

SECOND REPORT ON THE FISHES OF THE IRISH
ATLANTIC SLOPE.

BY

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i.—INTRODUCTORY NOTES.

Many of the fishes which inhabit the deeper water of our Atlantic coast are unfamiliar to fishermen, and are not described in the books to which the general reader has ready access. It is therefore our intention to give an account and figure, or sketch, of all except the well-known kinds. Experience of the amount of time of which we can dispose for work of this sort has made it evident that we must either put out our observations piece-meal or defer them to the Greek Calends, and we therefore propose to publish a note on each family or other group as soon as it is ready. It follows that the notes will appear in no natural systematic order, but this will be a matter of unimportance to readers who are in any sense ichthyologists and of indifference to others. We shall not, in all instances, attempt to define families of fishes, nor, except in the briefest manner, to diagnose genera, since we hope that the general reader will be able to obtain from our figures as much knowledge of the grosser characters of the genus as he may care to possess.

In the citation of synonyms it seems best to adopt no hard and fast rule, for while in some cases it suffices to give references to a few of the principal and most accessible accounts of a species, in others a more or less complete list may be required.

In each successive note we shall endeavour to bring up to date information acquired as to fishes mentioned in previous reports.

METHODS OF PRESERVATION.—Some remarks made by Koehler (1896), on the action of formaline on the pigments of deep-sea Fisheries, Ireland, *Sci. Invest.*, 1906, V, [Published, December, 1908].

fishes require attention. With all that he says as to the utility of this preservative in regard to form and tissues we are in complete accord, but he accuses it of destroying the pigments, especially those of dark colour, which last he regards as less assailable by alcohol. Our experience is that weak formaline, say 5 per cent. of the commercial 40 per cent. solution, or about 2 per cent. of formaldehyde, has no more effect on dark fish-pigments than alcohol, and has the further advantage of not dissolving the red and yellow pigments to a very appreciable extent for some considerable period. Exposed to the light these paler pigments rapidly disappear even in formaline; but if the specimens are kept in light-proof vessels, or even wrapped in muslin, the warm colours can be studied with reasonable security some months after preservation, whereas the pigments to which they are due are extracted by alcohol in a few days. Blue colours are usually due to the optical properties of prismatic bodies overlying black chromatophores, and in such cases soon disappear or lose their brilliance in any preserving medium, though the indigo-blue or violet-blue of some deep-sea fishes is fairly permanent. When a blue or greenish-blue colour is due to an actual colouring matter, the latter is rather rapidly extracted by either alcohol or formaline, as in the case of some of the Labridae.

Koehler recommends that after due fixation in formaline, deep-sea fishes should be transferred to alcohol in order to save their dark pigments. Though we think the reason unsound, the advice is undoubtedly good, because formaline may under certain circumstances seriously attack the skeletal tissues, and in general it leaves the fins rather too stiff for easy counting of the rays without rupture of their membranes. In practice we transfer after a few weeks to a mixture of equal parts of alcohol 95 per cent. and formaline 5 per cent., but the permanent value of this medium has still to stand the test of time. It must, however, be noted that there are some fishes of which the natural external form is intolerant of alcohol. In the genus *Stomias*, for instance, the body is normally invested by a very definite gelatinous epidermic sheath, which is faithfully preserved by formaline; but even prolonged fixation in that medium will not save this essential part of the natural structure of the fish from immediate shrinkage and opacity on transference to alcohol. Such instances apart, it is well in transferring any fish from formaline to alcohol to observe the same precautions as are requisite in the proper preservation of fresh specimens, viz., successive dehydration in 30 per cent., 50 per cent. and 75 per cent. alcohol; because, as far as our experience goes, the fixation of form by formaline is not always absolute against alteration by strong alcohol.

RECORDS.—In the list of captures by the *Helga* given under each species, it must be understood that when the fishing engine is not mentioned the captures were effected by a beam-trawl of about 32 feet beam. Other nets mentioned were fished chiefly at the depths cited in each case; but, being open nets, they also fished during their descent and ascent. This applies, of course, equally to the trawl, at least during its ascent.

ii.—FAM. SCORPAENIDAE.¹

The British-and-Irish fauna comprises no truly littoral representatives of this family, but three more or less exclusively deep-water species occur regularly within the area. These are *Sebastes marinus*, *Scorpaena cristulata*, and *Scorpaena dactyloptera*. A fourth, *Scorpaena scrofa*, has to our knowledge been occasionally landed at British fishing ports from littoral waters in the Bay of Biscay, and is probably a not infrequent item of the catch of steam trawlers which work the coasts of Portugal and Morocco. It is known to occur in water of 187 fathoms depth, and may possibly range as far north as the southern part of the Irish Atlantic slope. Certain other deep-water *Scorpaenae* at present only known from the slopes of the African and North American plateaux, are not debarred by any known factor of distribution from occurrence within our area. These species are described and in some cases figured, by Lowe (1843-1860), Vaillant (1888), Goode and Bean (1895), Jordan and Evermann (1896-98), and Collett (1896), to whose works reference should be made if Scorpaenids, not mentioned in these notes, should be taken on our coasts.

For purposes of identification the species of *Sebastes* and *Scorpaena* hereinbefore mentioned may be briefly distinguished as follows:—

- A. Suborbitals not forming a conspicuous scaleless, superficial ridge.
Dorsal fin normally with 15 spines.²

Sebastes marinus.

- B. Suborbitals forming a more or less conspicuous scaleless, superficial ridge. Dorsal fin normally with 11 or 12 spines.

- (i.) Pectoral fins with at least the distal third of their lower rays free from the fin-membrane; suborbital ridges spineless, or with a single small spine. No skinny filaments or lappets on the head or body. No marked depression in the occipital region.³

Scorpaena dactyloptera.

¹ See Note added in press, p. 63.

² It is as well to remember that the length of the spines of the dorsal fin have no value for specific determination unless the size of the individual is taken into account, since the spines decrease in relative length with the growth of the fish. Appreciation of this fact becomes of greater importance in the case of spinous-rayed fishes which attain a huge size (cf. Boulenger, 1907).

³ The subdivision into several genera of *Scorpaena* adopted by American authors does not appear to us to be justifiable, but we think that there is some ground for treating *Helicolenus* (i.e., in our view *S. dactyloptera*) as a distinct sub-genus, characterised by the free lower pectoral rays, the feebly developed suborbital ridges, and the constant absence of skinny filaments or lappets on the head and scales. Our acquaintance with the majority of other *Scorpaenae* is so slight that we are not prepared to express any opinion as to the propriety of recognising other sub-generic groups.

(ii.) Pectoral fins with all rays connected by membrane throughout; suborbital ridges with several spines or groups of spines; skinny filaments or lappets more or less developed on the head and some of the scales of the body.

(a.) A well marked transverse depression in the occipital region; suborbital ridges moderately developed; head and preoperculum scaleless. *Scorpaena scrofa*.

(b.) Occipital region without a transverse depression; suborbital ridges strongly developed; sides of head and preoperculum, except upon the bony ridges, scaled.¹ *Scorpaena cristulata*.

In general remark of the distribution of these fishes it may be said that *Sebastes marinus* is primarily an Arctic form which does not, on our side of the Atlantic, range further south than the coasts of Denmark and the north of England. We have no reliable record of its occurrence on any of the western coasts of the British Isles. *Scorpaena dactyloptera* is present on the Atlantic slope from the Canaries to Norway, and has in the North Sea a local *sedes* in the deep hole off Troup Head in Aberdeen, from which place, presumably, young examples have been known to wander as far south as the Humber. *S. cristulata* is known from the Bay of Biscay to the S. W. coast of Ireland, and all three species occur also at suitable depths off the coast of North America. *S. scrofa* has not so far been traced north of the Bay of Biscay as a littoral form, and as a deep-water fish has as yet only been recorded off Madeira and off Cape Spartel in Morocco. *S. scrofa* and *S. dactyloptera* both occur in the Mediterranean.

For culinary purposes *Sebastes marinus* may be said to be about equal to the common sea-bream, *Pagellus centrodontus*, being of good flavour but somewhat dry. *Scorpaena dactyloptera* is also distinctly palatable, and under the name of "red bream" appears to have acquired a recognised status in the London market. Smitt says it is not so good as *S. marinus*. *S. scrofa* is chiefly known to us as an ingredient of the Provençal "bouillabaisse," a confection in which the original flavour of the zoological constituents is wont to be somewhat overpowered by vegetable condiments. *S. cristulata* is as good as *S. dactyloptera*, and larger, but its appearance is uninviting.

Sebastes marinus and *Scorpaena scrofa* being at present unrecorded from the Irish Atlantic slope are not, strictly speaking, within the purview of these notes, but for the sake of completeness we include brief descriptions of them.

¹ Goode and Bean include *S. cristulata* in a group said to have a quadrate occipital pit and scaleless cheeks, whereas their artist, no doubt correctly, delineates the type with scales on its cheeks and no occipital depression, as in our specimens.

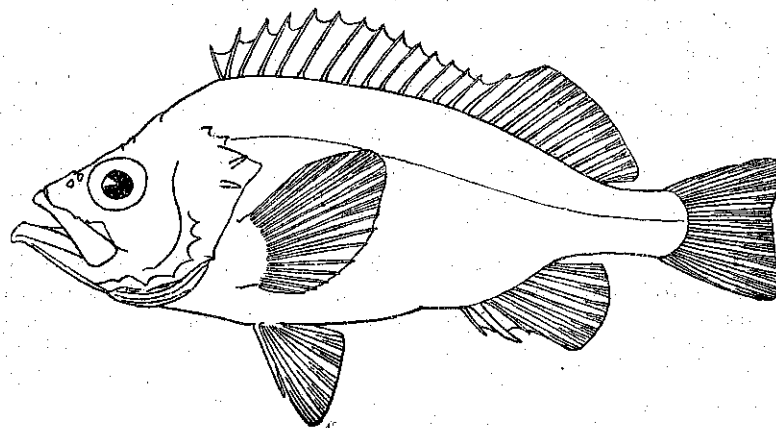
(*SEBASTES MARINUS* L.)

NORWAY HADDOCK (Scotland.)

S. marinus, Smitt (1893), Goode and Bean (1896), Jordan and Evermann (1896-98).

S. norvegicus, Day (1880-1884), (*partim* as to recorded occurrences, some of which refer to *S. dactyloptera*).

S. viviparus, Kröyer (1844-5).



Sebastes marinus, outline after Goode and Bean $\times \frac{2}{3}$.

Form somewhat compressed, back arched, ventral outline rather straight. Head about 3 times, or a little less, depth of body about $2\frac{2}{3}$ to 3 times in total length without caudal fin. Eye 3 to $3\frac{1}{2}$ times in head and about as long as snout. Supra-orbital ridges low, armed with two small spines above the orbit and two at their posterior extremity; width between ridges opposite centre of eye rather less than horizontal diameter of orbit; inner ridges (equivalent to inner keel of supra-orbital ridges in *S. dactyloptera*) feeble, widely separate from outer. Inter-orbita-space (that between outer supra-orbital ridges) entirely scale-clad, only slightly concave between inner ridges. Occipital ridges low, diverging, armed with terminal spines. Mouth large, maxilla reaching at least to level of centre of eye; lower jaw projecting. Suborbitals not forming a scaleless projecting ridge and not reaching as far as preopercular margin. Preoperculum with 5 sharp marginal spines; operculum with two sharp depressed spines internal to its upper posterior angle, and a spine on the subopercular bone at its lower posterior angle. Two well marked spines above origin of operculum. Scales small and irregular,

about 75 in a longitudinal series, about 35 with lateral line tubes. D. XV 13-15, its spines strong and sharp, the 4th or 5th the longest, and the last longer than the immediately preceding spine, soft rays in adults longer than spines. A. III 7-9, the second spine stouter but slightly shorter than the third. Pectoral with the rays of its lower half unbranched. Caudal slightly emarginate.

Colour nearly uniform orange or vermilion red, sometimes with ill-defined dusky bars on operculum, back and sides.

Attains a length of at least 1,000 mm.

Though no one who had seen both forms, or who would be at the trouble of counting the dorsal fin rays, could confuse *S. marinus* with *S. dactyloptera*, the two species rather closely resemble each other. They may, however, be at once distinguished by the characters of (i) the interorbital space, broad, and nearly flat in the first-named, narrow and deeply concave in the second; (ii) the sub-orbital ridge, scaled in the first, naked in the second; and (iii) by the difference in the lower rays of the pectoral fin, which are conspicuously detached in *S. dactyloptera*.

An Arctic species of both shores of the Atlantic, apparently usually found in water of over 100 fathoms depth in the southern part of its range. Nowhere common on the British coast and certainly very rare south of the Moray Firth; confusion with *S. dactyloptera* makes it impossible to define its exact range, but it appears never to have occurred in Irish waters.

S. marinus is viviparous; the young have been figured and described by Collett (1880).

We have included Krøyer's *S. viviparus* in the synonymy because the differences which some authors have held to be of specific value appear to be indefinite (cf. Smitt, 1893). It may, however, be quite entitled to rank as a race characterised by darker colouration, smaller size, and, perhaps usually, by a slight difference in the radial formulae. In habitat it seems to be more littoral (occurring commonly between 20 and 60 fathoms), and in horizontal distribution usually more southern than the larger typical race. The few strictly British examples that have come under the observation of one of us certainly belonged to the smaller, darker race, and if the specific distinction of the two be upheld it is probable that only *S. viviparus* ought to be included in the British-and-Irish list. The vernacular name "Norway Haddock" belongs to *S. viviparus*, which, at least usually, has a rather conspicuous black blotch on the operculum; but so far as one of us can recollect the name was also applied at Grimsby to the big orange-red examples of the typical form which became common in that market when the Iceland trawling grounds were opened up (ca. 1892).

SCORPAENA DACTYLOPTERA, Delaroche (1809).

Pl. I.

RED BREAM.

S. dactyloptera, Günther (1859), Smitt (1893), Holt and Calderwood 1895.

Sebastes dactylopterus, Günther (1859-70).

Sebastes imperialis, Cuvier and Valenciennes (1828-49), Lowe (1843-1860).

Helicolenus dactylopterus, and *H. maderensis*, Goode and Bean (1895), Jordan and Evermann (1896-98).

[*Not Scorpaena madurensis*, Cuvier and Valenciennes (1828-49), *Sebastes maderensis*, Lowe (1843-1860), Günther (1859-70), Collett (1896).]

Goode and Bean regarded *S. imperialis*, Lowe, as distinct from *S. imperialis*, C. and V. (which is a synonym of *S. dactyloptera*, Delaroche), and applied to it the name of *H. maderensis*, which was preoccupied in *Scorpaena*. Lowe, himself, as his synonymy and description show, regarded his species as identical with the *S. dactyloptera* of Delaroche and Risso. There is a good series of *S. imperialis* of all sizes, collected by Lowe at Madeira, now in the British Museum; we have examined these, and feel no hesitation in following Lowe and Günther in regarding them as *S. dactyloptera*. There is also in the British Museum a specimen 125 mm. long (105 mm. without caudal fin) received from the Smithsonian Institution as *H. maderensis*, Goode and Bean; we have carefully compared this specimen with *S. dactyloptera* of the same size from both Madeira and the West of Ireland, and can find no trace of the alleged specific differences between the two supposed species, the so-called *H. maderensis* being, in fact, a perfectly normal young specimen of *S. dactyloptera*. We can only surmise that Goode and Bean have been misled by looking at Lowe's figure without carefully studying his synonymy and description, and by failing to take note of the ordinary changes of form in *S. dactyloptera* in the course of its growth. Their figure, described on the plate and in the text as *H. dactylopterus*, but in their list of plates as *H. maderensis*, is apparently drawn from a half-grown *S. dactyloptera*.

