When the writer entered, the sand on the floor was even and smooth, except for the track of some animal, and under a little projecting ledge of rock was an abandoned nest of small sticks, &c., whilst near-by were a few whitened bones of a small animal.

On the outer edge of the part of shelter furthest north were three or four artefacts, lying as though they had been left there by the last user—one was nearly falling from the edge of the floor into the bush below. The sand of the floor at this point yielded several more—one or two buried 6 or 7 inches deep. Fine black dust and a few old pieces of burnt bone are mixed all through the sand.

Behind where the fire must have been was a small flattish stone, sized roughly 9 inches by 7 inches, and placed level and parallel with the back of the shelter. This was remarkable because of the absence of other large stones.

The artefacts are all rather small and comparatively neatly formed. Other scrapers found in the neighbourhood are much bolder in design.

The implements are interesting, as affording examples of most of the ordinary types found in Tasmania. They are as follows:—

1. Side scrapers, 3½ inches long, worked full length of one side.
2. End scraper, 2¾ inches long, worked at point (approximates to Aurignacian type).
3. Awl, worked to good point. One side may have been of service as concave scraper 2¾ inches long.
4. Stone similar to oval "oyster" or thumb stone types, though not finished on one side.
5. Roughly heart-shaped stone, top edge concave.
6. Broadened end scraper—a good edge, well chipped, rest of stone roughly shaped.
7. Nondescript stone, very thin, but with delicate chippings on edge.

OBSERVATIONS ON SOME TASMANIAN FISHES, WITH DESCRIPTIONS OF NEW SPECIES.

By

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Plates VI.-VIII.; and Two Text Figures.

(Read 25th September, 1933.)

Scope.

The present paper deals with material that has come under observation in the course of Museum routine. It falls into three sections—

(*a*) Some general observations; species mentioned being *Regilophotes güntheri, Phyllopteryx foliatus, Cephaloscyllium isabella, Urolophus viridis, Anguilla reinhardtii, Solegnathus fasciatus, Galaxias affinis.* In view of the scant attention our Tasmanian fishes, except in so far as they come within the purview of general Australian ichthyology, are at present receiving, it has seemed worth while to record these notes, and, though their incidental nature is fully realised, to give them in enough detail to render them reasonably self-sufficient memoranda, available when the need for them arises.

(*b*) Additions to the Tasmanian list: *Exonautes cribrosus, Solegnathus robustus.*

(*c*) Descriptions of a new species of *Galaxias,* and a new species of *Agrostichthys,* the latter, incidentally, constituting the first Australian record of the family Agrostichthyidæ.

Except where otherwise stated, the registration numbers are those of the Queen Victoria Museum, Launceston, Tasmania.

Regilophotes güntheri (Johnston).

Lophotes güntheri Johnston, Pap. and Proc. Roy. Soc. Tas., 1882 (1883), pp. xlv., 142, and 176.

Regilophotes güntheri (Johnston), Whitley, Rec. Aus. Mus., XIX., I., Aug., 1933, p. 72.

Johnston's type of *Lophotes güntheri* was obtained "near Emu Bay," North-Western Tasmania. A contemporary news-

paper account of it, *ex* Johnston MS., has been made available by Whitley (1928, p. 50).

Australian and New Zealand records of Lophotidæ are few, Whitley (1933, p. 72) is of the opinion that the New Zealand records (Waite, 1914) of *Lophotes cepedianus* and *L. fiskii*, and the Victorian record (Kershaw, 1909) of *L. cristatus* Johnson, a Madieran species, probably all refer to Johnston's *L. güntheri*. Remarking that "the very distinct Australian genus evidently requires a new name," he institutes *Regilophotes* gen. nov.: orthotype, *Lophotes güntheri* Johnston, 1883.

A topotypical specimen of *Regilophotes güntheri* (Johnston) is in the Australian Museum, Sydney; Regd. No. B. 5776 (*fide* Whitley).

As any particulars relating to this rare fish are of interest, I give below such information as I have been able to collect on a topotypical specimen caught, on rod and line, at Cooee Creek, near Burnie, by Mr. P. Saunders, on 23rd September, 1931, and forwarded, through the kind offices of the late R. S. Sanderson, to the Museum. Unfortunately, the specimen, which had been exhibited for some time in a fish-shop, was found by the taxidermist to whom it was handed on its arrival to be beyond preservation.

In a letter dated 1st October, 1931, acknowledging the receipt of some observations on, and measurements of, the specimen, Mr. Sanderson made the following interesting comments:

> "The close approximation to each other of the 1882 and 1931 specimens is very striking, but apart from that I can say positively that the two specimens might well be regarded as merely two units of a mass-production so much do they resemble one another. I saw the 1882 specimen on the rocky beach—about opposite the present Burnie Hotel—very shortly after some lads had discovered it (if I remember rightly it was not caught—at least, not by hook and line, and where it was lying was no place for a seine net), and have always retained a clear mental impression of its remarkable appearance. Consequently I had no hesitation in identifying the fish when called downstairs to look at the strange creature which some boys had brought in."

Speaking of the degeneration of the specimen through keeping, Mr. Sanderson observed:

> "When first caught, the brilliant silvery gleam largely overpowered the salmon pink look which it had next day. The eye when fresh was a beautiful object—of great depth and luminosity—more like that of some animal (the 'mild eyed kine' of the classics, for instance), and the dorsal fin was well defined."

On its arrival in Launceston, the fish was in general colour a rich pink or red, frosted over with sheer silver. In some regions the silver was dominant, being scarcely influenced at all by the underlying red; in others the rich background blushed through the argentine wash; the net effect being now that of silvered purple, and now that of purpled silver. This pomp of general body-colour was elegantly relieved by the lustrous brown-black of the head-region (particularly the opercle) and by the limpid dark-brown of the eye.

Some dimensions of the 1931 specimen (with corresponding measurements of the 1882 specimen in parentheses): Length, 44 inches (43¾ inches); depth behind shoulder, 8⅝ inches (7¾ inches); length of pectoral ray, 2 inches (2¼ inches); diameter of eye, 2 inches (2 inches); greatest thickness of body, 1¾ inches (1⅝ inches).

PHYLLOPTERYX FOLIATUS (Shaw).

Syngnathus foliatus Shaw, Gen. Zool. (Pisc.), V., 2, 1804, p. 456, Pl. clxxx. (*fide* Sherborn).

