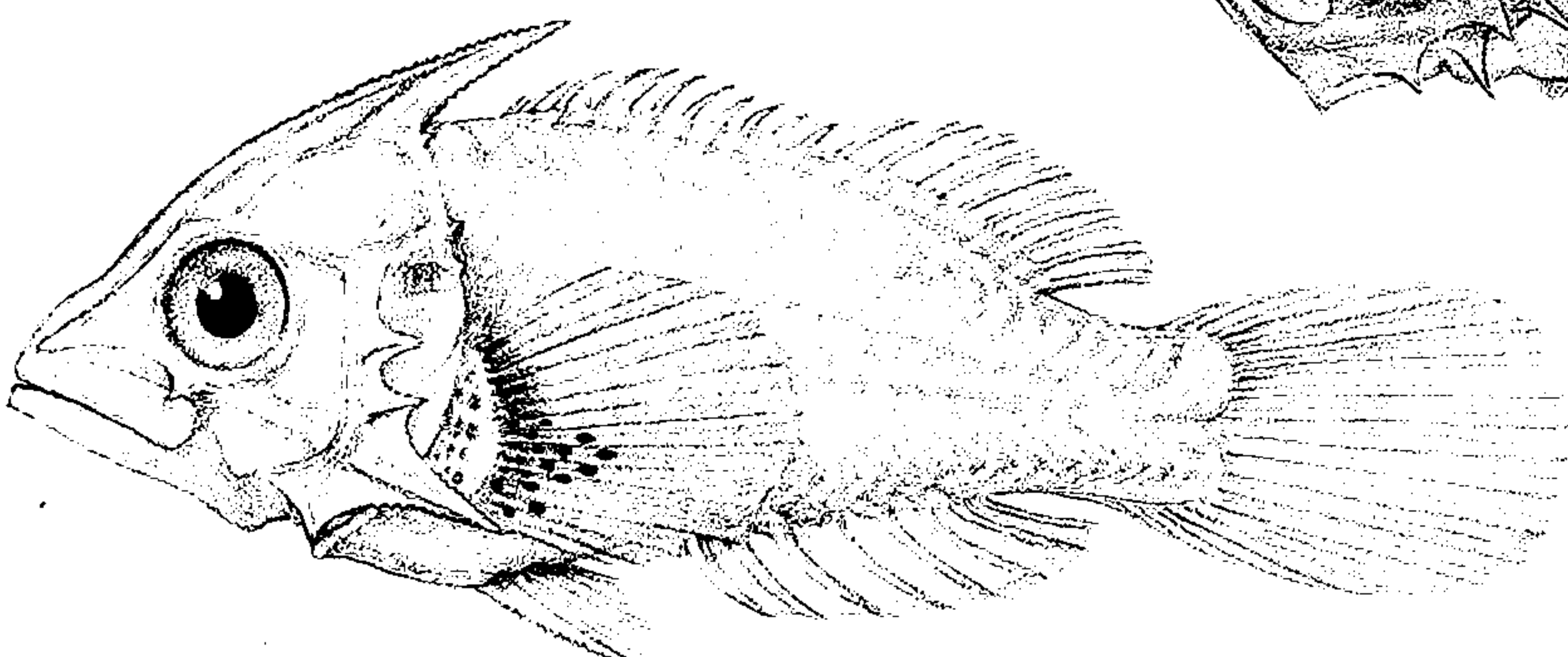

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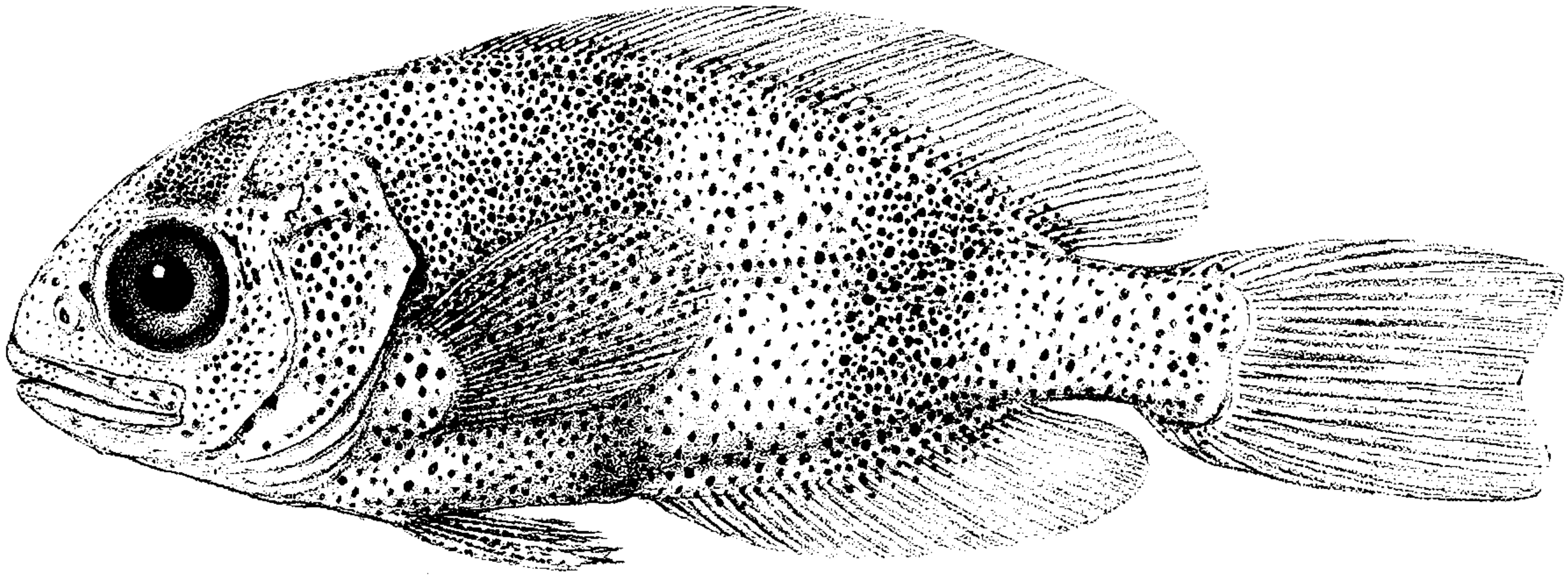

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Pediculati, Scleroparei, Monacanthus and Centrolophus.