The characters of Irish specimens of *S. dactyloptera* measuring from 78 to 330 mm., without caudal fin, are as follows:—

Form moderately compressed throughout, head not flattened nor laterally expanded. Greatest height of body (at origin of ventral fins) about 3, length of head (without lower jaw) about $2\frac{1}{2}$ to $2\frac{3}{4}$ in total length without caudal fin. Horizontal diameter of orbit from about $2\frac{1}{4}$ in young, to about $3\frac{1}{2}$ in adults, greatest width of body (at shoulders) about 2 in length of head. Length of snout about $1\frac{1}{2}$, width between outer edges of supraorbital ridges from about 3 in young to about $2\frac{1}{2}$ in adults in horizontal diameter of orbit, which is greater than least height of caudal

peduncle. Length of caudal peduncle, measured between base of last dorsal ray and central caudal rays, somewhat greater in young, somewhat less in adults, than its least height. Length of longest ray of dorsal fin about $1\frac{4}{5}$ in young, about $2\frac{3}{5}$ in large adults (330 mm.) in greatest height of body. Dorsal profile of head descending in a rather even curve from occipital region, snout somewhat humped in adults, with a spine of moderate size on each side. Jaws equal in young, or with the upper slightly projecting; lower jaw slightly projecting in adults. Small, rather stout, curved teeth in bands on the jaws, vomer, and palatines. No teeth on the premaxillary symphysis. Anterior end of tongue free. Maxilla extending at least beyond vertical of hind edge of lens in young, nearly to vertical of hind edge of orbit in adults. Orbit nearly circular in young, considerably longer than high in adults. Supraorbital ridges doubly keeled, with a spine in front, and two or three small spines behind on the inner keel, outer keel terminating behind in a small spine outside origin of occipital ridge. Occipital ridges diverging, with a small terminal spine, and another, obsolete in adults, a little in front of it. Interorbital space narrow, concave, especially in young, and scaleless. Suborbital ridge with or without a single small spine. One or two small spines at insertion of operculum. Operculum with 2, preoperculum with 5 flat spines. Upper or first preopercular spine much shorter than the next or second, which is considerably longer than the remainder, the fourth and fifth reduced to mere serrations in large adults, all the spines rather evenly spaced, or with the third rather near the second. Pectoral and ventral fins reaching beyond anus, occasionally to anal fin, in young, not, or scarcely, reaching anus in adults. Pectoral fin with 18 to 20 rays, the 2 upper slender and spinous, the next 8 to 10 branched, the lower 7 to 9 soft but unbranched, free of membrane as to about their distal thirds, slender in young, all except the uppermost thickened and fleshy in their middle parts, and tapered distally to a rather fine point in adults¹. Dorsal fin, commencing between verticals from base and tip of second preopercular spine, with 12 rather strong spines, of which the third to fifth are the longest, and 12 branched rays, last spine considerably longer than that immediately proceeding it. Membrane not produced into lappets. Anal fin commencing about opposite second part of dorsal, and at some distance behind anus, with three spines and five branched rays, the third spine almost or completely clothed in membrane². Caudal fin slightly emarginate. Integuments of fins not conspicuously thickened in old examples. Scales finely ctenoid, in about 8 or 9 longitudinal rows above, and about 15 to 18 rows below lateral line in front of anus (exclusive of some small scales on dorsum and ventrum), and in about 50 to

¹The pectoral fins are frequently asymmetrical either as to the total number of rays or as to their division into the several categories, e.g., right, 2, 9, 8, left, 2, 9, 7, right, 2, 10, 8, left, 2, 9, 9. In the last case the two uppermost simple soft rays of the right fin are slender, the lower eight only being thickened.

²The spines of this fin are subject to rather frequent abnormality. In a specimen before us the second spine is greatly swollen, after the manner apparently normal in *S. cristulata*. As to other abnormalities see Jaquet (*Bull. Mus. Océanogr. Monaco*, No. 79, 1906).

63 transverse rows¹ between head and origin of caudal rays, the rows usually more or less irregular. Scales present on head, except on bony ridges, interorbital space, snout, jaws, and under side; also present on bases of soft part of dorsal and of caudal fin, and on basal part of pectoral fin. No dermal lappets or filaments on any part of head or body.

General colouration red, shading through rose-pink to white, or yellowish white, on ventrum, with bands of intense scarlet descending from dorsum; fins pink, with scarlet mottlings, margins of median fins white. Black or dark brown pigment, masked during life by red, present in young in position of bands, variable in adults, and when present usually disposed in general mottling of upper parts of head, body, and dorsal fins. Iris bright yellow, lens opalescent in life. Pharynx black or lead-coloured. Size, 450 mm.² Female may be fully mature at 210 mm. (without caudal fin).

Measurements in millimetres, and number of Scales and Fin Rays in five Irish specimens.

	a.	b.	c.	d.	e.
Station (Series S.R.), ...	360	97 B.	97 B.	97 B.	361
Total length, ...	105	180	245	287	410
Total length without caudal fin, ...	84	139	196	235	330
Length of head without lower jaw, ...	34	57	77	91	130
Length of snout, ...	8	11	15	21	29
Length of orbit, ...	12	21	27	30	40
Width between supra-orbital ridges, ...	4	8	10	10	16
Width of body at base of pectoral fin, ...	16	29	38	46	65
Length of pectoral fin, ...	27	44	54	59	80
Length of ventral fin, ...	21	33	40	45	65
Snout to first dorsal spine, ...	25	50	61	73	97
Snout to anus, ...	50	88	124	150	213
Anus to first anal spine, ...	5	11	15	19	19
Height of head behind eye, ...	22	38	50	61	89
Height of body at origin of ventral fins, ...	27	47	61	75	117
Height of caudal peduncle, ...	8	15	21	24	34
Length of caudal peduncle from base of dorsal fin to anterior caudal rays, ...	10	22	22	30	30
Number of scales above lateral line opposite anus, ...	—	9	9*	8	8*
Number of scales below lateral line opposite anus, ...	—	62	61	62	62
Number of scales between head and caudal fin, ...	—	16	16	18	18
Number of dorsal fin-rays, ...	XII. 12	XII. 12	XII. 12	XII. 12	XII. 12
Number of anal fin-rays, ...	III. 5.	III. 5	III. 5	III. 5	III. 5
Number of pectoral fin-rays, left side, ...	2, 9, 8	2, 8, 9	2, 9, 8	2, 9, 9	2, 9, 8
Number of pectoral fin-rays, right side, ...	2, 9, 8	2, 9, 8	2, 9, 8	2, 9, 8	2, 9, 7

* Exclusive of some small scales at the dorsum.

¹ See post, p. 12.

² Fide Smitt.

Length in millimetres, of Dorsal Spines and of longest Soft Ray.

—	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	Ray.
Specimen c,	15	23	28	31 ca.	27+	27	26	26	22	18	18	21	33
Specimen s,	17	37	43	44	43+	40	36	35	27	26	24	30	52

Number of Rays of Pectoral Fins in other specimens from Station S.R. 97 B.

Length of Specimen without Caudal fin.	Left Pectoral fin.	Right Pectoral fin.
212 mm.	2, 9, 8	2, 9, 8
210 mm.	2, 9, 7	2, 9, 8
210 mm.	2, 9, 9	2, 10, 8*
144 mm.	2, 8, 9	2, 9, 8

This specimen has the two uppermost of the lower simple rays of the right fin slender.

Our figure is sketched from the largest specimen in our possession, measuring 410 mm. in total length, 330 mm. without the caudal fin. Its other measurements, and those of some smaller specimens, are detailed above, but for rough verification of proportions we have examined twelve specimens, and suppose that, with the necessary allowance for individual variation, the proportions are stated with sufficient exactitude for the range of size to which they are intended to apply. One female, very heavy in roe, has the length of head and height of body relatively somewhat greater than we have stated, but the body is somewhat curved and may have been shrunk by post-mortem changes before preservation. The armature of the head is of course more formidable in young examples than in the old specimen figured; but it is never very much developed, and the cranial and sub-orbital ridges, though always easily seen, are never very stout. An intelligible statement of the scale formula presents great difficulty, for it is not possible to say of the species that its scales are either regular or the reverse, for both conditions occur in specimens from the same haul, especially in the case of the longitudinal rows. Usually in the count of these in a transverse line a little in front of the anus, the enumeration of scales above the lateral line is confused by the presence of more or fewer small irregular scales (which we omit to count) on the dorsum, but sometimes the large scales go right up to the bases of the dorsal fin rays.¹ Below the lateral line all specimens have more or fewer irregular scales on the actual ventrum, but in their extension on to the sides there is

¹ In our figure, Pl. I., the scales are shown diagrammatically. In a correct lateral view the dorsal and ventral scales would be fore-shortened.

considerable variety. The transverse rows which cross the lateral line between the head (which we take as terminating at the posterior angle of the operculum) and the origin of the central caudal rays may be, to first glance, apparently regular or obviously irregular, but when one comes to count them they are found to be always more or less confused, so that different observers might easily give counts of apparently important difference. Our record gives the widest range covered by counts made separately by each of us, and is probably sufficient to cover the limits of observation however the count is made. One of us, counting as many as could reasonably be included, obtained a range of 58 to 63; the other counting as few as could reasonably be included, obtained in other specimens a range of 50 to 57; one specimen yielded a count of 52 on one side of the body and 57 on the other. We presume that the numerous authors who give "about 50" as the number have counted on somewhat conservative lines.

Certain authors have enumerated the perforated scales of the lateral line, which we consider to be impossible of exact count without stripping off all the ordinary scales. Smitt gives 26 to 30, no doubt as the result of autopsy; we should personally have been inclined, from a superficial examination only, to put the number somewhat higher.

The actual form of the membrane of the spinous part of the dorsal fin is rather difficult to determine, because the membrane is almost always detached from the back of the tips of the spines, and in that condition looks very much as if it had been, when *in situ*, produced behind the tip of the spine in the form of a lappet. A few of our specimens, however, have the membrane perfect between some of the spines, and its outline is simple, as in our figure. Quite possibly the same is true of some other bathybial species of *Scorpaena* which are credited in literature and art with the possession of dorsal fin lappets.

The colouration which we have noted above varies, according to Messrs. Farran and Kemp, in the distinctness of the transverse bands, some specimens being almost uniform in colour. We have no means of deciding whether or no the more vividly coloured specimens are breeding males, but it is not improbable that this is the case.

We have mentioned above that in young specimens the position of the red bands is defined, after the red pigment has faded, by black chromatophores. In a series measuring from 78 to 99 mm. without the caudal fin, these dark bands are fairly constant. The first is at the shoulders, continuous with practically diffuse dark pigment on the upper parts and sides of the head. The next two are in the form of very crooked wedges, and are succeeded by a V-shaped band from the part of the back occupied by the soft part of the dorsal fin. The last band is on the hinder part of the caudal peduncle. The bands are not continued very definitely on to the dorsal fin, but in a few specimens there is a large blotch of dark pigment occupying the membrane of several of the hinder spines of the spinous portion above the second wedge-shaped band. In older examples before us dark pigment

is very indefinite and never in the form of bars, but in some very fine examples from Troup Head, which one of us had the opportunity of examining soon after their reception at the British Museum, there was a good deal of dark colour in the region of the bars, but in no sense defining their extent as in the case of young fish. Some authors mention brown markings on the bands, which we suppose to be due to post-mortem effects.

A number of very small examples, about 41 to 44 mm. in total length, taken by Mr. W. S. Green in August, 1890, were examined by one of us a few weeks after capture and preservation in undiluted methylated spirits. They then had the bars very conspicuously defined in dark brown pigment, with the dorsal fin blotch extremely well marked in the same colour (Holt and Calderwood, 1895, p. 411). No note of colour was made at the time of capture, but Mr. Green, shortly after the event, had no recollection of their having been red. The specimens are extant, and do not differ much in general proportions from the larger forms which we have used for description. The length of the head, without the lower jaw, is about $2\frac{1}{2}$ to $2\frac{2}{3}$, the height of the body about 3, in the total length without caudal fin, and the length of the orbit about 3 in that of the head. The interorbital space is relatively wide, about $1\frac{4}{5}$ in the length of the orbit, and rather distinctly flatter than in half grown and young adult specimens. The longest dorsal spine is longer than the orbit, and the cephalic spines, especially the second of the preopercular series, are rather formidably developed. All the rays of the pectoral fin are simple, and, so far as can be determined, the lower rays are naturally united by membrane except at the extreme tips. This was also the case in a specimen obtained by one of us from the Humber River in 1893, though the total length was 121 mm.; but in all our Irish material, ranging in total length from about 105 mm. upwards, the lower pectoral rays are certainly separate to a distance which does not seem to vary much in relation to size of individuals.

In a perfect specimen measuring 63 mm. in total length, evidently killed in formaline, the branching of the middle pectoral rays is already accomplished, while the lower rays have the extremities free for about a third of their total length. The pectoral fins are expanded and probably serve to illustrate the extent to which the lower simple rays can be brought into action as ventral tactile organs. The general direction of the fin is at about 45° to the horizontal axis of the body, but the lower simple rays are depressed so that the tips of all of them are well below the ventrum. They are, moreover, somewhat incurved, which may or may not be their natural condition when the fin is expanded. Sundry specimens, preserved after death, show that the fin can be brought forward along the head, in which position the lower rays, if depressible under such circumstances, would seem to have some value as ground-searchers, if one assumes them to exercise a sensory function, as is the case in the corresponding rays of the gurnard.

The specimen referred to, 63 mm. in total length, measures 51 mm. without the caudal fin, the head 21 mm., orbit 8 mm., interorbital a little over 3 mm., height of body 16 mm., least height of caudal peduncle a little under 5 mm., longest dorsal spine a little over 6 mm. The upper jaw projects a little.¹ The dorsal fin blotch and the transverse bands are well defined in black pigment, but there is in addition a rather diffuse dark pigmentation along the middle region of the sides, except on the caudal peduncle. This is the smallest specimen of adult form taken by the *Helga*, and, as to its colouration in life, Messrs. Kemp and Farran consider it must have been red, because knowing the species quite well at all its stages, they have no recollection of ever seeing a specimen that was not red.

Among the larvae in the *Helga* collections we have found a few that appear to us to be of this species, but they are all more or less mangled, and not worthy to be used as evidence of distribution.

Scorpaena dactyloptera has been taken by the *Helga* during the years 1901-1906 at the stations listed below. The measurements of specimens are transcribed from the fishing log and were made only to the nearest centimetre. The first capture recorded is from a long-line station. At all the subsequent stations the captures were made either in the beam-trawl or in fine-meshed, nets attached thereto.

Helga, LXXVII.—29-6-'01, Porcupine Bank, $53^\circ 24' 30''$ N., $13^\circ 36'$ W., ca. 91 fathoms.

One, 16 cm., in mouth of a larger fish.

Helga, CXXI.—24-8-'01.—64 mi. N.W. $\frac{1}{2}$ W. of Cleggan Head, Co. Galway, 199 fathoms.

Four, 19 to 26 cm.

S.R. 97 B.—3-5-'04, off Fastnet Lt., Co. Cork, $50^\circ 31'$ N., $10^\circ 55'$ W., 181 fathoms, fine sand.

Ten, 17 to 29 cm., one female with ripe ovaries.

S.R. 169.—4-11-'04, off Tearaght Lt., Co. Kerry, $51^\circ 50'$ N., $11^\circ 26'$ W., 129 fathoms, fine sand. Temperature 10.3° C.

One, 18 cm.

S.R. 171.—5-11-'04, off Tearaght Lt., $52^\circ 7'$ N., $11^\circ 58'$ W., 337 fathoms, fine muddy sand.

Fifty-two, 15 to 29 cm.

S.R. 188.—3-2-'05, off Tearaght Lt., $51^\circ 53'$ N., $11^\circ 59'$ W., 320 to 372 fathoms, mud. Temperature at 300 fathoms, 10.125° C., salinity 35.50 ‰.

Nineteen, 14 to 30 cm.

S.R. 211.—5-5-'05, off Fastnet Lt., $50^\circ 20'$ N., $10^\circ 20'$ W., 81 fathoms, fine sand. Temperature at 70 fathoms, 10.38° C. salinity 35.30 ‰.

Three, 15 to 18 cm.

¹ In Mr. Green's smaller specimens the lower jaw projects slightly, but this is obviously due to shrinkage of the receptive apparatus of the premaxillae in strong alcohol.

- S.R. 212.—6-5-'05, off Tearaght Lt., 51° 54' N., 11° 57' W., 411 fathoms, muddy sand. Temperature at 350 fathoms, 9.82° C., salinity 35.28 ‰. Seven, 16 to 29 cm.
- S.R. 215.—9-5-'05, off Tearaght Lt., 52° 01' N., 11° 21' W., 107 fathoms, fine sand. Eighteen, 6 to 19 cm.
- S.R. 216.—9-5-'05, 52° 21' N., 11° 54' W., 164 fathoms, fine sand. One, 17 cm.
- S.R. 217.—9-5-'05, 52° 44' N., 12° 30' W., 208 fathoms, fine sand. Temperature at 200 fathoms, 10.0° C. Two, 16 and 35 cm.
- S.R. 220.—11-5-'05, off Cleggan, 53° 39' N., 12° 24' W., 185 fathoms, fine sand and shells. Eight, 16 to 33 cm.
- S.R. 222.—12-5-'05, 53° 01' N., 14° 34' W., 293 fathoms, fine sand. Temperature at 100 fathoms, 9.9° C. Forty-seven, 6.5 to 28 cm.
- S.R. 227.—13/14-5-'05, 53° 20' N., 13° 00' W., 164 fathoms, fine sand. Temperature at 120 fathoms, 9.5° C. One, 29 cm.
- S.R. 321.—1-5-'06, 50° 56' N., 11° 17' W. to 51° 0' 30' N., 11° 17' W., 480 to 208 fathoms, fine sand. Seven, 18 to 27 cm.
- S.R. 329.—9-5-'06, 51° 22' 30'' N., 11° 31' W. to 51° 20' 30'' N., 11° 38' W., 215 to 415 fathoms. Temperature at 400 fathoms 9.55° C., salinity 35.33 ‰. Forty-one, 17 to 41 cm.
- S.R. 330.—9-5-'06, 51° 18' 30'' N., 11° 39' W. to 51° 14' N., 11° 35' W., 374 to 415 fathoms, fine sand. Ten, 19 to 28 cm.
- S.R. 338.—13-5-'06.—51° 31' N., 11° 38' W. to 51° 26' N., 11° 40' 30'' W., 291 to 330 fathoms, mud. Twenty-four, 21 to 34 cm.
- S.R. 351.—5-8-'06, 50° 18' N., 11° 5' W. to 50° 21' N., 11° 7' W., 230 to 250 fathoms, fine sand. Temperature 10.1° C. Eighteen, 16 to 28 cm.
- S.R. 353.—6-8-'06, 50° 37' N., 11° 32' W. to 50° 40' N., 11° 32' W., 250-542 fathoms, muddy sand. Temperature at 500 fathoms 8.58° C. Ten, 2 to 35 cm.
- S.R. 360.—8-8-'06, 50° 4' 30'' N., 11° 25' W. to 52° 4' N., 11° 30' W., 108 to 120 fathoms, fine sand. Twenty, 9 to 12 cm.
- S.R. 361.—8-8-'06, 51° 50' N., 11° 40' W. to 51° 49' N., 11° 45' W., 177 to 213 fathoms, fine sand. Eighteen, 16 to 40 cm.