Phyllopteryx foliatus Günther, Cat. Fish. Brit. Mus., VIII., 1870, p. 196; *id.*, McCoy, Prod. Zool. Vict., dec. VII., 1882, pp. 19-20, Pl. lxv., Figs. 1, 1a, 1b.

Phyllopteryx altus McCoy, Prod. Zool. Vict., dec. VII., 1882, p. 20.

(Text Figure 1.)

McCoy (1882) described and figured *Phyllopteryx foliatus* as having two small tags depending from the ventral surface of the snout. He notes (p. 19) the occurrence of "two minute spines on upper edge of snout, considerably nearer to the eye than the tip, and two slender filaments (often united) on under opposite side"; and his natural size, coloured representation of a "moderate specimen" (Pl. 65, Fig. 1) depicts these tags as two separate brown ribbon-like appendages, in the position described, and measuring, roughly, 7 mm. long and 0·5 mm. wide.

The presence of these tags has not, I think, been recorded by any other observer; and Waite and Hale (1921), in reviewing the Lophobranchiate material of the South Australian Museum, state (p. 315): "The small tags, as figured

by McCoy, beneath the snout, are not present in any specimen we have seen."

In a specimen (Reg. No. 952) netted at Stanley, North-West Coast, by Mr. T. B. Smith on 2nd October, 1932, one of these tags occurs, plastered on to the right side of the snout. Length, about 10 mm.; colour, black. Though quite narrow proximally, it expands distally to a width of about 2·5 mm.; its general shape suggesting a stalked, narrowly ovate-acuminate leaf. It would hardly be described as a "slender filament": though this expression applies quite well to the appendage as figured by McCoy. (See Text Fig. 1.)

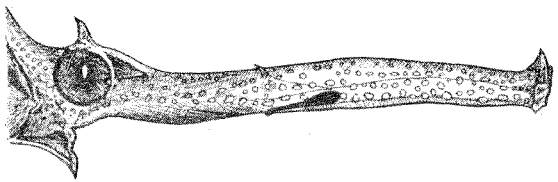

Fig. 1. *Phyllopteryx foliatus* (Shaw): Snout, showing Tag. (About natural size.)

An examination of this and other Tasmanian specimens suggests the following additions to, and enlargements upon, the excellent description of the species given by Waite and Hale.

Small spine on the nape, about midway between the occipital and nuchal appendage-bearing spines; sometimes a second, smaller, more anterior spine. Of the two small spines on the upper surface of the snout, one is commonly in advance of the other. "A small" bifid "spine on the front edge of the orbit." "A small patch of bristle-like spines below the hinder part of the orbit and a row of spines on the lower edge of the eye occasionally present," the bristle-like patch regularly including, in Tasmanian specimens, at least one conspicuous backwardly directed spine. Sometimes a row of small spines running forward along the supraorbital ridge from the two large supraorbital spines (which may be secondarily spined, and may have small spines round their bases). Occipital spine commonly with four distal spikes. Spines on dorsal body-ridge "strongest alongside the fin and almost obsolete on the dorsal arch," but usually well developed in advance of the latter. Of the spines on the paired ventral body-ridges, that of the antepenultimate body-annulus is much stronger than any others,

and is generally serrated; and that on about the fourth body-annulus is larger than its neighbours. "A pair of spines in front of the lower half of each pectoral base," with occasionally several smaller spines between them and the fin. Two or three spines above superior margin of preoperculum, that situated nearly below the appendage-bearing occipital spine being the largest. The inferior nuchal region in advance of pectorals, which McCoy describes as "swollen conically," tends to form, in dried specimens, a subrectangular platform: this bears spines at its posterior angle (commonly two pairs), at its anterior angle (one pair), and occasionally along the longitudinal diagonal (several rows; spines small). Total length reaches 388 mm. Appendage-bearing spines may be spotted or blotched with lighter colour, these spots and blotches being, like those on snout and elsewhere, translucent in dried specimens.

All the Tasmanian specimens that have come under my notice are of the deep-bodied type, in which the greatest depth of the body is equal to or exceeds the length of the snout, or the equivalent of about 10 body-rings, as against barely 0·75 of the length of the snout, or the equivalent of about seven body-rings, as in Shaw's original figure of *S. foliatus*. McCoy's *P. altus*, which is based on this feature, and on the marked difference in colour between the Victorian specimens, as shown in his own plate of *P. foliatus*, and the Tasmanian specimens, as shown in the painting by Mrs. Meredith (1880), has now been merged, seemingly with pretty general consent, with *Phyllopteryx foliatus* (Shaw): it is possible, however, that a survey of an adequate series of Tasmanian and mainland specimens might establish the validity of McCoy's species.

CEPHALOSCYLLIUM ISABELLA (Bonnaterre).

Squalus isabella Bonnaterre, Tabl. Encycl. Meth., Ichth., 1788, p. 6.

Scyllium laticeps Duméril, Rev. et Mag. Zool. (2) V., 1853, pp. 11 and 84, Pl. iii, Fig. 2 (head).

Cephaloscyllium isabella Gill, Ann. Lyc. Nat. Hist.; N. York, VII., 1862, p. 412.

In dealing with *Cephaloscyllium isabella*, Lord and Scott (1924, p. 22), after giving "Reference:—Waite, Trans, N.Z. Inst., 1909, XLIX., p. 384; McCulloch, 'Endeavour' Scientific Results, 1911, p. 6"—observe: "Recorded by McCulloch

from East Coast of Flinders Island, Bass Straits." McCulloch (*loc. cit.*) states: "A small example is in the collection which was trawled off the east coast of Flinders Island, Bass Strait."

As Lord and Scott's synopsis constitutes the most recent revision of the fish-fauna of Tasmania, and will form, it may be presumed, the basis for future work, it is perhaps worth while to call attention to the fact that this species, as *Scyllium laticeps*, is accredited to Tasmania by Günther (1870, p. 404), and appears in Johnston's list of 1882 (p. 138) and 1890 (p. 39).

It is apparently fairly common in Tasmanian waters. A specimen, having a total length of 885 mm., was secured in a graball at Penguin, North-West Coast, by Mr. W. J. Beaumont, on 18th June, 1933, and was received at the Museum (Reg. No. 964) the next day. It may be remarked, in passing, that this shark, after having travelled to Launceston by train in a sack, exhibited distinct evidences of life while being examined, and on being placed in fresh water at 4.15 p.m. on 19th June, revived sufficiently to breathe quite regularly and to move the pectoral fins and the tail. A specimen, 961 mm. in total length, was found by me washed up on the beach at Ulverstone, North-West Coast, on 4th August, 1933. Mr. J. A. Begent, B.Sc., informs me that this shark is frequently met with at Stanley, North-West Coast, where it is commonly referred to as the "Nurse" or "Grey Nurse"—a rather unfortunate vernacular name in view of the well-established association of "Grey Nurse" with species of *Carcharias*, including our own *C. arenarius*.

Urolophus viridis McCulloch.

Urolophus viridis McCulloch, Biol. Res. "Endeavour," IV., 4, 1916, p. 176, Pl. li.

It is of interest to note the presence in the Museum of an Old-Collection spirit-specimen (Reg. No. 971a) of this species, dating back at least 36 years, and originally determined as *Narcine tasmaniensis*. Total length, c. 197 mm.; disc-width, c. 123 mm.

Anguilla reinhardtii Steindachner.

Anguilla reinhardtii Steindachner, Sitzb. Akad. Wiss. Wien, LV., I., 1867, p. 15, Figs. a-b.

Anguilla marginipinnis Macleay, Proc. Linn. Soc. N.S. Wales, VIII., July 17th, 1883, p. 210.

Anguilla reinhardtii is not included in either of Johnston's lists; and Günther (1870, p. 27) gives as its range "North-eastern Australia."

This species is, however, accredited to Tasmania by Lord (1922, p. 64), Lord and Scott (1924, p. 36), and McCulloch, "Rivers of Eastern Australia (Queensland to Tasmania)" (1929, p. 64); but on just what records these attributions are based I am unable at the moment, through lack of literature, to determine.

On the other hand, Schmidt (1928) says of *A. reinhardtii* (p. 193): "in Tasmania it has not yet been observed"; and in his chart of "Distribution of the Australian eels according to the examination of a number of samples consisting of about 900 specimens" (Fig. 13) he also represents our only species as being *A. australis*. Among the 928 specimens of *Anguilla* examined by Schmidt were "51 from Tasmania, including Flinders and Vansittart Islands" (p. 192).

In view of the element of uncertainty introduced by the statement of so eminent an authority on the genus *Anguilla* as Schmidt, the following facts seem worthy of record.

In the Museum are three long-finned eels from Longford, 20.3.1908; Cataract mill-race, Launceston, 25.8.1908; and "near Launceston," 1928 (Reg. Nos. 946, a, b, and c). These specimens, which were preserved on account of their unusually large size, measure 1635, 1525, and 1531 mm. in total length.

In 1932 I brought these specimens under the notice of Professor Schmidt, and forwarded to him a note on their $\frac{a-d}{t} \times 100$ values (a = length to vent; d = length to origin of dorsal fin; t = total length). The factors for these three specimens are, as nearly as can be determined, 11·4 (a = 688 mm., d = 501 mm., t = 1635 mm.), 11·2 (a = 647 mm., d = 476 mm., t = 1525 mm.), and 10·8 (a = 682 mm., d = 517 mm., t = 1531 mm.). Schmidt determined the $\frac{a-d}{t}$ percentages for *A. australis f. occidentalis* as from − 1·5 to + 4·0, average 1·27; and for *A. reinhardtii* as from 7·8 to 13·2, average 10·72.

Concerning these eels, Professor Schmidt remarked (*in litt.*): "From the $\frac{a-d}{t} \times 100$ values stated by you, I have no doubt that the specimens really belong to this species" [*A. reinhardtii*]. At the same time, he called attention to the possibility of *A. aucklandi*, whose known range is sur-

prisingly restricted, reaching our waters, stating: "There seems to be reason to keep a sharp look-out for this species in Tasmania."

Without an anatomical examination, there is little to distinguish *A. reinhardtii* from *A. aucklandi*. On the whole, however, the evidence afforded by external features and teeth seems to indicate that the present specimens are to be relegated to the former species.

Unfortunately the death during the present year of Professor Schmidt prevented the completion of an arrangement I had entered into with him to submit for his detailed examination a further series of Tasmanian specimens.

Fishermen inform me that both *A. reinhardtii* and *A. australis* are common in Tasmania, the opinion commonly being held that the distribution depends upon the nature of the river, either as a whole or in given sections, the former species preferring a sandy or gravelly, the latter species a muddy, bottom.

In his paper cited above Schmidt remarks (p. 193): "It would be useful in the work of further research if zoologists or other interested parties in Australia would endeavour to ascertain the length and weight attained by *Anguilla reinhardti*." After quoting reports of eels up to 30 lb. in weight from "Eastern Victoria," and of up to 20 lb. from the Tambo River, East Gippsland, Victoria, he observes: "It will be apparent from the above that I have not personally seen any specimens of *Anguilla reinhardti* over 135 cm. in length and 6·7 kilograms in weight. It is most likely, however, that the larger eels, of 20 or 30 lb. weight, noted above belong to this species rather than to *Anguilla australis*. In any case, it is remarkable that eels of this size should be specially noted as occurring only in the eastern part of the State of Victoria, for *Anguilla australis* is, as we have seen, extremely common also in the western part."

The three Museum specimens of *A. reinhardtii* have, as already noted, a total length of 1635, 1525, and 1531 mm., as preserved. The register records that the weight of the Longford specimen (Reg. No. 946a) was 34 lbs.; of the Cataract mill-race, Launceston, specimen (Reg. No. 946b) 28 lbs.; while the weight of the specimen from "near Launceston" (Reg. No. 946c) is entered as "said to be 42 lbs."

It should be observed that Johnston (1883) says of *Anguilla australis*, "Reaches to an immense size in the South

Esk River" (p. 133); and, again, "Some of the eels have been taken in the Ringarooma and South Esk Rivers over 30 lbs. in weight and over 20 inches in girth" (p. 61).

Mr. I. Tyler, fishmonger, Launceston, informs me that there passed through his hands, during the latter half of 1932, a short-finned eel, caught at the Power Station, South Esk River, near Launceston, that measured about 5 feet in length, and weighed 36 lb.

SOLEGNATHUS FASCIATUS (Günther).

Solenognathus fasciatus Günther, Rept. Voy. "Challenger," Zool. I., 6, 1880, p. 30, Pl. xiv., Fig. B.

The locality of this species, the type of which was secured by the "Challenger" off Twofold Bay, is given by McCulloch (1929) as New South Wales.