- S.R. 362.—9-8-'06, 51° 34' 30'' N., 11° 25' W. to 51° 35' N., 11° 30' W., 145 to 160 fathoms, fine sand. Temperature at 150 fathoms 10.05° C. Eight, 11 to 21 cm.
- S.R. 365.—10/11-8-'06, 51° 25' N., 11° 29' W. to 51° 25' N., 11° 36' W., 385 to 440 fathoms. Temperature at 380 fathoms, 9.44° C. Two, 24 and 27 cm.
- S.R. 367.—11-8-'06, 51° 38' N., 11° 34' W. to 51° 38' N., 11° 41' W., 287 to 332 fathoms, muddy sand. Three, 24 to 27 cm.
- S.R. 379.—1-11-'06, 50° 14' N., 10° 50' W. to 50° 14' N., 10° 57' W., 126 to 139 fathoms, fine sand and shells. Temperature at 135 fathoms, 10.66° C., salinity 33.60 ‰. Twenty-five, 7 to 28 cm.
- S.R. 380.—1-11-'06, 50° 29' N., 11° 0' W. to 50° 32' N., 11° 0' W., 142 to 214 fathoms, fine sand. Eleven, 12 to 20 cm.
- S.R. 384.—6-11-'06, 51° 54' 30'' N., 11° 37' W., 162 to 218 fathoms, fine sand. Temperature at 200 fathoms, 10.2° C., salinity 35.41 ‰. Sixteen, 13 to 27 cm.

While the list sets forth the positive results of trawling in so far as concerns this species, the negative results require brief mention. In the years 1901 to 1906, inclusive, the *Helga* made 51 hauls of the 25 or 30 feet beam trawl off the west and south west coasts at depths exceeding 50 fathoms. A detailed analysis of these hauls in regard to locality and season may properly be deferred until we have opportunity of dealing with the whole catches. For present purposes it may suffice to say that the winter hauls are relatively few, viz., 2 in November, 1904, 1 in January, 1905, 1 in February, 1904, 1 in February, 1905, 1 in February, 1906. Summer and autumn hauls are more numerous, viz., 2 in May, 1904, 11 in May, 1905, 13 in May, 1906, 2 in August, 1901, 1 in August, 1903, 2 in August, 1904, 11 in August, 1906. The distribution of the hauls in zones of depth is as follows:—

- 50 to 100 fathoms.—1 in February, 1904, 2 in January, 1905, 1 in May, 1905.
- 100 to 200 fathoms.—1 in August, 1901, 1 in August, 1903, 2 in May, 1904, 2 in August, 1904, 1 in November, 1904, 5 in May, 1905, 2 in August, 1906, 1 in November, 1906.
- 100 + to 200 + fathoms.—1 in August, 1906, 1 in November, 1906.
- 200 to 300 fathoms.—2 in May, 1905.
- 200 + to 300 + fathoms.—1 in May, 1906, 2 in August, 1906.
- 300 to 400 fathoms.—1 in August, 1901, 1 in November, 1904, 1 in February, 1905, 1 in May, 1906.
- 300 + to 400 + fathoms.—1 in May, 1906, 1 in August, 1906.
- 400 to 500 fathoms.—2 in May, 1905, 1 in August, 1906.

- 400 + to 500 + fathoms.—1 in May, 1906.
 500 to 600 fathoms.—1 in May, 1905, 1 in February, 1906, 2 in May, 1906.
 600 to 700 fathoms.—1 in May, 1906, 1 in August, 1906.
 600 + to 700 fathoms.—2 in May, 1906, 1 in August, 1906.
 200 + to 400 + fathoms.—2 in May, 1906.
 200 + to 500 + fathoms.—1 in August, 1906.
 400 + to 600 + fathoms.—1 in August, 1906.
 500 + to 800 + fathoms.—1 in May, 1906.
 600 + to 800 + fathoms.—1 in May, 1906.

The list of captures contains only one record of *S. dactyloptera* between 50 and 100 fathoms, viz, 81 fathoms in May, 1905, but the total number of hauls at this zone of depth is four, of which three were made in winter months. The available data hardly suffice for suggestion of seasonal influence on vertical distribution, or might, indeed, be held to signify a winter shoreward migration (cf. Clarke, 1893, Holt, 1893). It appears that adults may occur on the Irish coast at not more than 81 fathoms. The young (p. 14), were taken there in number at 80 fathoms in August, 1891 (Holt and Calderwood, 1895). Two somewhat older examples occurred in February and April, 1893, on the coast of Yorkshire, the first washed ashore on the Coatham Sands, the second taken in the Humber estuary at less than 5 fathoms, but it would be unsafe to cite them as evidence of normal distribution. Indeed, according to the recollection of one of us (unsupported by any extant note), the early part of the year in question was characterised by disturbances which littered the shore of Holderness with lobsters (locally reputed to have come from Norway!) and strewn the Humber margin with young haddock, which have ordinarily no place in that estuary. Vaillant, however, records nine specimens presumably adult, from only 49 fathoms (Cape Verde Islands), and one from 54 fathoms (Spain), so that it would seem not improbable that the species may normally range on our Atlantic coast considerably above the 100-fathom line. Some specimens in the Dublin Museum, captured on the S.W. coast as early as 1843, must have come from no considerable depth.

The lower limit of distribution cannot be taken with certainty from the *Helga* captures beyond 411 fathoms, and the deepest sounding of any station at which specimens occurred is 440 fathoms.¹ Vaillant, however, gives an absolute record (Canary Islands) of 567 fathoms, and there is nothing to show that any part of the haul traversed shallower ground. Only one specimen was then taken, and the nearest station, in point of depth, in the *Travailleur* and *Talisman* list, is 428 fathoms (Soudan).

On the southern part of the coast of Norway *S. dactyloptera* appears to be taken regularly, but not in great number, between

¹This is modified by the list of captures in 1907, which can only be dealt with here in the form of a note. In September, one occurred between 470 and 491 fath., two between 447 and 515 fath., thirty-three between 346 and 400 fath. In May, thirty-four were taken between 221 and 341 fath., four between 343 and 346 fath., and four between 350 and 389 fath.

100 and 300 fathoms, and, having been recorded from Danish waters, must at least occasionally move southwards into considerable depths. It occurs, apparently regularly, in the 100-fathom hole off Troup Head in Aberdeenshire (whence presumably wandered the young examples noted from the Yorkshire coast). No record of it exists from the Färö Channel, nor from the deep water west of Scotland, which, however, is practically unexplored.¹

On the eastern side of the Atlantic its range may be taken to extend from lat. 70° N. off Norway, at least as far south as Cape Verde, chiefly at depths between 100 and 400 fathoms, but as to the influence which temperature and salinity may exercise on its distribution within this zone, available evidence seems to be insufficient. In the *Helga* captures the temperature, when observed, ranged between about 9° and about 11° C., and the observed salinity was usually oceanic, but at S.R. 379 distinctly littoral. Since the species occurs regularly in the North Sea an oceanic salinity cannot be essential to its well-being.

In the Mediterranean it extends as far east as Constantinople, but statements as to its vertical range in that sea lack precision. Since, however, it appears at least not rarely in fish markets, it must to some extent be an inhabitant of moderate depths, though in general affecting those beyond the ordinary range of local fishing operations (cf. Collett, 1896).

On the western side of the Atlantic it seems to be not rare between Lat. 30° and 40° N., at depths of about 71 to 312 fathoms (cf. Goode and Bean, 1896, *H. dactylopterus* and *H. maderensis*).

S. dactyloptera seems to live at the bottom, for we can find no evidence of its capture elsewhere after the larval stages. The thickened, detached, presumably tactile lower rays of the pectoral fin certainly suggest a bottom-groping habit, but it is to be remarked that while their extremities become detached at an early stage, the rays are not thickened until comparatively late in life. In the gurnards which search the ground with their detached rays² in a manner familiar to everyone who has seen the fish in an aquarium, these rays are specialised at or before the conclusion of the larval stage (cf. McIntosh and Masterman, 1897). Since, however, in *Scorpaena cristulata*, in which only the extreme tips of the lower rays are free, these rays, as also those of the ventral fins and the spines of the anal fin, become clothed in adults with thick fleshy integuments, it may be that the thickening has nothing to do with an increase in the sensory mechanism.

It is quite probable that the *Helga's* small slow-moving beam trawl gives no adequate account of the sizes of specimens procurable on the Irish coast by a commercial otter-trawl, and since the "red bream" seems to have established itself in the London market it is likely that the fish landed there run generally larger than those which we have listed. The largest of these is about 16 inches, and the great majority are of less than 12 inches, no

¹ Note added in Press.—We have lately received from Dr. R. Norris Wolfenden a specimen taken by the *Silver Belle* in the Färö Channel at 320 fathoms,—temperature 8.7°C.

² For description of the sensory apparatus in the pectoral rays of Gurnards cf. Williamson (1894).

great size in the British culinary standard of fishes, to which the alleged Irish comparison of the relative values of the goose and the snipe may be not inaptly compared. Smitt, evidently from autopsy, puts the maximum size of Scandinavian specimens at about $17\frac{3}{4}$ inches. Holt and Calderwood, on an authority which we cannot now trace, mention a size of 24 inches (ca. 573 mm.)

SCORPAENA CRISTULATA, Goode and Bean.

Pl. II.

S. cristulata, Goode and Bean (1895), Jordan and Evermann (1896-98).

S. echinata, Koehler (1896).

S. cristulata and *S. echinata* were described independently from specimens of the same size (150 mm. without the caudal fin) taken respectively off the coast of Georgia, U.S.A., at 440 fath., and in the Bay of Biscay at 722 fath.

Koehler, in a note inserted while his account of the fishes taken by the *Caudan* was in the press, gave it as his opinion that *S. echinata* was certainly identical with *S. cristulata*, and the same view has been adopted by Jordan and Evermann.

Several *Scorpaenae* recently taken by Messrs. Farran and Kemp in deep water off the south-west of Ireland (the smallest of which is longer by about one-third than the two specimens above alluded to) appear to us to be clearly referable to the same species as Koehler's specimen, and we see no good reason for refusing to regard his specimen and the type of *S. cristulata* as specifically identical, the only difference (other than those referable to growth) lying in the number, or supposed number, of the scales, to which, in view of the difficulty we have ourselves experienced in counting the irregularly arranged scales of young *Scorpaenae*, we are not disposed to attach any importance.¹

With our material and the published descriptions of Goode and Bean and Koehler, the series of specimens described is fairly complete, and the diagnosis which we subjoin will probably ensure the recognition of specimens of any size. In speaking of "young" we refer to examples of

¹ Koehler's drawing seems to represent a more massive fish than that shown by the American authors, with the cephalic armature more fully developed, and his specimen may have advanced further towards the adult form and appearance than the type of *S. cristulata*, although of no greater length.

Koehler remarks on the irregularity of the squamation of his specimen, without giving the actual number of scales; his figure shows about 55 in a longitudinal series from the operculum to the caudal origin; Goode and Bean attribute about 60 in the same distance to their specimen, while their artist has shown a few more than that number, a fact which appears to point to some room for doubt as to the number really present. In the Irish specimens the scales increase somewhat in size posteriorly. Goode and Bean's figure shows them the same size throughout, and Koehler represents the scales of the caudal region as smaller than those opposite the spinous dorsal.

In some other particulars of minor importance the description of the American type is at variance with the figure.

150 mm., as described by the American and French authors; by "adults" we mean specimens of 300 to 504 mm., measured in all cases without the caudal fin. A specimen of 215 mm. may be described as "half-grown"; but this stage seldom requires separate mention in diagnosis, as it is naturally intermediate between the young and adult conditions¹.

Length of head about $2\frac{1}{2}$ in young, about $2\frac{1}{5}$ to $2\frac{3}{5}$ in adults, greatest height of body about 3 to $3\frac{1}{4}$ in total length without caudal fin. Length of snout in young somewhat greater than, in adults about equal to length of orbit. Length of orbit in young about $3\frac{1}{3}$, in adults about $4\frac{1}{4}$, height of caudal peduncle in young about 5, in adults about $3\frac{1}{4}$ to $3\frac{3}{4}$ in length of head. Width between interorbital ridges in young about $2\frac{1}{2}$ to $2\frac{4}{5}$, in adults about 2 in length of orbit.

Lower jaw slightly projecting, mandibular symphysis with a well-marked ventral process in adults. Maxilla reaching to, or nearly to, vertical from hind margin of orbit in adults, relatively shorter in young. Snout with a more or less prominent hump between the olfactory organs. Interorbital space slightly concave, with a pair of feeble carinae internal to the supraorbital ridges. Teeth in bands on the jaws, vomer and palatines, villiform in the young; of moderate size, stout and recurved, interspersed at the front ends of the jaws with villiform in adults. No teeth on the premaxillary symphysis.

Form massive anteriorly; greatest height and width (about $\frac{2}{3}$ of height in adults) at level of anterior spine of dorsal fin. Snout bluntly rounded in dorsal view. Belly somewhat flattened from isthmus to opposite extremities of ventral fins, trunk somewhat compressed post-anally.

Head heavily armed with spines, mostly set in longitudinal series on scaleless ridges. A small inwardly directed spine on either side of snout. Supra-orbital ridges with a single, sometimes bifid, spine at the front end (pre-orbital), followed at an interval by three, of which the first is the smallest, and the third, about opposite hind margin of orbit, usually the largest. Supra-orbital ridges continued on the occiput by slightly diverging ridges armed posteriorly with two keel-like spines, of which the first may be obsolete in adults. Three or more spines in a row behind the eye, forming in adults processes of a more or less continuous ridge, first spine small, second large, keel-like, somewhat deflected in adults, third and fourth at the upper insertion of operculum, the third sometimes bifid, the fourth of uncertain occurrence, present in adults as a low ridge only. Two thin flat spines on the operculum, often obsolete in adults. A strong sub-orbital naked bony ridge extending from above insertion of maxilla to upper posterior angle of preoperculum, set with spines which are arranged in adults in four groups²: first group of 1 to

¹ Since our manuscript went to the printers the *Helga* has brought in ten additional specimens ranging in total length from 245 to 520 mm. This new material does not materially affect the diagnosis of characters, and it is only necessary to make note of a colour variety and to complete the list of captures.

² In a half-grown specimen the second and third groups are practically continuous and their spines are not deflected.

3 small spines at anterior end of ridge; second of 2 or 3 rather large keel-like, somewhat deflected, below middle or hinder half of eye; third of 3 or 4 similar to last; fourth of 1 large backwardly directed spine, with a subsidiary spine on its anterior shoulder at symphysis of suborbitals with upper angle of preoperculum. Hind edge of preoperculum armed in addition with four serrations, the uppermost small, persistently acute, and (in adults) near the spine of the angle; the remainder wider and more or less completely masked with skin in adults.

Scales relatively rather small, thin, non-deciduous, finely ctenoid at the margin in young, sometimes practically smooth in large adults, wanting in adults on maxilla, and never present on bony ridges of head, praemaxillary and mandibular parts of jaws and underside of head; imperfectly developed on inter-orbital region; small and not imbricating on ventral region in front of ventral fins; present on basal parts of dorsal and caudal fins; 7 to 9 longitudinal rows above, 15 to 17 rows below lateral line opposite anus; 48 to 53 (60) transverse rows between posterior angle of operculum and origin of central caudal rays.

Dermal processes in the form of short slender filaments, of which one appears to be normally present behind each of the cephalic spines and at each of the pores of the lateral line. Shorter and more slender filaments arise singly or in pairs from more or fewer of the perfectly developed scales of the head and body. A ring of filaments round the eye, those of the dorsal part the stronger and more numerous.²

Pectoral fins extending in young considerably beyond level of anus, relatively shorter in adults; their upper rays (except the first) branched; their lower rays unbranched, protruding slightly from the fin-membrane, and covered with a very thick integument in adults.

Ventral fins much shorter than pectorals, and clothed in thick skin in adults.

Dorsal fin commencing in front of posterior angle of operculum, with 11 or 12 spines and 9 or 10 soft rays (XI-XII 9-10); first spine shorter than those which follow it; fourth and fifth spines longest, and last spine much longer than those immediately in front of it.³ Anterior soft rays longer than spines in adult, equal

¹ *Fide* Goode and Bean.

² We are inclined to think that the development of dermal filaments varies a good deal in individuals, since some of our specimens have filaments on the majority of the perfect scales, while others have only a few, as in the case of the specimen figured. None of them show any signs of serious abrasion in the net.

³ In the young the first spine is very close to second, third nearer to second than to fourth. In large adults the interspaces are nearly equal, that between first and second shorter than that between second and third only by a distance equal to the width of base of second, those between second and third and third and fourth sub-equal. In life the fin membrane may possibly be produced behind the tips of the spines in small lappets, but is more probably simple in outline. Our artist has omitted to note the slight difference in the lengths of the interspaces between the first and second and second and third dorsal spines.

to, or shorter than spines in young; base of whole fin scaly in young,¹ spinous portion practically naked in adults. Soft part obscured basally in adults by thick scale-clad integument extending forward in large examples to base of the penultimate spine.

Anal fin with three spines and five soft rays, second spine longer than third and much longer than first. In adults spines clothed with thick skin, except tips of first and second, skin of second remarkably voluminous.

Caudal fin, when expanded, slightly rounded in young, practically truncate in adults, and slightly emarginate when normally compressed.

General colouration of adults bright red, paler on ventral parts. Blackish or brownish blotches usually present on gill-cover. Indistinct dark mottlings, not forming regular transverse bars, present on body. Pectoral, ventral, and anal fins with more or less black pigment on membrane between rays. All unpaired fins with a rather broad dead-white margin. Spinous part of dorsal fin with black blotches on membrane behind second and few succeeding spines, membrane of posterior rays more or less completely black except at margin. Soft part of dorsal fin, between basal scales and white margin, with black pigment in varying extent—may be almost completely black or only with black streaks between rays. More or less black pigment between rays of caudal fin. Half grown (and probably also young) examples with oblique dark bars on the sides.²

Reaches a length of at least 520 mm.

¹ *Fide* Koehler *nec* Goode and Bean.

² In an example of 215 mm. (without caudal) the front part of the head is mottled, except ventrally, with brown. The gill-cover behind the preoperculum is almost uniformly blackish brown. The dorsum from the base of the third dorsal spine to the occipital region bears a broad ring of brown. The dorsal fin has a large dark brown patch between the fifth and ninth rays from which an oblique band is continued forward on the side to below the lateral line. The membrane of the soft dorsal rays is blackish and forms the upper part of a second oblique band which reaches the pectoral fin. A third but less distinct band descends from the upper surface of the caudal peduncle, which is in addition rather diffusely mottled. The pectoral has a distinct, broad blackish band on the membrane of its branched rays, and some blackish pigment occurs on the ventral, anal and caudal fins.

In addition to the marks already mentioned the dorsal fin has a large dark spot behind the second, third and fourth spines. All these markings remain quite distinct after a year's preservation in alcohol and formaline. A specimen of 408 mm. obtained in September, 1907, is much darker than any other. The black marking of the dorsal fin is continuous throughout, but is not carried to the base of the last few spines. On the sides from the base of the 6th dorsal spine to well below the lateral line every scale is outlined in dense black. Two completely black patches occur, one below the second half of the spinous part of the dorsal, the other below the soft rays. These patches do not quite reach the lateral line, and have not the appearance of oblique bars noted in the young. The caudal and anal have well marked black patches, but the head and shoulders are not unusually dark.

MEASUREMENTS, in millimetres, and number of Scales and Fin-rays of Seven Specimens.

a. Type of *S. cristulata*.

b. Type of *S. echinata*.

c. to g. Irish specimens, viz. c, S.R. 353; d, e, g, S.R. 400; f, S.R. 334.

—	a.	b.	c.	d.	e.	f.	g.
Total length, ...	175*	172	255	358	419	497	504
Total length without caudal fin.	145* (150)†	150	215	300	352	415	425
Length of head without lower jaw.	60* (68)†	66	89	127	160	178	175
Length of snout, ...	15* (14)†	16	19	30	33	41	38
Length of orbit, ...	20	20	23	30	37	43	38
Width between supra-orbital ridges.	8	7	10	14	18	24	24
Length of pectoral fin, ...	34*	34	46	72	86	97	105
Length of ventral fin, ...	28*	29	36	48	58	60	68
Snout to first dorsal spine, ...	55*	61	74	106	138	169	161
Snout to first anal spine, ...	98*	101	149	210	260	296	296
Anus to first anal spine, ...	—	15	17	25	26	31	30
Height of body at first dorsal spine.	50	46	68	94	120	138	137
Height of caudal peduncle, ...	14	13	23	35	45	48	51
Length of caudal peduncle from base of dorsal fin to anterior caudal ray.	20*	—	29	41	53	63	65
Number of scales above lateral line opposite anus.	8	7	9	9	8	8 or 9	9
Number of scales below lateral line opposite anus.	15	—	16	17	16	17	17
Number of scales between head and caudal fin.	(60 ca.)†	—	53	52 ca.	48,	51	53
Number of dorsal fin-rays, ...	XII 9	XII 9	XII 9	XII 10	XII 9	XI 10	XI 9
Number of anal fin-rays, ...	III 5	III 5	III 5	III 5	III 5	III 5	III 5

LENGTH in millimetres of Spines and Rays of Dorsal Fin.

Spinous Part.	a.	c.	d.	e.	g.
1st Spine, ...	8	11.5	13	—	28
2nd " ...	15*	20.5	26	29	40
3rd " ...	20* (22)†	29.5	36	40	41
4th " ...	22	30	40	43	43
5th " ...	22	29	40	41	42
6th " ...	21	28	36	44	40
7th " ...	20	27	36	42	38
8th " ...	17	25	35	39	32
9th " ...	14	21	31	34	25
10th " ...	11	18	28	27	22
11th " ...	10* (11)†	17	24	24	—
Posterior Spine, ...	16* (19)†	28	36	26	38
Longest ray, ...	21* (26)†	32	49	55	63

* Measurements shown in figure.

† These measurements given in the text differ from those shown in figure.

S. cristulata appears to be absolutely confined to deep water, and among deep water teleosteans which have come under our observation, is remarkable for the solidity of its tissues, both bone and muscle being apparently as strongly developed as in the familiar littoral species of the Mediterranean. From *S. dactyloptera*, the common species of our 100 fathom line, it is easily distinguished by the strong sub-orbital ridges and by the lower pectoral rays, which are not produced as apparently tactile organs beyond the fin membrane. In cephalic armature it rather closely resembles some of its congeners relegated by American authors to their genus *Pontinus*, but can be distinguished from them by the branched nature of some of the pectoral rays, all of which are simple in *Pontinus*.¹

S. cristulata has been trawled off the Irish coast at the following stations:—

S.R. 327.—8-5-'06. 51° 43' 30" N., 12° 15' W. to 51° 38' N. 12° 18' W., 550 to 800 fath., ooze. Temperature at 530 fath. 8.95° C., salinity at 500 fath., 35.16 ‰. One, 445 mm.

S.R. 334.—10-5-'06. 51° 35' 30" N., 12° 26' W., 500 to 520 fath. (Temperature at 51° 37' N., 12° 9' W., 500 fath. 9.19° C., salinity 35.10 ‰). One, 497 mm.

S.R. 353.—6-8-'06. 50° 37' to 50° 40' N., 11° 32' W., 250 to 542 fath., muddy sand. Temperature at 500 fath. 8.85° C. Two, 255 and ca. 450 mm.

S.R. 400.—5-2-'07. 51° 18' N., 11° 50' W., 525-600 fath. Temperature at 580 fath. 8.35° C., salinity 35.50 ‰. Three, 358 to 504 mm.

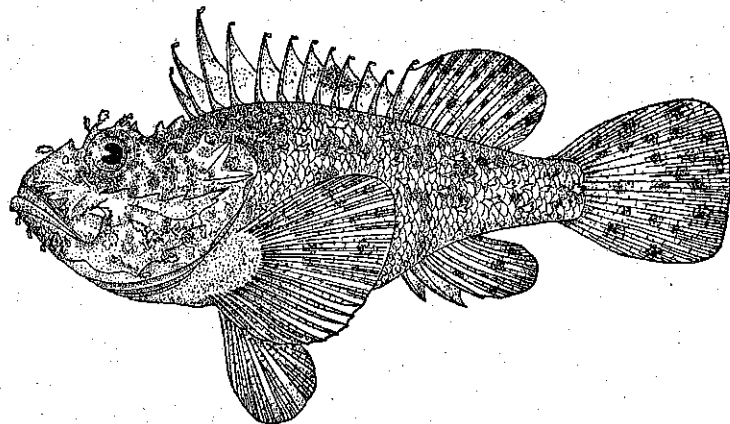
Other twenty-two specimens were taken in September, 1907, in the same neighbourhood at soundings ranging from 447 to 778 fath. Only two occurred at stations of which the greatest depth was less than 500 fath.

Reference to the list of deep water hauls on p. 17² suggests that the species does not occur at less than 400 fathoms off our coast, while it may be practically confined to depths of 500 fathoms or more.

It has also been taken, as already noted, at 722 fathoms in the Bay of Biscay, and at 440 fathoms off Georgia, U.S. America.

¹ This distinction is probably of no value in the case of very young *Scorpaenae* (of about 50 mm. or less) of any species or sub-genus.

² The list does not include the hauls made in September, 1907.

SCORPAENA SCROFA, L.*S. scrofa*, Lowe (1843-1860); Moreau (1882).*S. scrofa*, $\times \frac{1}{2}$.—Sketch adapted from Lowe.

Form thick, short, and clumsy; head very heavy and massive, especially in large examples; lower jaw slightly projecting. Head about $2\frac{1}{2}$ or $2\frac{3}{4}$ times in total length (without caudal), depth of body about $2\frac{3}{4}$ to $3\frac{1}{4}$. Length of orbit $3\frac{1}{2}$ to $4\frac{1}{2}$ times in head, diameter of eye considerably less than width of orbit, especially in large examples; length of snout in young about $\frac{1}{2}$ of length of orbit, in large examples equal to or longer than orbit, the relative proportions apparently depending upon the extent to which the circumorbital bones are developed; interorbital width varying in the same way from little more than half of to nearly as great as length of orbit. The long ridges and spines of the head are more developed in large examples, and appear to alter the contour and proportions of the head to a very great extent. Nasal region convex, with a single spine above each anterior nostril; supraorbital ridges standing out far above frontal profile, each with one spine anteriorly and two posteriorly. Interorbital space scaleless and very concave, with two faint ridges internal to the supraorbital ridges, each carrying a single or double spine interior and posterior to last supraorbital spine, and just in front of the broad transverse occipital groove, which they cross as low ridges, subsequently terminating on the nape in two spines, the anterior sometimes double, the posterior large and strong. Below these ridges other ridges run from the orbit backwards, bearing a small double spine near the orbit, and two larger spines near the opercular insertion. One or two more spines are situated on the body above the opercular insertion. Anterior suborbital with four to six strong diverging ribs, some of which overlie the maxilla when the mouth is closed; posterior suborbitals forming a stout ridge somewhat irregularly armed with about three spines. A stout bifid spine at symphysis of suborbitals with preopercular margin, below which, on preopercular margin, are four weaker spines, the lowest of them obsolete in large

specimens. Cheeks and preoperculum scaleless. Operculum dorsally elongated, and armed with two strong ridges, each carrying a stout adpressed spine. D. XII 9-10; A. III 5; the third spine largest. Rays of lower half of pectorals unbranched, and covered with thick skin in large examples. Caudal truncate. Scales about 40-45 in a longitudinal and 22-24 in a transverse series, somewhat irregular in arrangement. Head, mandible, and body with numerous lappets of skin, which may be very feebly developed in small examples.

Colours very variable, ordinarily some shade of vermilion, varying from orange to a deep ruddy cherry colour; head and cheeks with dusky and deep-red marblings and spots; body and fins with smaller speckles of various colours. A large dusky spot on posterior part of spinous dorsal.

The proportions and degree of development of the cephalic ridges in this fish are subject to very great variation. Lowe, who was well acquainted with the species, says—"Two states or varieties, depending chiefly upon age or size, may be distinguished of this fish; but they run so much into each other in respect to sex, locality, and season, as well as characters, that it had scarcely been desirable separately to define them, might not the observation of isolated individuals lead possibly to their erroneous distinction into species. That which may be called the normal sort, since it comprehends the largest full-sized fishes, from 15 to 20 inches long (Lowe's var. *obesa*), is deeper in proportion to its length than the other variety (Lowe's var. *histrion*), with the belly somewhat prominent or corpulent. The head, in consequence, seems shorter; and the eyes, though varying in this respect, are generally somewhat larger. The colours are altogether lighter or paler. . . . Such fishes are in general, but not uniformly, females; and full-sized old or aged fishes, of 18 or 20 inches long, almost invariably present these characters. They are said to be caught in deeper water, and further from the shore than the other sort."

"The other sort is a more slender or shallow fish; with the ventral line straight from the throat to the anal fin. The eye again varies in size, but is generally smaller. The head appears much thicker and longer, in consequence of its length greatly exceeding the depth; but is not actually longer or thicker in proportion to the whole length of the fish. The colours are altogether darker. . . . Such fish are caught nearer the shore or in shallower water than the others. . . . I have seen them of both sexes and at all seasons; but of never more than fifteen inches in length, and they are generally male fishes."

We have seen some specimens from depths of over 100 fathoms near Gibraltar which seemed to show some of the characters of Lowe's var. *obesa*, and also specimens from similar localities which, at about the same size, did not. The few other specimens of the species which we have carefully examined certainly showed a very wide range of variation, but we do not know from what depths they came, although none of them appeared to have either the pale colours or deep bodies of the var. *obesa*. Lowe does not mention the depth at which his specimens of that variety were

taken, but states in his note on *Sebastes Kuhli* that that species "is said to live in deeper water than the Carneiro (*S. scrofa*, L.), being caught with lines of from 100 to 250 fathoms, i.e. in a depth of from 3 or 4 to 10 linhas, instead of from 50 to 100 fathoms," so, presumably, the range of *S. scrofa* at Madeira, as in the Mediterranean and off Gibraltar, is not known to extend far below the 100 fathom line. As a littoral species it is unknown in British-and-Irish waters, but, like other species occurring both inshore and as deep as 100 fathoms at Madeira or in the Mediterranean, such as *Spinax niger* and *Pristiurus melanostomus*, it may occur in our area as a deep-water species only.

iii.—FAM. ALEPOCEPHALIDAE, Boulenger (1904).

These are exclusively deep-sea fishes, occurring in the Atlantic (including the Mediterranean) and Pacific Oceans, but apparently absent from the polar regions of either. In general external characters they may be said to be more or less compressed in form, sometimes considerably elongate. The head is scaleless, the body scaled or scaleless, sometimes set with numerous small tubercles having the structure but little of the appearance of luminous organs. The eyes are usually large, the mouth large or at least of moderate size, the margin of the upper jaw formed by the premaxillae and maxillae, the teeth small. The fins have no stout spinous rays; the dorsal is set far back opposite the hind part of the anal, which is at least as long as the dorsal and often much longer. Both fins are low, and there is no adipose fin. The pectoral and ventral fins are not large, the latter sometimes wanting, and, when present, usually set far back. The colour is generally black or dark brown.

GENUS ALEPOCEPHALUS, Risso.

As we understand the limits of this genus it may be defined as follows:—

Form moderately elongate and compressed; height of body less than length of head (including the membranous part of gill-cover). Length of head in adults not more than one-third of total length (without caudal fin). Cleft of mouth of moderate width, with the jaws nearly even in front; maxillae toothless, never extending beyond level of hind edge of orbit; small teeth on premaxillae, mandibles and palatines, absent from vomer, or if present, minute. Snout of variable length. Eye large. Opercular openings wide, gill membranes entirely separate. Opercular bones large and thin, their posterior edges imperfectly ossified; branchiostegals 6 (perhaps 7 in some species).

Pectoral and ventral fins well developed but relatively small. Dorsal and anal fins placed far back and opposite to one another; anal as long as or longer than dorsal. Caudal forked.

Head scaleless and covered with rather tough skin. Body covered with scales, thin, cycloid, and more or less deciduous, sometimes masking bases of dorsal and anal fins.