Its appearance in the Tasmanian lists of Lord (1922) and Lord and Scott (1924) is apparently based on the collection by the "Endeavour" of specimens "South-east from Babel Island, off Flinders Island, Bass Strait" (McCulloch, 1911).

In these circumstances, it may be noted that the Museum collection includes a specimen (total length, c. 350 mm.) from Scamander, East Coast (Reg. No. 951z).

GALAXIAS AFFINIS Regan.

Galaxias affinis Regan, Proc. Zool. Soc., Lond., 1905, II., (April 5th, 1906), p. 380, Pl. x, Fig. 1.

This species (type-locality, Lake St. Clair) is omitted from the published Tasmanian lists, all of which are in need of revision.

EXONAUTES CRIBROSUS (Kner).

(Exocoetus) cribrosa Kner, Reise Novara, Fische, III., 1867, p. 328. Alternative name of *E. unicolor* Kner, regarded as possibly distinct from *E. unicolor* Cuvier and Valenciennes, (*fide* McCulloch, 1929).

Exonautes fulvipes Ogilby, Proc. Roy. Soc. Qld., XXI., 1908, p. 8.

On the afternoon of Tuesday, 13th May, 1930, a live flying-fish was captured at West Bay, River Tamar, by Mr. R. S. Allison, who in a covering letter says: "I was standing near the beach when the fish rose from the water and flew

a short distance, when the strong southerly wind threw it back on the rocks, where I ran and caught it."

The specimen, which has a total length, as a formalin preparation, of approximately 295 mm., appears to be a fairly typical example of *Exonautes cribrosus* (Kner). Reg. No. 975.

First record of the species—and, *fide* McCulloch (1929), of the family Exocoetidæ—for Tasmania.

Solegnathus robustus McCulloch.

Solenognathus spinosissimus Zietz, Trans. Roy. Soc. S. Aus., XXXII., 1908, p. 299 (not of Günth.).

Solegnathus robustus McCulloch, Zool. Res. "Endeavour," I., 1911, p. 28, Pl. ix., Fig. 2.

This species was described by McCulloch from a single specimen "from 37 fathoms off Flinders Island, South Australia, August 30th, 1909." Waite and Hale (1921), who regard the South Australian specimens determined by Zietz (1908) as *Solenognathus spinosissimus* Günther as belonging to this species, state (p. 313): "Specimens are known from Corney Point, Pt. Lincoln, and Flinders Island [i.e., Flinders Island, S. Aus.], the longest being 364 mm."

The present notice of a dried specimen from Blue Rocks, Flinders Island, Bass Strait (Reg. No. 953), constitutes the first record for Tasmania.

It is perhaps as well to point out that the present note in no way affects *Solegnathus spinosissimus* (Günther), the position of which on our list is well established: a specimen of this species from Tamar Heads is in the collection (Reg. No. 952).

In dealing with *S. robustus*, Waite and Hale point out that whereas McCulloch (1911) gives the head as "3·7 in the trunk," his figure shows 2·7 is intended: in the present specimen the value is only 2·4. McCulloch says, "Length of tail a little less than the distance between the vent and the pectorals": but Waite and Hale observe, "The length of the tail is subject to slight variation; in two of our examples it is less than the distance between the vent and the pectoral fin, in the third it is as long as the trunk." In the Tasmanian example the tail is 1·08 times the trunk. As, however, the trunk is relatively shorter in this specimen than in the others described, the tail is not significantly

longer, relative to the total length, than in McCulloch's specimen, the ratio in that case, calculated from the other proportions given, being 2·3 (2·31), and in the present instance 2·4 (2·37).

The greater relative depth of the snout, and of the tail immediately behind the dorsal fin; the radiating rows of spines on the scutes; and the more imperfect attainment of the dorsal profile by the main lateral row of spines (an attainment delayed, in the specimen, till about the twenty-fifth caudal annulus)—the chief characters that serve to distinguish this species from *S. fasciatus*—are well marked in the present specimen. The length of the base of the dorsal fin, which McCulloch gives as "almost equal to the distance between the tip of the snout and the posterior border of the eye," is here 0·98 of that distance; while, it may be observed, the corresponding value in the case of *Solegnathus fasciatus*, determined from the specimen from Scamander, previously mentioned, is only 0·79.

Total length of specimen, 358·5 mm.

Family Galaxiidæ.

Genus Galaxias Cuvier, 1816.

Galaxias Cuvier, Regn. Anim., ed. 1, II., "1817" = Dec. 1816, p. 183. Haplotype, *Esox truttaceus* Cuvier.

Galaxias cleaveri, sp. nov.

[Plate VI.]

(a) History of the Specimen.

The history of this specimen is of some interest, both in itself and for the incidental light it throws upon the habits of the Galaxiidæ generally.

On the 23rd December, 1932, a eucalyptus stump, about 2 feet through, was blown out of the ground by explosives at West Ulverstone, North-West Coast, and on cutting up some of the wood for household purposes on 8th January, 1933, Mr. F. Cleaver found the fish in a root about 8 inches in diameter. The root, which was just damp, contained a cavity, in the middle of which the fish was lying. Mr. Cleaver says he has no idea how it got into the log, which was prone on the surface of the ground. He states: "There is no running water for about a quarter of a mile, but all through the

winter there is water lying in ponds close to where the stump stood in swampy ground."

The fish was kept alive in a tin of water, the tin being sunk in the garden, with the top flush with the ground. On one occasion, the specimen, which was always prone to jump out of a vessel in which it was placed, was missing from its tin, and was later found happily wandering about, some distance away, among the tomato-plants. While in its discoverer's possession, its longest spell out of water was 12 hours. As far as Mr. Cleaver is aware, no other fish of the same kind has been met with in the vicinity.

At the suggestion of Mr. H. Rodman, the fish was secured for the Museum. It was forwarded from West Ulverstone, by service car, in a bottle of water, and came to hand alive on Tuesday, 4th April, 1933.

On its arrival at the Museum, it was transferred to a bucket filled to a depth of about 4 inches with tap-water, in which were placed bread-crumbs—an item of diet to which Mr. Cleaver had found it readily took. During the afternoon it was placed on a table, where it remained, occasionally leaping, at no great height, for a distance of several inches, for seven minutes, every now and again gulping in a mouthful of air. Though it exhibited no marked signs of distress, retaining the normal upright position without difficulty, it is of interest to note that, seven minutes after it was returned to the water, its rate of respiration was 42 per minute, whereas in another eight minutes the rate had increased to 56.