Deep-sea fishes of wide range in temperate and tropical seas, apparently absent from arctic and antarctic waters.

Goode and Bean (1895) have given a key to the species which they refer to *Alepocephalus*, and have placed other closely allied forms in a new genus, *Conocara*. The distinctions upon which they rely for the separation of the latter are in part contradicted by their own specific definitions, and appear to us insufficient to justify the generic separation from *Alepocephalus* of the forms placed in it. While defining *Conocara* as having no teeth on the palatines, they describe palatine teeth in both *C. Macdonaldi* and *C. macroptera*, and, presumably as the result of a clerical error, they also ascribe maxillary teeth to the latter. *Alepocephalus* is credited with "small," *Conocara* with "acicular" teeth, but to us the teeth of the two suggested genera do not appear to differ materially in character. *Conocara* has the "mouth moderate, snout prolonged." So also have *A. niger* and *A. Blanfordi*. *Conocara* is said to have the anal fin "very elongate, nearly twice as long as the dorsal." It is in fact more than twice as long in *C. macroptera*, but in *A. niger*, *A. bicolor*, and *A. edentulus*, it is also very elongate and considerably longer than the dorsal. The scales are described in *Conocara* as "minute and deciduous." They are minute, but the difference in size which separates them from those of *A. niger* is only one of degree, and is not greater than the difference between those of the latter species and *A. rostratus*. The statement that in *Conocara* the branchiostegal membrane of the left side is folded conspicuously over that of the right, is equally applicable to at least one species of *Alepocephalus* (*A. rostratus*). The only external distinctions which seem to be valid are that in forms referred to *Conocara* (1) the maxilla does not extend beyond the vertical from the front margin of the eye; (2) the anal fin is about twice as long as the dorsal; (3) about 200 rows of scales cross the lateral line; whereas in all other known species of *Alepocephalus* the maxilla is relatively more or less longer (very little in *A. niger*), the dorsal fin is considerably more than half as long as, and sometimes equal in length to the anal, and the number of rows of scales which cross the lateral line is never greater than about 150, and may be as low as 50. It is not likely that the list of *Alepocephali* is complete, and since existing forms show a good deal of diversity in combination of characters, there seems to be no good reason for retaining *Conocara* as a genus. As a sub-genus it has its merits, which is more than can be said for *Mitchillina*, proposed as a genus by Jordan and Evermann, and very imperfectly defined or definable.

In the following key we show what appear to us to be the more salient characters that may be employed in distinguishing the species referred by us to *Alepocephalus* from one another. We have, however, refrained from attempting to do more than group the described species in such a manner as to facilitate the

preliminary determination of any example, as most of these forms are known to us from figures and descriptions alone; and we wish to refrain from expressing any view as to the validity or otherwise of species founded upon specimens which we have not examined.

The key must of course be used in the light of a general knowledge of the developmental changes of form in deep-sea fishes, since in some cases we have no means of knowing whether existing descriptions are founded upon specimens which have attained adult characters.

We cannot regard the lengths of the head and eye in this genus as altogether satisfactory characters for the purposes of a key. The bony part of the gill-cover seems to be too variably ossified to afford a constant hinder boundary for the head, and the membranous part may be defective, while the length of the eye may be based in description and figure indifferently on the whole organ or on so much of it as is not concealed by the integuments. In using the length of orbit in relation to that of the snout for broad distinctions, we believe we are justified by the adequacy of either description or figure of the species concerned. Although the scales of *Alepocephali* are more or less deciduous and the skin is soft, there is in fact no great difficulty in reading the scale formula within the wide limits here adopted.¹

I. Dorsal and anal fins of the same or almost the same length.

A. Scales large, about 50 to 70 series crossing the lateral line.

(i.) Horizontal diameter of orbit about equal to or greater than length of snout. Maxilla reaching to about level of centre of eye.

(a.) Length of base of anal fin much greater than combined lengths of snout and orbit. D. 18-22. A. 20-25.

- (1.) *A. rostratus*, Risso (1820).
Mediterranean and neighbouring parts of Atlantic, 400 (?) to 1,997 fath.²
- (2.) *A. Bairdi*, Goode and Bean (1879 and 1895), Günther (1887), Jordan and Evermann (1896-98).
North-Western Atlantic, 200 fath.
- (3.) *A. Giardi*, Koehler (1896).
North-Eastern Atlantic, 350 to 776 fath.

¹Goode and Bean's key of *Alepocephalus* is not intelligible, on account of the use made in it of the characters of the opercular flaps. The species are equally divided into those in which the opercular flaps are said to be "voluminous," and those in which they are "moderate." Among the latter is placed *A. edentulus*, among the former *A. Blanfordi*, but so far as we can interpret such a character at all the *Investigator* figures seem to show the flaps more voluminous in *A. edentulus* than in *A. Blanfordi* or any other species.

²No data of depth of occurrence in Mediterranean are available.

(b.) Length of base of anal about equal to combined lengths of snout and orbit. D. 16-17. A. 17-19.

- (4.) *A. asperifrons*, Garman (1899).
Pacific Coast of Central America, 780-1,020 fath.
- (ii.) Horizontal diameter of orbit less than length of snout. Maxilla only reaching to below front of eye. Base of anal shorter than combined lengths of snout and orbit. D. 16-17. A. 17.
- (5.) *A. Blanfordi*, Alcock (1892 and 1899), Illust. Zool. Invest. (1894).
Arabian Sea, 902 fath.
- (6.) *A. productus*, Gill (1883), Günther (1887), Goode and Bean (1895), Jordan and Evermann (1896-98).
North-Western Atlantic, 1,360 fath.
- B. Scales of moderate size, about 85 to 100 series crossing the lateral line. D. 15-18. A. 17-19.
- (7.) *A. Agassizi*, Goode and Bean (1882 and 1895), Günther (1887), Jordan and Evermann (1896-98). Lütken (1898).
North-Western Atlantic, 922 fath. South-West of Iceland, 912 fath.
- (8.) *A. tenebrosus*, Gilbert (1891), Jordan and Evermann (1896-98).
Pacific Coast of North America, 360-820 fath.
- (9.) *A. fundulus*, Garman (1899).
Pacific Coast of Central America, 1,270-1,670 fath.
- (10.) *A. convexifrons*, Garman (1899).
Pacific Coast of North America, 660 fath.

II. Anal fin considerably longer than, but not more than half as long again, as dorsal. D. 20-30. A. 26-35.

A. Scales large, 50 to 70 series crossing lateral line.

- (11.) *A. edentulus*, Alcock (1892 and 1899), Illust. Zool. Invest. (1900).
Bay of Bengal, 475 fath.
- (12.) *A. bicolor*, Alcock (1892 and 1899), Illust. Zool. Invest. (1892), Brauer (1906).
Indian Ocean, 240-410 fath.

B. Scales small, about 140 series crossing lateral line.

- (13.) *A. niger*, Günther (1878 and 1887).
South-Western Pacific, 1,400 fath.

III. Anal fin nearly twice as long as dorsal. D. 18-21. A. 36-40. Scales very small, about 200 series crossing lateral line. (*Conocara*).

- (14.) *A. macropterus*, Vaillant (1888).
Northern Atlantic, (68) 235 to 1,156 fath.
- (15.) *A. Macdonaldi* (Goode and Bean, 1895), Jordan and Evermann (1896-98).
Gulf of Mexico, 955 fath.

For the purposes of these notes we are only concerned with species which fall into the divisions I A (i) (α) and III, since the other divisions are not so far represented in collections made on the European Atlantic slope.

Messrs. Farran and Kemp have tested the gastronomic properties of *A. rostratus* and *A. Giardi*, and pronounce them to be indifferent. The flavour is distinct and unpleasant, while the texture is disagreeably gelatinous.

We cannot account for the exceedingly bad condition of Vaillant's material of the genus. He speaks of specimens coming to pieces in the process of examination. Our specimens, which were naturally derived from similar depths, must have come on board in excellent condition, and though the scales mostly fell off *A. rostratus* and *A. Giardi* and more or less of the fin-membrane is missing, the general tissues are in excellent condition after preservation in 5 per cent. formaline, and quite firm, though not stiff like those of more solidly built fishes. It is true that some *A. rostratus* placed at the bottom of trays in the *Helga's* store tank are very much flattened and of no use for study of the natural height of the body, but our material is sufficiently abundant to admit of neglect of these specimens. Some of the specimens of *A. macroptera* are practically perfect even as to scales. The experience of one of us suggests that Vaillant's specimens, though no doubt properly preserved in alcohol of the right strength when captured, may have subsequently been exposed for a lengthened period to a somewhat high temperature (probably unavoidable in the region of research covered by the *Travailleur* and *Talisman*), and may in this way have undergone a certain amount of maceration before they reached the museum. Fortunately or otherwise, collections made off the coasts of this island are not liable to danger from an unduly high temperature, other than that which may be traceable to proximity to the engine room.

ALEPOCEPHALUS ROSTRATUS, Risso (1820).

Pl. III, Fig. 1.

Alepocephalus rostratus, Cuvier and Valenciennes (1828-49), Johnson (1862), Günther (1887), Moreau (1882), Vaillant (1888), Goode and Bean (1895).

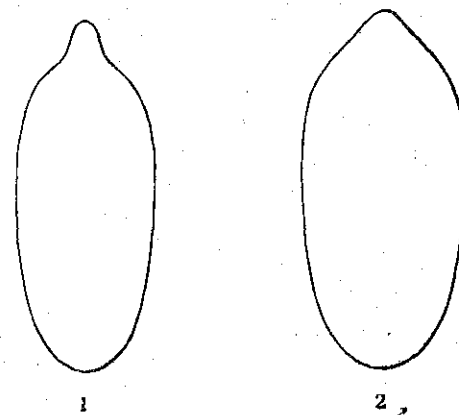
Form (in specimens of 220 mm. and upwards, without the caudal fin) somewhat elevated, compressed, greatest height of body (between vent and ventral fins) about 4 to 5 in total length (without caudal); back with a distinct narrow ridge running forward from dorsal fin to near region of shoulder. Length of head, with gill-cover membranes, about $3\frac{1}{2}$ to $3\frac{1}{4}$ in total length without caudal fin; hind margins of gill-covers nearly horizontal. Horizontal diameter of orbit about equal to or a little greater than length of snout, about 4 in length of head. Eye without external occluding membrane. Width between supraorbital ridges opposite middle of eye a little more than $\frac{2}{3}$ of horizontal diameter

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of orbit in adults, relatively less in young. Inter-orbital space nearly flat. Snout more or less prominently arched in profile over nasal region and inflected in front of it; a rather conspicuous depression at nape. Jaws subequal or with the lower slightly projecting. Maxilla reaching about to vertical from centre of pupil but somewhat variable, its posterior edge obliquely truncate, with broadly rounded posterior angle. Mandible reaching almost or quite to vertical from hind edge of orbit. Teeth small, sharp, closely set, in single series on premaxillae, mandibles, and palatines. Vent at more than $\frac{2}{3}$ (.67 to .70) of total length without caudal. Pectoral fins a third to nearly a half longer than orbit, their bases at some distance from gill-cover membranes. Ventral fins longer than orbit, set a little behind middle point of total length without caudal fin, not reaching vent. Dorsal and anal fins of nearly equal length, their bases fleshy and clothed with scaly integument which more or less masks the small anterior rays. Dorsal, commencing about opposite to vent, with about 16 to 20 rays; anal, continued some way behind dorsal, with about 18 to 22 rays. Caudal fin forked, its dorsal and ventral rays extending some way forward above and below peduncle. Caudal peduncle of variable height, about $\frac{1}{3}$ more or less of length of head; its length, measured from vertical of end of base of dorsal to origin of central caudal rays, more than $\frac{1}{4}$ but considerably less than $\frac{2}{3}$ of length of head.

Scales large, much longer than broad, truncated in front and rounded at their free edges, but tending to become pointed on the back and belly and at the base of the dorsal and anal fins, pearl-coloured with violet black exposed margin, in about 51 to 54 transverse rows between head and central caudal rays, and about 8 or 9 longitudinal rows above and about 10 to 14 below lateral line; present on all parts of body (except behind base of pectoral fin), and on bases of median fins. Colouration practically uniform black in life, head deep velvety black, body purplish black (except where scales are exposed by fraying off of the natural dark epidermal covering). Size, reaches 590 mm., including caudal fin.

For measurements of specimens, see p. 44.



Section in front of dorsal fin.

1. *A. rostratus*. 2. *A. Giardi*.

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The form of the back of *A. rostratus* is more easily expressed by diagram than in text, and we therefore refer readers to the figures given above, in which sections of *A. rostratus* and *A. Giardi*, taken some way in front of the dorsal fins, are shown side by side. It will be seen that in *rostratus* the sides, converging towards the middle line of the back, are abruptly elevated into a distinct ridge, whereas in *Giardi* they meet in the manner usual in fishes of moderately compressed form, and are without any marked interruption of the general direction of convergence. In the last-named species the back becomes somewhat flattened in the anterior region, but in *rostratus* the ridge is commonly more or less well defined as far forward as the shoulders. It is in fact a forward continuation of the thick fleshy base of the dorsal fin, and may be supposed to be homologous with the remarkable dorsal amputation of the presumably larval form which Vaillant described under the name of *Anomalopterus pinguis*, and with the bladder-like expansion of the embryonic dorsal fin which characterises the larvae of some species of *Scopelus* (Holt, 1898).

The scales of *A. rostratus* are deciduous, but a good proportion of them are found *in situ* in specimens which have not been much injured in the trawl, and permit of reasonably faithful restoration by the artist. They extend, however, somewhat further on to the rays of the dorsal and anal fins (and are there narrower and more pointed) than is shown in our figure. The fin-rays, though slender, are tough, but the fin-membranes are very delicate and are practically wanting in all our material. The tissues of the body are very soft when fresh, and specimens subjected on first preservation to the pressure of superincumbent material, become flattened to almost pleuronectid form. Such have naturally been neglected in our record of measurements and proportions. Females of 440 mm. without the caudal fin are mature, and it is probable that maturity is reached at a smaller size, though of this we have no evidence. The nearly ripe ovarian ova are large, probably at least 2.5 mm. in diameter, but none were measured. Females with such ova were taken in May and August, 1906.

The stomach of one specimen contained a hermit crab, *Eupagurus excavatus*, or the like. Several others examined contained no recognisable food.

Specimens were taken in the *Helga's* trawl at the following stations:—¹

- S.R. 327.—8-5-'06. 60 mi. W. $\frac{3}{4}$ N. of the Tearaght Light. 51° 46' N., 12° 14' 30" W., 550 fathoms, ooze. Temperature at 530 fathoms, 8.95°C., salinity at 500 fathoms, 35.16 ‰.
Six specimens, 365 to 568 mm.¹

¹ The measurements given in this list were made on capture and purport to be accurate only to the nearest centimetre, except in the case of S. R. 327, when the fish were measured after preservation to the nearest millimetre. The smallest specimen from this station had lost its caudal fin.

- S.R. 331.—9-5-'06. 51° 12' N., 11° 55' W. 610 to 680 fathoms, ooze.

Three specimens, 510 to 550 mm.

- S.R. 353.—6-8-'06. 50° 37' to 50° 40' N., 11° 32' W., 250 to 542 fathoms, muddy sand. Temperature at 500 fathoms, 8.85°C.

Three specimens, 510 to 590 mm.

- S.R. 359.—7 and 8-8-'06. 60 mi. W. by N. of Tearaght Light, 51° 59' N., 12° 9' W., 492 fathoms, ooze. Temperature at 475 fathoms, 9.04°C.

One specimen, 560 mm.

- S.R. 387.—7-11-'06. 51° 47' N., 12° 12' W., 530 to 535 fathoms, ooze. Temperature at 500 fathoms, 9.13°C., salinity 35.39‰.

One specimen, 280 mm.

- S.R. 397.—2-2-'07. 51° 48' to 51° 44' N., 12° 6' 30" to 12° 4' W., 646 to 549 fathoms, ooze. Temperature at 500 fathoms, 8.71°C., salinity 35.55‰.

One specimen, 480 mm.

- S.R. 400.—5-2-'07. 51° 22' 30" to 51° 16' N., 11° 48' to 11° 50' W., 525 to 600 fathoms, grey ooze. Temperature at 580 fathoms, a few miles to south-west, 8.35°C., salinity 35.50‰.

Nine specimens, 280 to 520 mm.

A. rostratus has long been known from the deep water of the Mediterranean, but we have seen no precise statement of its vertical range in that sea nor of the size to which it there attains. Vaillant records 24 specimens from the Azores, Cape Verde, Canaries, coasts of the Soudan and Morocco and the Banc d'Arguin (20° N.) at depths ranging from 454 to 1,997 fathoms. His collection, however, admittedly comprises some which could not be determined with absolute certainty, and at least one which seems to have been *A. Giardi*.