After being kept alive in its bucket for just over a week, the specimen was embedded at 2.30 p.m. on Wednesday, 12th April, in well-moistened earth, where it remained for three-quarters of an hour, apparently without suffering any discomfort, but becoming decidedly darker in general colour in harmony with its surroundings. At 3.15 p.m. it was taken out of the damp earth, washed, drained of excess moisture, and placed in a perfectly dry watering-can, the top of which was covered with newspaper perforated with several holes.

When examined the next morning, Thursday, at 9 o'clock, it was still very evidently alive, but apparently disinclined to make much movement. On being taken up, however, it at once began to move in very lively fashion—being excited, very possibly, by the warmth of the hand—and, when placed on the table, continued vigorously to leap about. After a few moments it was returned to its can.

On Friday morning the fish was still obviously alive, but during the day it began to shrivel up. By Saturday morning, at 9 o'clock, it presented much the appearance of a dried-up worm, the whole body being shrunken and wrinkled. As, after repeated tests, it gave no obvious evidence of life, it was placed in formalin. Immediately on coming into contact with the liquid, it revived, and demonstrated its vitality by several vigorous plunges, only to be overcome, in a few moments, by the preservative.

In this test, therefore, the fish first remained alive for three-quarters of an hour in damp soil. It then lived in a dry vessel from Wednesday, 12th April, at 3.15 p.m., till Saturday, 15th April, at 9 a.m.—i.e., for 65¾ hours. Even then, as has been noted, it was not dead, but, as events proved, merely very quiescent. It seems not at all unlikely that had the fish been kept even barely moist, it might have survived for a longer, possibly much longer, period.

(b) Ability of the Galaxiidæ to Live Out of Water.

The New Zealand *Neochanna apoda*, of course, burrows in damp clay, and it has been stated that it soon dies if placed in clear water.

T. S. Hall (1900) gives an account of a burrowing *Galaxias* from Strahan, Tasmania, found in "decayed peat and sand, eight inches below the surface." The only description given of the fish, the species being undetermined, is as follows: "It is a slender form, and is marked by chevron-shaped dark bands of small spots, which mark out the myotomes in the middle of the body, but become irregular towards the head and tail. Its total length is 44 mm." He also notes: "Fish are reported as being occasionally dug up in the button-grass country, on the west coast of the island, and are stated by a miner to have no eyes, though otherwise similar."

I have spoken with several people who have encountered this burrowing *Galaxias* on the West Coast; but I have not so far been able to secure a specimen. I am informed that about 30 years ago numbers were dug up in the grounds of the State school residence at Strahan.

It seems not unlikely that our little native trout generally, living as they often do in small creeks that periodically become partly or wholly dry, have been driven by the conditions of their existence to acquire, to a greater or lesser extent, the power of burrowing and the ability to survive

for considerable periods in damp earth. Mr. R. Slater, of Kelso, informs me that a *Galaxias* is sometimes met with on his estate, some distance below the surface in dried-up waterholes.

That native trout will frequently revive on being thrown into water, after lying for some hours in a bag or basket, is a fact with which many fishermen are familiar. A specimen of *Galaxias truttaceus*, placed in the dry vessel used previously in the experiment with Mr. Cleaver's fish, was found to be very much alive after 19 hours. On being supplied with water, it opened its gill-covers widely, and in about a minute was swimming round blithely, and breathing in normal fashion. If its degree of vitality after 19 hours afforded any criterion, it would probably have survived in the dry state for a considerably longer period. Further experiments along similar lines on the various members of the genus would probably throw much interesting light on their habits.

(c) Description: Galaxias cleaveri, sp. nov.

General form, moderately stout, subcylindrical.

Depth of body (14·2 mm.), 8·4 in total length (119 mm.), or 7·6 in standard length (108 mm.). Length of head (17·5 mm.), 6·2 in standard length. Eye small, its diameter (2·5 mm.) 8·8 in length of head, or 2·0 in length of snout (5 mm.), or 2·4 in interorbital width (7 mm.). Teeth in the jaws subequal, except for one enlarged lateral canine in each side of lower jaw. Lower jaw projecting; maxillary extending to below anterior third of eye. Branchiostegals, 9.

Dorsal III + 8; the length to its origin (76 mm.) 4·0 times length to origin of pectoral (19 mm.), or 2·1 times space between base of pectoral and origin of ventral (37 mm.): distance from origin of dorsal to end of caudal peduncle (32 mm.) 3·7 in total length: length of base of dorsal (14 mm.) twice interocular distance, or nearly equal to greatest depth of body. When laid back, dorsal reaches beyond superior procurrent caudal rays, but only to level of inferior procurrent caudal rays.

Anal III + 7; its origin (82 mm. behind snout) behind the origin of dorsal by 1·2 times length of snout, or by 0·75 of depth of caudal peduncle; its base (13 mm.) 1·08 times base of dorsal. When laid back, anal reaches about

to middle of inferior length of caudal peduncle, and extends behind laid-back dorsal by a distance equal to length of snout.

Pectoral with 14 rays; its length (11 mm.) 0·6 of length of head, or 2·2 times length of snout; extending 0·3 of the distance from its base to base of ventral.

Ventrals 6-rayed; their origin (56 mm. behind snout) about equidistant from anterior margin of eye and base of caudal, or about equidistant from base of pectoral and posterior sixth of base of anal; their length (8·5 mm.) rather less than half length of head, or 2·2 in distance between their origin and origin of anal.

Caudal with 22 major rays; rounded subtruncate, its most posterior point being (in alcohol-specimen) 3·6 mm. (i.e., rather more than half distance from tip of snout to posterior margin of eye) behind the vertical joining its postero-superior and postero-inferior angles. Superior procurrent rays of caudal begin 1·5 mm. behind base of dorsal, or 91·5 mm. behind snout; inferior procurrent rays begin immediately at distal end of base of anal, with which they are just continuous, or 95 mm. behind snout. Hence superior length of caudal peduncle (16·5 mm.) is 2·1 times depth of caudal peduncle, or 1·3 times length of base of anal, while inferior length (13 mm.) is 1·6 times depth of caudal peduncle, or equal to base of anal.