Richard (1904) records a single specimen of *A. rostratus* from 986 fathoms in the Bay of Biscay, but none were taken there by the *Caudan*. Our own records extend the range northwards to the deep water off the south-west coast of Ireland, where the 400 fathom line may be supposed to be somewhere near the upper limit of vertical distribution. In one haul in which specimens were taken the least soundings were 250 fathoms, but the haul also included soundings down to 542 fathoms, while those in all other hauls were at least 492 fathoms. The greatest depth of capture was 778 fathoms. Deeper grounds in this region are as yet practically unexplored,¹ but from the 400 fathom line shorewards the *Helga* has made many hauls, without revealing the presence of the species. A certain amount of trawling has been done off the Mayo section of the coast, at depths extending to about 500 fathoms, without encountering *A. rostratus*, which is likewise absent from the list of fishes taken by the *Michael Sars* off the Färös and Hebrides in similar soundings.

¹ For analysis of hauls see p. 17: for additional records see p. 36.

ALEPOCEPHALUS GIARDI, Koehler (1896).

Pl. III, Fig. 2; Pl. IV, Figs. 1, 2.

A. Giardi, Collett (1905).

Form elongated and compressed, greatest height of body between vent and ventral fins, and about $5\frac{1}{2}$ to 6 in total length without caudal fin; back rather flattened anteriorly and without any trace of a ridge in front of dorsal fin. Length of head, with opercular membranes, about 3 to 4 in total length without caudal fin (3 times or a little less in specimens of 250 mm. or under, 4 times or rather less in specimens of 500 mm. or over). Opercular membranes with an obliquely descending margin and longest ventrally. Horizontal diameter of orbit greater than length of snout, and about 3 to 5 in head (3 times or a little more in specimens of 200 mm. or under, $4\frac{1}{2}$ times or more in specimens of 550 mm. or over). Eye as in *A. rostratus*. Width between supraorbital ridges opposite middle of eye more than $\frac{2}{3}$ of horizontal diameter of orbit (in specimens exceeding 350 mm.) not more than $\frac{1}{2}$ such diameter in very young; interorbital space depressed internal to supraorbital ridges, but reaching their level in central region. Snout only slightly arched in profile over nasal region and scarcely inflected in front of it, but rather variable in both particulars; profile descending more steeply from level of eye in large than in small examples. Depression at nape inconspicuous or absent. Jaws subequal or with the upper slightly projecting. Maxilla reaching about to vertical from centre of eye or even to hind margin of orbit in adults, relatively shorter in young, its posterior edge very obliquely truncate with narrowly rounded posterior angle. Mandible reaching beyond hind margin of orbits in adults, relatively somewhat shorter in young. Teeth as in *A. rostratus*. Vent at about $\frac{2}{3}$ of total length without caudal. Pectoral fins a third or more longer than orbit, their bases close to margins of gill-cover membranes. Ventral fins apparently relatively shorter than in *A. rostratus* (imperfect in our material), set at or a little in front of middle point of total length without caudal fin, not reaching vent. Dorsal and anal fins of nearly equal length, their bases of moderate size, not very fleshy, clothed with scales. Dorsal, commencing opposite or a little behind vent, with about (18?) 20 to 23 rays. Anal, continued some way behind dorsal, with about

1 *A. rostratus*—additional records may be epitomised as follows:—

- S.R. 477, 28-8-'07, 707-710 fath. One, 55 cm.
- S.R. 483, 30-8-'07, 610-664 fath. One, 46 cm.
- S.R. 487, 3-9-'07, 540-660 fath. One, 50 cm.
- S.R. 489, 4-9-'07, 720 fath. One, 52 cm.
- S.R. 490, 7-9-'07, 470-491 fath. One, 38 cm.
- S.R. 491, 7-9-'07, 491-520 fath. Five, 37 to 55 cm.
- S.R. 493, 8-9-'07, 533-570 fath. One, 54 cm.
- S.R. 494, 8-9-'07, 550-570 fath. One, 52 cm.
- S.R. 499, 11-9-'07, 666-778 fath. One, 40 cm.
- S.R. 506, 12-9-'07, 661-672 fath. One, 51 cm.

21 to 25 rays. Caudal fin as in *A. rostratus*. Height of caudal peduncle about $\frac{1}{3}$ of length of head in adults, relatively less in young; its length, measured from vertical of end of base of dorsal to origin of central caudal rays, about $\frac{1}{4}$ of length of head in adults. Scales longer than broad, the free margins more or less angular in form, not simply rounded as in *A. rostratus*,¹ though scarcely angular on anterior parts of sides; brownish grey in colour with black margin, and in about 60 to 67 transverse rows between head and origin of central caudal rays, and about 6 to 8 longitudinal rows above and about 9 or 10 below lateral line, present on all parts of body (except as in *A. rostratus*) and on bases of median fins. Colouration as in *A. rostratus*. Size, reaches 840 mm. including caudal fin.

A male *A. Giardi* of 378 mm. without caudal fin appears to be immature. Another of 522 mm. has the testes still small, but is probably mature. A female of 730 mm. has the ovary full of spawn, the largest ova measuring about 3.5 mm. in diameter. These were semi-translucent when the specimen was first examined after some months' preservation in formaline, and are probably nearly ripe, but smaller than they would have become after extrusion and swelling in the water. No oil-globules were noticed on casual examination, and as the specimen was afterwards transferred to alcohol their presence or absence cannot now be determined. The date of capture was 9th May, 1906.

No food was found in the stomachs of several specimens examined.

For measurements of large specimens see page 44.

The smallest specimens that can be referred to *Alepocephalus* are 9-11 mm. in length (without caudal fin), and lack their integuments and the greater part of their fins in addition to having suffered from more or less crushing. They appear to differ from larvae of similar size attributed by us to *Bathytroctes* in the absence of the supra-clavicular appendage present in the last named specimens and in the toothless maxilla, while in such remains of fins as are left, and in the form of the head, they resemble them. The presence in the net in which they were captured of undoubted *Alepocephalus* larvae of larger size affords some further ground for referring them to that genus.

Of the generic identity of the specimens hereafter mentioned we do not think there can be any doubt, and those of 35 mm. and upwards seem to be undoubtedly referable to *A. Giardi*; the smaller specimen figured by us we also regard as belonging to that species, and others of the same approximate size do not appear to differ from it in any material respect, although the risk involved in relying upon the number of fin-rays as a character for distinguishing *A. Giardi* from *A. rostratus*, and the somewhat crushed condition of the specimens, makes it unsafe to attempt to refer them with absolute certainty to the former.

The general appearance of a specimen 20.5 mm. long (without the caudal fin) is shown in Pl. IV, fig. 1. It is difficult to ascertain

¹ The scales are not correctly shown in our figure. They should be slightly more angular in outline.

the true contour of the opercular and abdominal regions, and it is possible that our figure represents them as proportionately rather too deep; a larval fin-fold may at this size persist between the anal and caudal fins, as well as between the dorsal and caudal. Save in these particulars our figure shows accurately enough the appearance of specimens of between 19 and 23 mm. long (without the caudal fin); we refrain from setting out the measurements of these small, and often crushed or damaged specimens, but in all of them the length of the head is contained about 3 times, and the length to the origins of the dorsal and anal fins $1\frac{1}{2}$ times or a little more in the total length without caudal; the eye is longer than the snout, and its longitudinal diameter is contained 3 times or slightly more in the head, and the maxilla reaches as far as the level of the centre of the eye, or a little short of it; the head is at least $1\frac{1}{2}$ times as deep as the body at the origin of the ventrals, and nearly $2\frac{1}{2}$ times as deep as the caudal peduncle. There are about five small teeth on each side on the mandible and premaxilla, the maxilla is toothless.

The outline of the pectoral girdle is plainly visible through the skin; there is no supra-clavicular appendage (such as is well marked in *Bathytroctes* at the same size). The pectoral fins are small, the ventrals well developed and situate somewhat nearer to the caudal origin than to the point of the snout. The dorsal and anal fins originate opposite to one another; their rays appear to be, D. 20-23, A. 21-25.

Myomeres cannot be counted, but are apparently more numerous than in *Bathytroctes*, and no sign of developing scales can be detected.

Lower part of head, operculum and abdominal region very darkly pigmented, the rest of the body after preservation pale fawn or sepia.

The next stage represented is of the length (without caudal) of 35-36 mm. (see Pl. IV, fig. 2). The differences between this stage and the last are such as might be expected to occur with growth; the eye is relatively smaller, the fins more developed, and we can see no trace of the larval marginal fin. The teeth in the upper jaw appear to be relatively smaller, and are confined to the premaxilla. Myomeres cannot be counted, but there seem to be signs of developing scales on the anterior part of the body. Colours much as in the smaller specimens, but generally darker, the caudal region and upper parts being sepia rather than fawn.

A specimen 47 mm. long (without caudal) is rather damaged; the changes in proportions with growth continue, and the points worthy of note seem to be the comparatively more anterior position of the ventrals, the apparent further reduction in comparative size of the teeth, the generally darker colour, and the practical certainty that there have been scales on the anterior part of the body.

A specimen 72 mm. long (without caudal) is again more darkly pigmented, and has had a complete scaly covering to the body, L.L. about 66. Relatively to the eye the maxilla appears longer than in earlier stages, and carries a few very minute teeth. The

ventrals originate a little posterior to midway between the point of the snout and the caudal origin, but apparently comparatively farther back than in the specimen of 47 mm. The bones of the pectoral girdle are barely visible through the skin.

Our records of *Alepocephalus* furnish no explanation of the apparent immunity from capture of the larvae of *A. rostratus*, which seems to be commoner in the region investigated than *A. Giardi*.

In regard to specimens of adult form it is easy to distinguish *A. Giardi* from *A. rostratus* by the absence of the dorsal ridge¹ and consequent less height of the body, by the longer caudal peduncle and by the greater number of scales. Vaillant, who doubtfully counted the traces of 71 scales in a specimen which he supposed to be *A. rostratus*, may probably have had to do with *A. Giardi*, since he remarks that his specimens of *Alepocephalus* were in such bad condition that specific differences may have been overlooked. The scales of *A. Giardi* are more deciduous than in *A. rostratus*, and the fin-rays considerably more brittle, but the tissues of the body are firmer and the form is not subject to serious alteration by pressure under the ordinary circumstances of preservation.

A. Giardi comes at least very near to *A. Bairdi*, an older species known from a single specimen, measuring about 620 mm. without the caudal fin, taken at 200 fathoms on the Newfoundland Banks. It may be briefly described, abridging Goode and Bean's text, as follows:—D. 22, A. 25. Scales 7/65/11, free part of scales triangular in form. Length of head $4\frac{1}{2}$, height of body $5\frac{1}{2}$, height of caudal peduncle 11 in total length without caudal fin. Snout as long as orbit, about $4\frac{1}{2}$ in length of head. The figure shows the snout abrupt, rather inflated above the nostrils, and shorter than the orbit, and the lower jaw is shown as projecting beyond the upper. The pectoral fin is shown somewhat remote from the gill-cover membrane.

There is nothing in the formulae of scales and fin-rays to distinguish *A. Bairdi* from *A. Giardi*, and as the type of the former was captured by a fishing schooner its proportions may well have been somewhat altered by post-mortem changes before it reached the hands of a naturalist.

Our nearest example of *A. Giardi* in point of size measures 560 mm. without the caudal fin, and has length of head about $3\frac{3}{4}$, height of body less than $5\frac{1}{2}$, height of caudal peduncle about $12\frac{1}{2}$ in total length without caudal fin, orbit a little longer than snout, and about $4\frac{1}{2}$ in length of head.

Our table of measurements (p. 44) demonstrates the existence of considerable minor variations of proportions in *Alepocephali* even when preserved in formaline on capture, and we have noticed that undue drying tends to emphasise the prominence of the snout above the nostrils even after fixation in formaline, while the same process would undoubtedly shorten up the gill-cover membranes, which the figure shows to have been used, as in our measurements, as defining the length of the head. By

¹ See text-figure on p. 33.

altering the snout of *A. Bairdi* to its probably normal form and extending the possibly shrunken or defective gill membranes to the neighbourhood of the base of the pectoral, any serious discrepancy of proportion between that form and *A. Giardi* would be removed. The form of the scales demands remark. In *A. Bairdi* they are described as having the free part triangular, and are so depicted all over the body, mostly, one may suppose, in restoration. Koehler's type of *A. Giardi* had no scales. Taking Collett's figure with his description it appears that he found them somewhat produced, but hardly triangular. In our specimens the scales are exceedingly deciduous, but at least one specimen retained a considerable number when it first reached the hands of one of us, who failed to notice any conspicuous difference in the shape of the scales as between *A. Giardi* and *A. rostratus*, though difference in colour was obvious.

All our specimens are now scaleless, except in the pectoral region where the scales are more or less rounded, certainly not triangular in posterior outline. It is not improbable from the appearance of the scale insertions that the scales of the sides in *A. Giardi* are more pointed than in *A. rostratus*, but we believe them to be less so than in the figure of *A. Bairdi*, and we suspect that the appearance of that figure may be due to a general restoration of scales on the evidence of the lateral line or fin bases.

While it is possible that *A. Bairdi* and *A. Giardi* are identical, no serious inconvenience is likely to arise from the retention of Koehler's name for European specimens until opportunity may arise of comparing them with the American type. Koehler, in describing *A. Giardi*, notes the proportions of *A. Bairdi*, but does not seem to have considered the difference in size between his type and that of the American species. Collett notes the resemblance between the two species in scales and fin rays, remarking that *A. Giardi* has a bigger head, and differently placed anus and dorsal, but this last difference does not seem to be supported by measurements.

Adult or half-grown specimens of *A. Giardi* were taken in the *Helga's* trawl at the following stations¹ :—

S.R. 327.—8-5-'06. 60 mi. W. $\frac{1}{2}$ N. of the Tearaght Light. 51° 46' N., 12° 14' 30" W., 550 fathoms, ooze. Temperature at 530 fathoms, 8.95°C., salinity at 500 fathoms, 35.16‰.

One specimen, 530 mm. (without caudal fin).

S.R. 331.—9-5-'06. 51° 12' N., 11° 55' W., 610 to 680 fathoms, ooze.

Three specimens, 530 to 850 mm.

¹ More recent captures may be epitomised as follows :—

S.R. 400.—5-2-'07. 525-600 fath. Three, 43-68 cm.

S.R. 484.—30-8-'07. 602-610 fath. One, 69 cm.

S.R. 489.—4-9-'07. 720 fath. One, 74 cm.

S.R. 495.—8-9-'07. 346-400 fath. One, 63 cm.

S.R. 505.—12-9-'07. 464-627 fath. One, 61 cm.

S.R. 365.—10 and 11-8-'06. 51° 25' N., 11° 32' W., 385 to 440 fathoms, sand and stones. Temperature at 380 fathoms, 9.44°C.

One specimen, 652 mm.

S.R. 440.—16-5-'07. 51° 45' N., 11° 49' W., 389 fathoms, Temperature at 300 fathoms, 9.94°C.

One specimen, 550 mm.

The larvae and young above recorded occurred as follows :—

Helga CXX.—24-8-'01, 77 mi. W.N.W. of Achill Head. Townnets on trawl, 382 fathoms.

One specimen, 20.5 mm. (without caudal fin).

S.R. 327 (see above).—Sprat net and townnets on trawl.

Three, 72, 36, and 35 mm. (without caudal fins).

S.R. 331 (see above).—Sprat net on trawl.

One, 36 mm. (without caudal fin).

S.R. 333.—11-5-'06. 51° 37' N., 12° 9' W. Temperature at 500 fathoms, 9.2°C. Sprat net on trawl, 557-579 fathoms.

One, 47 mm. (without caudal fin).

S.R. 352.—5-8-'06. 50° 22' N., 11° 40' W. Soundings 800 fathoms. Temperature 7.33°C. Mid-water otter trawl, 700 to 750 fathoms.

Two, 23 and 22 mm., and three, 9.11 mm. (without caudal fins).

S.R. 363.—10-8-'06. 51° 22' N., 12° 0' W. Mosquito net on trawl, 695-720 fathoms.

Five, 19-13 mm. (without caudal fins).

The types of *A. Giardi*, two small specimens, were taken by the *Caudan* in the Bay of Biscay at 437 and 776 fathoms. The *Talisman* or *Travailleur*, as we have seen, probably got at least one example of the species within the area covered by Vaillant's records of *A. rostratus*. On the west coast of Ireland *A. Giardi* cannot be common, in adult form, on grounds of less than about 350 fathoms, and seems to be somewhat less abundant on deeper grounds than *A. rostratus*. Larvae and very young forms, apparently referable to *A. Giardi*, have been taken somewhat frequently by the *Helga*, as appears above, and it may be that the habits of this species when adult render it somewhat less susceptible to capture in the trawl than the other. The *Michael Sars* obtained her six specimens north-west of the Hebrides and south-west of Färö in soundings of about 400 to 650 fathoms.