In life, general colour olivaceous, subtranslucent; undersurface in advance of ventrals greyish, behind ventrals greyish-green, immaculate. Snout dark-brown; rest of head, except ventral surface, which is greenish-yellow minutely and sparsely dotted with brown, is heavily blotched with brown, especially dorsally. Sides of body heavily barred and blotched with dark-brown; bars about 22, irregular, but tending to form forwardly directed chevrons with apex near midlateral line, bases of bars with irregular prolongations giving a somewhat reticulated effect, bars about equal in width to their interspaces; between and below bars some irregular blotches. Dorsal surface like lateral surface, but with more brown, the bars showing marked tendency towards confluence. Pectorals light greenish-grey, darker in proximal third. Dorsal, anal, and ventrals greyish or yellowish green, darker in proximal half or more. Caudal greenish, with dark spot at base. In the preserved specimen the ground colour has become opaque, and more yellowish olivaceous.

(d) Remarks.

The present species is distinguished from all the described Australian species in having the caudal rounded subtruncate. In general appearance, though not in size, it perhaps more closely approaches the South African *G. zebratus* than any other species; but apart from the improbability, on the grounds of distribution, of it being conspecific with this form, it is readily distinguishable from it by such characters as presence of enlarged lateral canines, much more backwardly placed dorsal, smaller pectorals, shorter head, &c.

It differs from all the Australian species, except *G. dissimilis*, in having 6-rayed ventrals. From *G. dissimilis*, the first published figure of which anomalous form has just been made available by Whitley (1933, Pl. xii., Fig. 2), it is at once separated by the normal, more forward position of the ventrals, size of the pectoral, character of teeth, &c.

In general form and in colouration it closely approaches *G. weedoni*. From this species it is distinguished chiefly by the rounded subtruncate caudal, different number of rays in the dorsal, anal, and ventral, shorter pectoral and ventral, projecting lower jaw, and smaller eye.

The extremely small size of the eye, the diameter of which is 8·8 in the length of the head, is remarkable: the average value of this ratio for the Australian species is about 4·7, the maximum (*G. affinis*) 5·5. According to Tate Regan (1906), the value for *Neochanna apoda* is 6-8. To what extent, if at all, the minute size of the eye might be correlated with the individual history of the specimen, it is difficult to say.

The ventrals are relatively small. The length of these is not regularly recorded in specific diagnoses: judging from figures, however, it would seem that their length is seldom, if ever, contained in the total length more than about 12 times, the average value being apparently about 9·5. In the present specimen this value is 14. Again, it is difficult to determine the likelihood of this being an individual character.

While it is with some diffidence that I venture to create, on the strength of a single specimen, a new species in a family so variable as the Galaxiidæ, this seems to be, on the available evidence, the only honest course, and is accordingly followed.

The species is named in honour of Mr. F. Cleaver, West Ulverstone, the collector of the specimen.

Described and figured from the unique holotype in the collection of the Queen Victoria Museum, Launceston, Tasmania; Reg. No. 938 HT.

Suggested vernacular name, Cleaver's Jollytail.

Family AGROSTICHTHYIDÆ.

Genus AGROSTICHTHYS Phillipps, 1924.

Agrostichthys Phillipps, Proc. Zool. Soc., Lond., 1924, II., p. 539. Haplotype, *Regalecus parkeri* Benham.

AGROSTICHTHYS BENHAMI, sp. nov.

[Plates VII. and VIII.; Text Figure 2.]

(a) Description.

General form very elongate, and very compressed; ribbon-like.

Greatest depth of body (17·5 mm.), which is immediately behind head, 46·3 in total length (811 mm.), or 46·2 in standard length (808 mm.). Depth at vent (14 mm.) 57·9 in total length. Thickness at greatest depth (6·6 mm.) 2·7, at vent (5·2 mm.) 3·4, and at distal end of body (0·9 mm.) 19·4 in greatest depth. Length of head (38·5 mm.) 21·1 in total length, or almost twice height of head (19·3 mm.). Eye large, its horizontal diameter (9·5 mm.) 1·7 in length of snout (16·2 mm.), which is 2·4 in length of head; about 1·5 times as far from maxillary plate as from dorsal profile of head. Preanal region (252 mm.) 3·2 in total length.

Upper profile of head gently and evenly convex. Actual length of maxillary plate (12 mm.) 1·6 times its actual width (7·6 mm.), but its horizontal extent (11·4 mm.) 1·2 times its vertical extent (9·3 mm.); plate with conspicuous striæ, those on anterior half forwardly concave, those on posterior half backwardly concave, the two sets divided in their superior third by a vertical subtriangular pit, and, behind it, a backwardly concave sulcus. Similar striæ on operculum, radiating from antero-superior angle; on suboperculum, radiating from antero-superior angle; on preoperculum, becoming distinct near the middle from a median sulcus that occupies most of the narrow anterior half or more, and fanning out distally; on interoperculum, running backwards and somewhat downwards.

Dorsal III (?) + c. 400. Three long, pale golden rays in crest-like nuchal section of dorsal; first 108 mm. long (i.e., 2·8 times head, or 2·3 in preanal region), second 70 mm., third 102 mm.; with nodes, placed irregularly (at least, in preserved specimen), clustered round with minute brownish pigment-spots, 3 nodes being traceable on first ray, 7 on second (where pigmented regions about equal their interspaces), 2 on third. As it is possible some of these filaments may be lost, the number is queried: I can, however, find no definite indication of the previous presence of others. In second section of dorsal there are 374 rays up to within 35 mm. of posterior end of body, beyond which point actual count is impracticable: calculation gives 401 as total. Rays to level of vent, 103. Membrane reaches to tip of rays, longest of which is 11 mm. Rays with small spine at base, and with a single linear series of 20-30 microscopic spines, on button-like supports, along each of the two flattened surfaces.

Pectoral with 8 rays; length 9 mm.; supported on basal lobe 3 mm. long, less than 1 mm. high.

Ventrals represented by two very low ridges, about 5 mm. long, contiguous and flush with body in front, diverging and rising behind to end in two subtriangular knobs, directed downwards and outwards; each knob, 1·25 mm. high, with two spine-like projections, of which the antero-internal is the larger. Knobs 5·5 mm. behind level of posterior end of base of pectoral. By moving the ridges, one or two longitudinal slits are disclosed at the base of their external walls. The specimen affords no evidence as to whether the knobs ever bore long rays, like those of *Regalecus;* nor, if so, how many.

The body of the specimen ends posteriorly in a vertical line, 1·7 mm. high, from both the superior and inferior ends of which runs back a free filiform process 3 mm. long. It is difficult to determine from the specimen whether, on the one hand, the extreme tip of the body is damaged, the threads being merely remnants of the body-wall, or whether, on the other hand, the body is intact, the threads relating to the caudal fin: the latter alternative, though not definitely established, has for convenience been selected in determining the length of the fish.