If *A. Giardi* proves to be a synonym of *A. Bairdi*, the species occurs also on the west side of the Atlantic (Newfoundland Banks, 200 fathoms).

It would seem from the *Helgas* records that the vertical range of *A. Giardi* is similar at all stages of which we have cognisance. The three hauls in which young specimens of over 35 mm.

long occurred were all in the neighbourhood of grounds on which the adult has been taken, and adults were actually present in the trawl in two out of these three hauls. When the nature of the net used is taken into consideration it seems reasonable to presume that the habits of the adult have been assumed by the time that a length of 35 mm. or thereabouts is attained.

At smaller sizes, specimens from 19 to 23 mm. long occurred on two occasions in nets attached to the trawl (adults being taken on neither such occasion), and once in a mid-water net fished about 50 or 100 fathoms above the bottom, in company with much smaller specimens apparently referable to the same species.

ALEPOCEPHALUS MACROPTERUS, Vaillant (1888).

Pl. V, Fig. 1.

Conocara macroptera, Goode and Bean (1895).

Form (in specimens of 203 mm. upwards without the caudal fin) elongate, compressed: greatest height of body (at shoulder) about $6\frac{2}{3}$ to $6\frac{1}{4}$ in total length without caudal fin. Upper surface of head and preanal region of back rather flattened. Length of head with gill-cover membranes about $3\frac{3}{4}$ in total length without caudal fin; hind margins of gill-cover membranes rounded. Horizontal diameter of orbit about $\frac{2}{3}$ of length of snout and about 4 to $4\frac{2}{3}$ in length of head. Eye large, partly occlusible by a fold of skin. Width between supraorbital ridges opposite middle of eye about $\frac{4}{5}$ of horizontal diameter of orbit. Interorbital space nearly flat. Snout rather narrow, depressed, obtusely pointed in dorsal view. No depression at nape. Jaws subequal, or with the upper slightly projecting. Maxilla hardly reaching vertical from front margin of orbit. Teeth as in *A. rostratus* and *A. Giardi*, but somewhat more widely separate. Vent at slightly in front of middle of total length without caudal fin. Pectoral fins as long as or longer than snout, their bases at some distance from gill-cover membranes. Ventral fins as long as or longer than orbit, reaching slightly beyond vent, their bases set considerably in front of middle of total length without caudal fin. Dorsal fin commencing far behind vertical from anus; length of its base about equal to its distance from vertical of origin of central caudal rays; with about 19 to 21 rays, of which the first few are small and more or less masked by skin and scales. Anal fin commencing at a noticeable interval behind anus; its base about twice as long as, and extending beyond, that of dorsal fin, with about 37 to 40 rays. Caudal fin deeply forked, anterior rays extending forward above and below peduncle more than half way from origin of central rays to vertical from end of base of dorsal. Height of caudal peduncle about $4\frac{1}{2}$ to $4\frac{1}{4}$ in length of head; its length measured from vertical of end of base of dorsal to origin of central caudal rays about $1\frac{1}{2}$ to 2 in length of head.

Scales minute, rather longer than broad, in about 194 to 222 transverse rows between head and origin of central caudal rays, and about 20 to 24 longitudinal rows above, and about 36 rows below lateral line; present on all parts of the body (except behind base of pectoral fin and on a part of the axillary region), and on the bases of the median fins. Colouration practically uniform black, head deep velvety black with blue iridescence, body purplish black, extremities of median fins brownish grey. Size reaches 330 mm. The eye actually fills the orbit to the extent usual in the genus, but considerably more of its external surface is clothed with skin than in *A. rostratus* and *A. Giardi*. The edge of the skin is moreover in the form of a fold, at least dorsally, where it can be expanded in such a way as to occlude much of the upper half of the normally exposed part of the eye. It would be rash to assume that this provision is indicative of vertical movements on the part of the fish through strata materially differing in circumstances of illumination by atmospheric or other light. The nostrils are immediately in front of the orbit, as shown in Vaillant's figure. His text statement that they are midway on the snout shows that he measured the latter, for this purpose, from the exposed part of the eye. *A. Macdonaldi* (Goode and Bean) appears to be chiefly distinguished from *A. macropterus* by the relatively higher body and larger head, respectively described as $5\frac{1}{2}$ and $3\frac{1}{2}$ in the total length without the caudal fin. Its sponsors appear to have had the opportunity of comparing it with a specimen of *A. macropterus* of practically identical size.

Five specimens, measuring 235 to 330 mm., were taken in the *Helga's* trawl, and in nets attached thereto, at the following station:—

S.R. 335.—12-5-'06. $51^{\circ}12'30''$ to $51^{\circ}17'30''$ N., $12^{\circ}18'$ to $12^{\circ}16'$ W. 893 to 673 fath. Temperature at 700 fathoms a few miles away, 6.84° C., salinity, 34.99 ‰.

Vaillant records 16 specimens from the Canaries, coasts of the Soudan and Morocco, and the Banc d'Arguin, at depths of 473 to 1,156 fathoms. None were taken in the Bay of Biscay by the *Caudan*, and none have been recorded in the lists of fishes taken by the *Hirondelle* and *Princess Alice*. Our record above is the only indication of the existence of the species further north on this side of the Atlantic. A specimen was taken by the *Albatross* at $16^{\circ}54'$ N., $63^{\circ}12'$ W., the depth being 687 fathoms.

¹ Vaillant gives the colour of the body as reddish brown, but must have taken his description from a specimen more or less denuded of the dark epidermal covering of the scales.

MEASUREMENTS, in millimetres, and Numbers of Rows of Scales and Fin Rays in Irish specimens of *Alepocephalus*.

	A. rostratus.						A. Giardi.		A. macropterus.	
	Station number, series S.R., ...	Sex, ...	Total length, ...	Total length without caudal fin, ...	Length of head, including skin of gill-cover, ...	Length of snout, ...	Horizontal diameter of orbit, ...	Width between supra-orbital ridges opposite centre of eye, ...	Snout to origin of dorsal fin, ...	Snout to anus, ...
1.	327	♂	491	415	70	18	20	12	147	151
2.	327	♀	526	440	124	31	31	23	*	114
3.	327	♀	556	465	133	31	35	21	*	30
4.	327	♀	552	468	131	28	34	24	*	48
5.	327	♀	552	468	131	28	34	24	*	25
6.	327	♀	552	468	131	28	34	24	*	17
7.	327	♀	552	468	131	28	34	24	*	34
8.	327	♀	552	468	131	28	34	24	*	?
9.	327	♀	552	468	131	28	34	24	*	ca. 50
10.	327	♀	552	468	131	28	34	24	*	?
11.	327	♀	552	468	131	28	34	24	*	?
12.	327	♀	552	468	131	28	34	24	*	?
13.	327	♀	552	468	131	28	34	24	*	?
14.	327	♀	552	468	131	28	34	24	*	?
15.	327	♀	552	468	131	28	34	24	*	?
16.	327	♀	552	468	131	28	34	24	*	?
17.	327	♀	552	468	131	28	34	24	*	?
18.	327	♀	552	468	131	28	34	24	*	?
19.	327	♀	552	468	131	28	34	24	*	?
20.	327	♀	552	468	131	28	34	24	*	?
21.	327	♀	552	468	131	28	34	24	*	?
22.	327	♀	552	468	131	28	34	24	*	?
23.	327	♀	552	468	131	28	34	24	*	?
24.	327	♀	552	468	131	28	34	24	*	?
25.	327	♀	552	468	131	28	34	24	*	?
26.	327	♀	552	468	131	28	34	24	*	?
27.	327	♀	552	468	131	28	34	24	*	?
28.	327	♀	552	468	131	28	34	24	*	?
29.	327	♀	552	468	131	28	34	24	*	?
30.	327	♀	552	468	131	28	34	24	*	?
31.	327	♀	552	468	131	28	34	24	*	?
32.	327	♀	552	468	131	28	34	24	*	?
33.	327	♀	552	468	131	28	34	24	*	?
34.	327	♀	552	468	131	28	34	24	*	?
35.	327	♀	552	468	131	28	34	24	*	?
36.	327	♀	552	468	131	28	34	24	*	?
37.	327	♀	552	468	131	28	34	24	*	?
38.	327	♀	552	468	131	28	34	24	*	?
39.	327	♀	552	468	131	28	34	24	*	?
40.	327	♀	552	468	131	28	34	24	*	?
41.	327	♀	552	468	131	28	34	24	*	?
42.	327	♀	552	468	131	28	34	24	*	?
43.	327	♀	552	468	131	28	34	24	*	?
44.	327	♀	552	468	131	28	34	24	*	?
45.	327	♀	552	468	131	28	34	24	*	?
46.	327	♀	552	468	131	28	34	24	*	?
47.	327	♀	552	468	131	28	34	24	*	?
48.	327	♀	552	468	131	28	34	24	*	?
49.	327	♀	552	468	131	28	34	24	*	?
50.	327	♀	552	468	131	28	34	24	*	?
51.	327	♀	552	468	131	28	34	24	*	?
52.	327	♀	552	468	131	28	34	24	*	?
53.	327	♀	552	468	131	28	34	24	*	?
54.	327	♀	552	468	131	28	34	24	*	?
55.	327	♀	552	468	131	28	34	24	*	?
56.	327	♀	552	468	131	28	34	24	*	?
57.	327	♀	552	468	131	28	34	24	*	?
58.	327	♀	552	468	131	28	34	24	*	?
59.	327	♀	552	468	131	28	34	24	*	?
60.	327	♀	552	468	131	28	34	24	*	?
61.	327	♀	552	468	131	28	34	24	*	?
62.	327	♀	552	468	131	28	34	24	*	?
63.	327	♀	552	468	131	28	34	24	*	?
64.	327	♀	552	468	131	28	34	24	*	?
65.	327	♀	552	468	131	28	34	24	*	?
66.	327	♀	552	468	131	28	34	24	*	?
67.	327	♀	552	468	131	28	34	24	*	?
68.	327	♀	552	468	131	28	34	24	*	?
69.	327	♀	552	468	131	28	34	24	*	?
70.	327	♀	552	468	131	28	34	24	*	?
71.	327	♀	552	468	131	28	34	24	*	?
72.	327	♀	552	468	131	28	34	24	*	?
73.	327	♀	552	468	131	28	34	24	*	?
74.	327	♀	552	468	131	28	34	24	*	?
75.	327	♀	552	468	131	28	34	24	*	?
76.	327	♀	552	468	131	28	34	24	*	?
77.	327	♀	552	468	131	28	34	24	*	?
78.	327	♀	552	468	131	28	34	24	*	?
79.	327	♀	552	468	131	28	34	24	*	?
80.	327	♀	552	468	131	28	34	24	*	?
81.	327	♀	552	468	131	28	34	24	*	?
82.	327	♀	552	468	131	28	34	24	*	?
83.	327	♀	552	468	131	28	34	24	*	?
84.	327	♀	552	468	131	28	34	24	*	?
85.	327	♀	552	468	131	28	34	24	*	?
86.	327	♀	552	468	131	28	34	24	*	?
87.	327	♀	552	468	131	28	34	24	*	?
88.	327	♀	552	468	131	28	34	24	*	?
89.	327	♀	552	468	131	28	34	24	*	?
90.	327	♀	552	468	131	28	34	24	*	?
91.	327	♀	552	468	131	28	34	24	*	?
92.	327	♀	552	468	131	28	34	24	*	?
93.	327	♀	552	468	131	28	34	24	*	?
94.	327	♀	552	468	131	28	34	24	*	?
95.	327	♀	552	468	131	28	34	24	*	?
96.	327	♀	552	468	131	28	34	24	*	?
97.	327	♀	552	468	131	28	34	24	*	?
98.	327	♀	552	468	131	28	34	24	*	?
99.	327	♀	552	468	131	28	34	24	*	?
100.	327	♀	552	468	131	28	34	24	*	?

GENUS *BATHYTROCTES*,¹ Günther.

In general characters similar to *Alepocephalus*, but differing in the presence of teeth on the maxilla, in (constantly?) having seven branchiostegals, and in having the dorsal fin equal to or longer than the anal, and originating in front of or opposite to it. Deep-sea fishes with a range similar to that of *Alepocephalus*.

BATHYTROCTES ROSTRATUS, Günther.

Pl. IV, Figs. 3, 4, 5.

B. rostratus, Günther (1878 and 1877), Goode and Bean (1895), Koehler (1896)², Brauer (1906).

Bathytroctes (?), Scharff (1891).

B. proroscopus, Brauer (1902).

This species has not yet been taken by the *Helga* in the adult condition, but larvae and young specimens taken by her on several occasions seem undoubtedly referable to the genus, and, although it might be difficult to refer such specimens to any species without further evidence, a specimen of *B. rostratus* taken by the *Valdivia* and figured by Brauer (1906), which, at a length (without caudal fin) of about 80 mm., still shows a vestige of the supra-clavicular process, hereinafter mentioned, in the shape of a small papilla, serves to connect them with the adult of *B. rostratus*, with which they also agree in the number of fin-rays and in possessing forwardly-directed teeth on the premaxilla.

The smallest specimen taken by the *Helga* is 10 mm. long (without caudal fin), and has the general appearance shown in fig. 3. The eye is about equal in length to the snout, and is contained about $3\frac{1}{2}$ times in the head, which is itself contained 3 times in the total length without caudal. The maxilla reaches to about the level of the centre of the eye, and bears a few teeth set at rather wide intervals. The premaxilla and mandible are toothed. The pectorals are very small, ventrals not yet apparent. The specimen is damaged, but appears to have had a persisting

¹ Goode and Bean divide this genus into two sub-genera, to one of which they apply the name *Talismania*; the two sub-genera, founded upon the relative positions of the dorsal and anal fins, are not at all clearly distinguished from one another, and the lack of substantiality in the division is shown by the fact that *B. rostratus* is placed in one sub-genus and Vaillant's *B. homopterus* in the other. Whether or no the last-named author was right in identifying his *B. homopterus* with *B. rostratus*, the two certainly agree very closely in the relative positions of the dorsal and anal fins. To make *Talismania* a substantive genus, as is done by Jordan and Evermann, seems perfectly unjustifiable.

² Although Vaillant himself identified his *B. homopterus* as a specimen of *B. rostratus* we are by no means sure that such identification was correct, and it seems best to follow Koehler in regarding the two forms as provisionally distinct.

larval marginal fin of about the extent shown in our sketch. In colour it is dark sepia on the lower part of the head and abdomen and elsewhere pale fawn. The most striking character, however, of the fish is a darkly pigmented backwardly and upwardly directed process, possibly tubular, situate apparently upon the supra-clavicle etc. (though we have been unable to ascertain this); the nature and function of this process we are unable to suggest, but it seems to disappear entirely long before the fish has attained its full growth.

A slightly more advanced stage is represented by three rather damaged specimens, 13-14 mm. long (without caudal fin), one of which is shown in fig. 4. Beyond the ordinary changes associated with growth these show no points of difference from the smaller specimen, but the protruding premaxillary teeth can just be detected. The outline of fig. 4 was drawn from a specimen in which we suspect that the head may have been crushed laterally.

A specimen, 27.5 mm. long (without caudal), is in bad condition, but appears to agree in all material respects with the specimen next mentioned.

The largest *Bathytroctes* yet taken by the *Helga*, 32 mm. long (without caudal fin), is shown in fig. 5; this specimen, save for the loss of its epidermis and larval marginal fin, is in very good preservation.

The eye slightly exceeds the snout in length, and its length is contained about three times in the length of the head, which is itself contained just over three times in the total length (without caudal). The maxilla extends nearly to the level of the centre of the eye, and bears minute teeth, with larger teeth at intervals; the premaxillae are somewhat protruding, and each bears three or four forwardly directed teeth, of which the inner are the longer. The supra-clavicular process is darkly pigmented, and nearly as long as the exposed diameter of the crystalline lens. Figure 5 and the table of measurements sufficiently show the form and proportions of this little fish, whose head, except (the dorsal part of the postorbital region) and abdominal region are black, while elsewhere the colouration is brownish-grey. The epidermis is gone, and no sign of scales can be detected; the myomeres number about 38.

The specimens above described were taken as follows:—

S.R. 139.—11-8-'04. 55° N., 10° 48' W., soundings 1,000 fath. Triangular net, 1,000 fath.
One, 13 mm. *ca.*

S.R. 193.—10-2-'05. 54° 50' N., 10° 30' W., soundings 650 fath. Triangular net, *ca.* 650 fath.
One 10 mm.

S.R. 224.—12-5-'05. 53° 7' N., 15° 6' W., soundings 860 fath. Mid-water otter trawl, 650-750 fath.
Three, 32, 27.5, and 14 mm.

S.R. 282.—18-11-'05. 54° 59' N., 10° 53' W., soundings 1,000 fath. Triangular net, 700 fath. Temperature, 9° C.
One, 13.5 mm.