Lateral line appears externally as a ridge, more or less semicircular in section. Originates behind postero-superior angle of operculum; swings down, touching tip of longest ray

of pectoral, in a gentle, forwardly convex curve, to a point 40 mm. behind head, and below 28th ray of major section of dorsal, where it is 2 mm. above ventral margin of body; thereafter extends caudad virtually parallel with, but actually imperceptibly and continuously approximating to, ventral margin, its distance from which, at a point 25 mm. from posterior end of body, is 0·75 mm.; hence average distance of horizontal portion of lateral line from ventral margin is about 1/6th depth of body.

Near anterior end of each lower jaw, two small, closely opposed, conical teeth, directed backwardly; no teeth in upper jaw; a single elegant median vomerine tooth, about 2·5 mm. long, with five cusps, central cusp longest, directed somewhat backwards from the plane of the two pairs of lateral cusps, the proximal pair of which is the larger; beside and behind the median vomerine tooth, one delicate simple conical tooth, on each side. (See Text Fig. 2.)

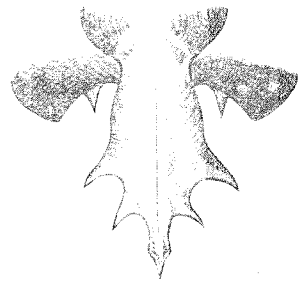

Fig. 2. *Agrostichthys benhami*, sp. nov.: The Vomerine Teeth. (About twelve times natural size.)

Mouth protractile to rather more than 1/5th length of head.

General colour (in formalin) greenish silver; body marked by faint dingy vertical bands, averaging 10 mm. wide and 40 mm. apart, formed by sparsely sprinkled brown pigment-cells; similar pigment-spots occur along whole superior margin of body. Head greenish; upper and lower lips narrowly margined with dark-brown; narrow bar of dark-brown behind, and parallel with, maxillary plate, continuous over dorsal surface of head with its fellow on the other cheek; some dark-brown elsewhere on top of head. Iris black, minutely but abundantly speckled with pale-green; pupil

green. Membrane of dorsal fin colourless, with occasional irregular patches of dingy-orange. Pectoral fin pale-green.

Scaleless. Body everywhere covered with subcircular cushion-like structures, 0·6-0·9 mm. across, interspaces 0·1-0·3 mm.

It is with pleasure I associate with the present species the name of Professor W. B. Benham, whose description of his *Regalecus parkeri* provides the first account of a representative of the interesting family Agrostichthyidæ.

Described and figured from the unique holotype, from Ulverstone, North-West Coast, Tasmania, in the collection of the Queen Victoria Museum, Launceston, Tasmania (Reg. No. 906 HT).

Suggested vernacular name, Benham's Streamer-Fish.

(b) General Remarks.

Benham's type of his *Regalecus parkeri* was washed ashore in Deborah Bay, near Port Chalmers, in Otago Harbour, New Zealand, in or about November, 1902. In an addendum to his paper, Benham (1904) noted the capture at Stewart Island of a second example, 75 inches long. Phillipps (1924) recorded a specimen, approximately 9 feet long, secured at Island Bay, Wellington, New Zealand, in July, 1921. No other records have come under my notice. According to McCulloch (1929) and Whitley (1933), the genus *Agrostichthys* has not hitherto been recorded for Australia. The specimen here described was obtained at Ulverstone, North-West Coast, Tasmania, by Mr. H. G. K. Wells, and was donated to the Museum on 14th February, 1908.

The creation by Phillips of a new genus, *Agrostichthys*, and a new family, Agrostichthyidæ, for Benham's *Regalecus parkeri* marks an important step towards a satisfactory arrangement of the Australasian Allotriognathi. Genus *Agrostichthys* Phillipps, 1924; "Body enormously elongated to 22½ times length of head; nearly 42 times greatest depth and 45 times depth at vent; 390 to 525 dorsal fin rays; teeth on head of vomer and on lower jaw; ventral reduced to a single filament or marked by a minute depression if absent. Operculum extended downwards and backwards with suboperculum below it; maxillary plate longer than deep; upper profile of head slightly convex; mouth protractile to ¼ length of head." A key for the differentiation of the families Trachypteridæ, Regalecidæ, and Agrostichthyidæ,

formulated by Phillipps (p. 539), has been improved, and extended to cover the family Lophotidæ by Whitley (p. 73), who has also revised the Australian and New Zealand Ribbon-Fishes, of which he admits only four species, namely, *Trachipterus arawatæ* Clarke, *Regalecus pacificus* Haast, *Agrostichthys parkeri* (Benham), and *Regilophotes güntheri* (Johnston).

(c) Comparison of A. parkeri and A. benhami.

A comparison between Benham's type of his *Regalecus parkeri*, as described and figured, and the present specimen reveals the following differences.

In *A. parkeri* the lateral line comes into virtual parallelism with the ventral border of the body at "about 1¼ in. (28 mm.) behind the head," i.e., a little more than half (0·53) the length of the head (53 mm.) behind the head, and, judging from the figure (pl. ix), about below the 11th ray of the main portion of the dorsal. In *A. benhami* the corresponding point is 40 mm., i.e., rather more than (1·04 times) the length of the head (38·5 mm.) behind the head, and is below the 27th ray.

In *A. parkeri* the greatest depth of body is at the vent. In *A. benhami* it is immediately behind the head, and the depth at the vent is only 80 per cent. of the greatest depth, the falling-off behind the nuchal region being quite striking, even on casual examination. It may be observed that in his diagnosis of the genus Phillipps gives the depth at the vent as being about 93 per cent. of the greatest depth of the body; and speaks of his specimen as being "2½ in. high along the greater part of the anterior portion of the body."

In *A. parkeri* the ventrals are represented by "a pair of minute knobs just behind the level of the pectorals on the throat." If Benham's figure is trustworthy, "just behind the level of the pectorals" is to be interpreted as "just behind the level of the beginning of the base of the pectorals." In *A. benhami* the knobs are wholly behind the base of the pectoral by a distance 1·6 times distance of base of pectoral from ventral border of body.

In *A. parkeri* the crest-like nuchal portion of the dorsal comprises 7 rays; in *A. benhami* apparently only 3.

In *A. parkeri* the pectoral has 10 rays, in *A. benhami*, 8. I can in no way reconcile the large barrel-like lobe, intersecting the lateral line, and surmounted by short terminal rays,

as figured by Benham, with the delicate acuminate pectoral, supported on a small basal lobe, of the present specimen, which, however, is closely approached by that in Phillipps' photograph.

In *A. parkeri* there is "on the palate a small median tooth." In *A. benhami* there are one median and a pair of much smaller lateral vomerine teeth.

In *A. parkeri* the iris has a black border enclosing a vertical oval silver region. In *A. benhami* it appears to be wholly black, speckled with green.

Minor points of difference, as judged from Benham's plate, include: (*a*) distance of eye from maxillary, expressed in terms of distance of eye from dorsal profile of head, is about twice as great in *A. parkeri* as in *A. benhami*; (*b*) posterior border of maxillary, which is shown as being backwardly convex in *A. parkeri*, is backwardly concave in *A. benhami*, in which latter, also, the postero-inferior section of the border is more nearly rectilinear; (*c*) some differences in arrangement of striæ on maxillary and operculum; (*d*) the depression extending forward in front of the upper fourth of eye is narrowly subtriangular in *A. parkeri*, broadly oval in *A. benhami*.

The data relating to Phillipps' specimen are too few and indefinite to permit of a detailed comparison being made between it and the present specimen.

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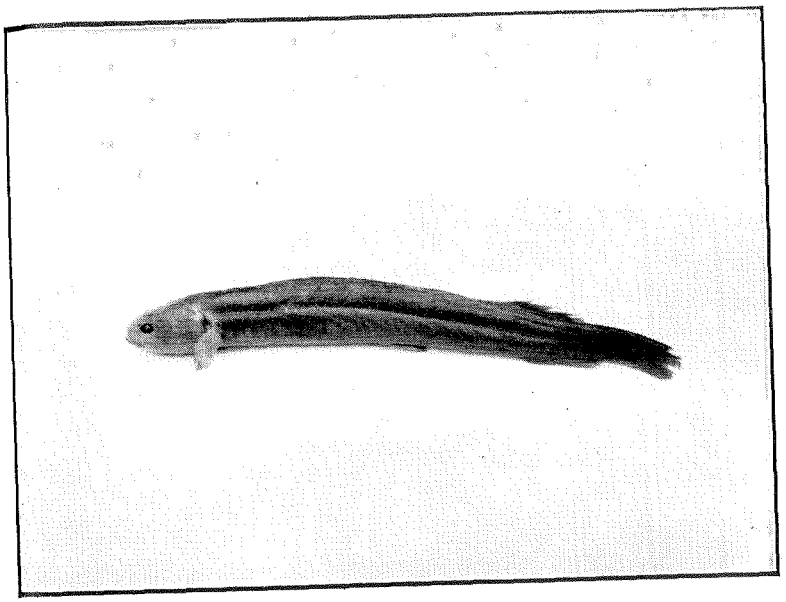

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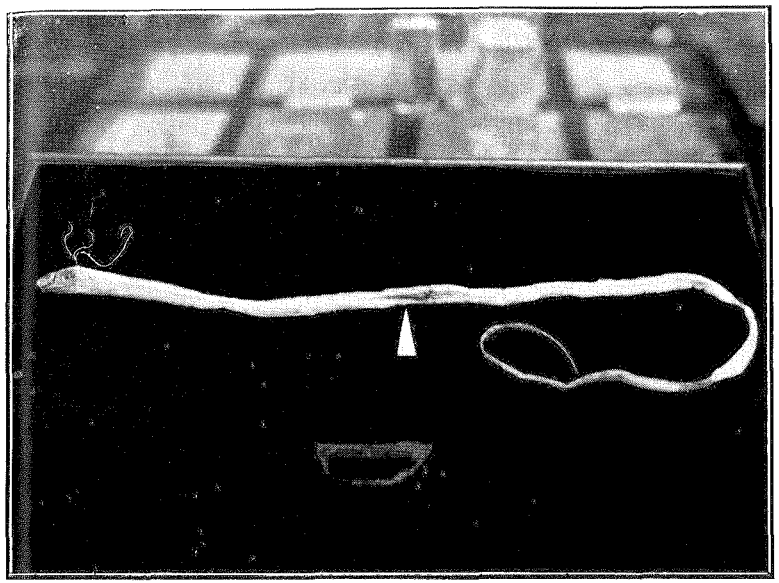

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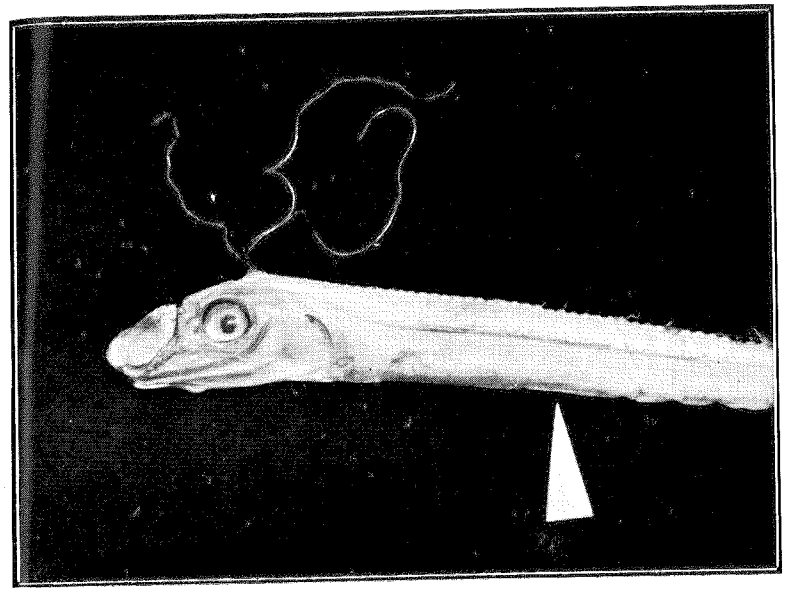

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EXPLANATION OF PLATES.

PLATE VI.—*Galaxias cleaveri*, sp. nov. Holotype. About natural size.

PLATE VII.—*Agrostichthys benhami*, sp. nov. Holotype; total length 811 mm. The arrow-head marks the position of the vent.

PLATE VIII.—*Agrostichthys benhami*, sp. nov. Anterior end of holotype, slightly enlarged. The arrow-head marks the point at which the lateral line comes into virtual parallelism with the ventral margin of the body.