The known range of *B. rostratus* includes the Atlantic, off Pernambuco, soundings 675 fathoms (Günther, 1887); Banc d'Arguin, Soudan, soundings 600 fathoms (Vaillant, 1888); Bay of Biscay, 46° 28' N., 7° W., soundings 940 fathoms *ca.* (Koehler, 1896), and off the west coast of Ireland. Also the Indian Ocean, in nets fished at 820 to 1,080 fathoms *ca.* over soundings of 1,850 to 2,770 fathoms (Brauer, 1906).

The available evidence points to a vertical range of at least 600-1,100 fathoms, and the young stages up to 80 mm. long are certainly normally found at such depths over considerably deeper soundings both off the Irish coast and in the Indian Ocean. Whether they are also found on or near the bottom in suitable soundings, and whether larger specimens live normally on the bottom, it is impossible to say. The largest recorded specimen was only 165 mm. long (including caudal fin), and the species in all probability attains a considerably larger size, as may be inferred from a comparison of its young with those of *Alepocephalus* at comparable stages of development.

MEASUREMENTS, in millimetres, and Fin-ray formulae of Specimens from S.R. 224.

	a.	b.	c.
Length without caudal fin,	14	27.5	32
Length of head,	4.5	9.5	10.5
Length of snout,	1.5	3	3.25
Length of orbit,	1.5	3	3.5
Interorbital width,	—	1.5	2
Length of maxilla,	—	4.5	5
Length to origin of dorsal fin,	8.5	17	18.5
Length to origin of anal fin,	9.5	18	20
Depth of head,	—	4.75	5
Depth of body at ventrals,	—	2.25	3
Depth of caudal peduncle,	—	1.5	2
Dorsal fin-rays,*	17 <i>ca.</i>	17 <i>ca.</i>	17
Anal fin-rays,*	18 <i>ca.</i>	18 <i>ca.</i>	18

* Including other specimens, too damaged to permit of full measurements being given, the fin-ray formula is—D. 17-19 *ca.*, A. 17-20 *ca.*

GENUS *XENODERMICHTHYS*, Günther.

Form elongate, more or less compressed. Snout more or less obtuse, never long. Skin thick, sometimes longitudinally wrinkled, scaleless or with only rudimentary, non-imbricating scales, except sometimes in the lateral line. Numerous small papillae or nodular photophores, generally distributed, but usually without definite linear arrangement, on head and

body. Lateral line indistinct, without conspicuous scales or distinct, with more or less conspicuous and perfect scales. Small teeth on premaxillae and mandibles and usually on maxillae; (probably) none on vomer, palatines and tongue. Dorsal and anal fins of equal or nearly equal length, and opposite or nearly opposite to each other. Caudal fin forked. Ventral fins near anus behind middle of total length.

Gill (1884), Goode and Bean (1896), Jordan and Evermann (1896-98), and Brauer (1906) divide the genus, as we understand it, into *Xenodermichthys* and *Aleposomus*, referring *X. nodulosus*, Günther, to the former and all other species to the latter. The most obvious reason for this division seems to be that *X. nodulosus* has a smaller mouth and eye than any other species, and to us it appears that *X. socialis* is less remote from *X. nodulosus* than from such as *A. lividus*, Brauer.

XENODERMICHTHYS SOCIALIS, Vaillant (1888).

Pl. V, Fig. 2.

Xenodermichthys socialis, Collett (1896), Koehler (1896).

Aleposomus socialis, Goode and Bean (1896), Brauer (1906).

Form compressed, elongate. Height of body (subequal from pectoral region to origins of dorsal and anal fins) about $5\frac{1}{2}$, length of head about 4 to $4\frac{1}{2}$, bases of dorsal and anal fins about $3\frac{1}{2}$ to $3\frac{3}{4}$ in total length without caudal fin. Snout obtuse, much shorter than horizontal diameter of orbit, which is about $2\frac{1}{2}$ or $2\frac{3}{4}$ in length of head. Lower jaw slightly protruding, maxilla reaching beyond vertical from front margin of crystalline lens. Minute teeth present on premaxillae, maxillae (few) and mandibles; none on palatines, tongue and pterygoids. Anus a little nearer to insertion of pectoral fins than to origin of central caudal rays. Pectoral fins slender, set rather low on body. Ventral fins set a little in front of middle of total length without caudal fin.

Dorsal fin low, with about 27 to 29 rays. Anal fin opposite and similar to dorsal, with about 27 or 28 rays. Caudal fin deeply forked. Skin (in perfect examples) longitudinally wrinkled, set with numerous very minute papillae representing scales, and with small tubercular photophores generally distributed over head and body. Lateral line indistinct. Colouration deep velvety black. Size exceeds 147 mm.¹; female mature at 132 mm.

The lateral line becomes fairly distinct and somewhat tubular in appearance if a well-preserved specimen is allowed to become slightly dry.

¹ The type cited by Vaillant measured 147 mm., or 130 mm. without the caudal fin. Our largest specimen measures 134 mm. without the caudal fin.

Among the large-eyed species which we should refer to *Xenodermichthys* (*Aleposomus* spp. of Goode and Bean and Brauer) all except *X. Copei* (Gill, 1884, Goode and Bean, 1896), appear to have no more than about 20 rays in either dorsal or anal fin, and in this way can be distinguished from *X. socialis*, which has about 27, very difficult to count exactly without injuring the skin. The radial formula of *X. Copei* is not stated, but Mr. Todd, who is usually accurate, depicts D. 27, A. 27 in Goode and Bean's figure. The species, however, seems to taper rather regularly in height from the shoulders to the caudal peduncle, and in this way differs from *X. socialis*. *X. nodulosus* has the eye very much smaller than any other known species, and has more than 30 rays in both dorsal and anal fin.

The characters of the skin which we have noted above are not of very much account in the determination of species, because much depends upon the condition of the specimen. The plications of the skin disappear rather readily if the fish is chafed in the net, and more or fewer of the photophores may be rubbed off without leaving conspicuous traces. Even when perfect they look more like small nodules or tubercles than photophores. The tiny structures which represent the rudiments or vestiges of scales are hardly visible without magnification, and were in fact overlooked by Vaillant in his types, though found in one of them by Collett.

The diagnosis which we have given refers to specimens of adult form. A rather badly mangled fish of 20 mm., without caudal fin, seems to be a young member of this species, with which it agrees in general conformation, allowing for differences, such as the large size of the head, due to age. The eye is about $2\frac{1}{2}$ in the head and longer than the snout, the length of the head about $3\frac{1}{4}$ in the total length (without caudal). The greatest height of the head, about equal to the length of the eye and snout, is more than half of the length of the head and more than twice the height of the caudal peduncle. The height of the body tapers gradually from the head to the caudal peduncle. The dorsal and anal fins are not in good condition, but do not differ materially in extent and position from those of the adult. Their formulae are illegible.

Whether naturally or as the result of abrasion in the net the photophores are almost wholly confined to the ventral parts. As compared with those of the adult they are relatively large and look much like those of some *Scopeli* (e.g. *S. crocodilus*, *S. glacialis*) at a similar size, but are not brilliant as in the young of *S. punctatus*. Moreover, they show some attempt at regularity of arrangement. They form a border external to the lower half of the periphery of the eye, and are rather closely set on the isthmus and neighbouring parts of the gill-cover. Between the head and the ventral fins they are scattered over most of the surface below the region of the lateral line. Behind the ventral fins they become more confined to the lower edge of the body, forming a band, irregularly treble or double, as far back as the middle of the anal fin, whence they are continued as

a single row on each side of the ventral edge to the origin of the caudal fin. The head (except the upper post-orbital part) and the belly are black: elsewhere the colour, after preservation, is brown, thickly dotted with black chromatophores.

MEASUREMENTS, in millimetres, and approximate number of Fin Rays in a specimen from S.R. 299.

Total length without caudal fin	134 mm.
Length of head	32 "
Length of snout	5 "
Horizontal diameter of orbit	11 "
Width between supra-orbital ridges opposite centre of eyes	5 "
Snout to dorsal fin	80 "
Snout to anal fin	81 "
Snout to base of ventral fins	64 "
Length of base of dorsal fin	40 "
Length of base of anal fin	40 "
Length of pectoral fin	16 "
Length of ventral fin	14 "
Height of body at origin of pectoral fin	24 "
Height of body at anus	24 "
Height of caudal peduncle	10 "
Length of caudal peduncle between verticals from hind end of base of dorsal and origin of central caudal rays	15 "
Number of dorsal rays	ca. 28 "
Number of anal rays	ca. 28 "

Our material was obtained as follows:—

S.R. 299.—4/5-2-'06, 50° 13' 30" N., 11° 16' W., soundings 500 fathoms, ooze. Temperature at 370 fathoms 10.8° C., at 470 fathoms 9.7° C.

One, 134 mm. (without caudal fin), taken in a trawl which failed to reach the bottom and captured nothing else except a big *Stomias boa*.

S.R. 351.—5-8-'06, 50° 19' 30" N., 11° 6' W., 230 to 250 fathoms, fine sand. Temperature at 245 fathoms 10.1° C.

One, 20 mm. (without caudal fin), taken in a bag of mosquito net attached to the back of the trawl.

We have also a specimen taken by Dr. Schmidt in the *Thor* at 49° 23' N., 12° 13' W.

X. socialis is otherwise known from the north-west coast of Africa to the Banc d'Arguin (20° N.), 392 to 740 fathoms; Azores, 380 fathoms; Bay of Biscay, 1,200 fathoms. The *Talisman* and *Travailleur* took it in seven hauls, one specimen in each of six hauls, and 133 in the remaining haul, from which Vaillant considers that it may be a gregarious species. The first *Helga* record suggests that it is not wholly a ground fish, though the trawl on that occasion must have been very near the bottom.

IV.—RECENT ADDITIONS TO THE BRITISH-AND-IRISH LIST.

The restoration to the list of *Bathytroctes rostratus* is noted above (p. 45). Other fishes, which have been only taken or recognised since our first report was published, are—

Pristiurus murinus, Collett.
Raia bathyphila, sp. n.
Raia sp.
Microstoma sp. (young).
Argyropelecus Olfersi (Cuv.).
Sternoptyx diaphana, Hermann.
Scopelus Humboldti, Risso.
Scopelus sp.
 (?) *Paralepis pseudocoregonoides*, Sarato.
Notacanthus rostratus, Collett.
Bathygadus melanobranchus, Vaillant.
Lyconus brachycolus, Holt and Byrne.
Halargyreus affinis, Collett.
Laemonema latifrons, Holt and Byrne.
Gargilius sp. (Jensen *vide* Schmidt).
Melamphæus megalops, Lütken.
Cyttosoma Helgae, Holt and Byrne.
Cottunculus Thomsoni, Günther.
Oneirodes megaceros, Holt and Byrne.

We add a note about some specimens of the genus *Crystallogobius* which may possibly be distinct from *C. Nilssoni*. They were taken in the Irish Sea.

FAM. SCYLLIIDAE.

PRISTIURUS MURINUS, Collett (1904).

Pristiurus murinus, Collett (1905).

S.R. 483.—30-8-'07. 51° 37' N., 11° 56' W., 610 to 664 fath. trawl. Temperature at 546 fath. 8.34° C. Salinity 35.32‰.

One adult male, 378 mm.

The type, a young example of 225 mm., was taken by the *Michael Sars* north-west of the Hebrides at about the same depth.

FAM. RAIIDAE.

RAIA BATHYPHILA sp. n.

S.R. 335.—12-5-'06, 51° 12' 30" N., 12° 18' W. to 51° 17' 30" N. 12° 16' W., 893 to 673 fathoms. Temperature at 700 fathoms, 6.84° C., salinity 34.99‰.

One, 101 mm. across disk.

The specimen is quite immature, but as some of its characters are of a nature not likely to be altered beyond recognition with growth, it may be used as a type.

Its nearest relative appears to be *R. isotrachys*, Günther (1887) known from a specimen taken by the *Challenger* south of Japan at 365 fathoms.

PRINCIPAL MEASUREMENTS.

Width of disk	101 mm.
*Length of disk	88 "
Total length	184 "
*Pre-ocular length	22 "
Length of eye	7 "
Distance from front edge of eye to hind edge of spiracle	9.5 "
Width of inter-orbital space	7 "
Length of tail from hind insertions of ventral fins	98 "
Length of part of tail occupied by median fins	25 "
Preoral length, measured to centre of nasal valves	26 "
Preoral length, measured to centre of gape	29 "
Width between nostrils	13.5 "
Width of exposed part of mouth	11 "
Snout to coracoid	45 "
*Snout to angle of pectoral fin	58 "

The measurements marked (*) are taken from the snout to the point where lines between hind margins of disk, front margins of eyes and angles of pectoral fins, respectively, cross the long axis of the body.

Anterior margins of disk only slightly undulated, forming, by lines drawn from lateral extremities of pectoral fins to tip of snout, a general angle of about 88.5° . Angle of snout, from extremities of a line (measuring 55 mm. in the type), drawn across disk through anterior margins of eyes, about 102° . Extremity of snout rounded. Angles of pectoral fins broadly rounded, their lateral extremities nearer to the hind end of the disk than to the snout. Teeth small and bluntly pointed, about 36 rows in the upper jaw. Lips without conspicuous papillae or fimbriation. Buccal region defined posteriorly by a conspicuous fold of skin. Dorsal and caudal fins confluent by means of narrow membranes. Dorsal surface (except a narrow border along anterior and a rather wide border along posterior margins of disk, and part of ventral fins) set with small, slender, backwardly directed thorn-like spinules, each supported by about four radiating basal processes, and, on the disk, distributed at intervals about equal to their length. Orbital spines, ¹ one in front and two behind the eye on each supraorbital ridge. Humeral spines, three in a median line from the head to the shoulder girdle, and two at each extremity of the latter, the outermost smaller than and slightly posterior to the others. Linear spines, thirty in a single median row from the shoulder to the first dorsal fin; some of the

¹ The structures here described as spines have swollen bases, but no radiating basal processes.

spinules on the sides of the tail larger than the rest and with somewhat swollen bases. Ventral surface smooth, except at the edges of anterior part of tail. Dorsal colouration cold sepia, appearing ashy-brown by reason of the spinules. Ventral colouration brown, except the front of snout, mouth parts and belly.

These notes must be taken as a brief description of the stage of growth under observation, and not as a diagnosis of the species. In older specimens the general shape of the disk will probably be found to remain much the same, save for minor undulations of the disk in adult males. The tail probably becomes relatively shorter, the teeth certainly more numerous and, in males, more sharply pointed as growth proceeds. The spinulation of the dorsal surface is not likely to undergo much alteration, but spinules may appear on the anterior margins of the ventral surface; and adult males may probably have the spinules of the dorsal anterior margins enlarged and the general spinulation of the dorsal surface reduced, and will, of course, have the usual rows of depressed, inwardly directed spines on the pectoral fins. The orbital and humeral spines may become obsolete in adults, but in intermediate stages there may be found (as indicated by enlarged spinules in the specimen before us) a row of six or eight small spines on either edge of the rostrum. The linear median spines will probably be replaced, as growth proceeds, to a greater or less extent by the intercalation of new spines in the same line as the present series becomes obsolete, but old specimens may have few or only small spines in front of the pelvic region. There may possibly be a single series of lateral spines on each side of the tail, not large at any stage of growth, and almost certainly obsolete or absent in adult males. The dorsal colouration is not likely to alter, but the dark colour may disappear from the ventral surface, or, on the contrary, may invade the whole.

RAIA sp.

A ray measuring about 230 mm. across the disk, taken at the same station as *P. murinus*, has a general resemblance to *R. circularis*, Couch (*sensu stricto*). It is, however, armed with much more formidable spines and lacks the white spots of the back. Some dark pigment is present ventrally.

FAM. SALMONIDAE.

MICROSTOMA sp.

S.R. 231.—20.5.05, 50 miles ca. N. by W. of Eagle Island, $55^\circ 1' N.$, $10^\circ 45' W.$, soundings 1,200 fath. Mid-water otter trawl at 1,150 fathoms.

Several. 10-12 mm. ca. (without caudal).

S.R. 337.—12-5-'06, 51° 19' 30" N., 12° 9' 30" W., soundings 768 fathoms.

Mid-water otter trawl at 1-20 fathoms.
One 14.5 mm. (without caudal).

The specimens are too small for specific determination, but may be *Microstoma groenlandica*, Reinhardt (1841).

FAM. STERNOPTYCHIDAE.

STERNOPTYX DIAPHANA, Hermann.

S.R. 481.—29-8-'07, 50° 59' N., 11° 52' W., soundings 920 to 1,064 fathoms, mid-water otter trawl fished at about 600 to 900 fathoms, and to the surface.
One, 45 mm. without caudal fin.

ARGYROPELECUS OLFERSI (Cuvier, 1829)

Argyropelecus Olfersi, Brauer (1906).

S.R. 302.—5-2-'06, 52° 54' N., 11° 54' W., soundings 460 fathoms. Mid-water otter trawl at 300-350 fathoms. Temperature at surface, 10.5° C., salinity 35.37‰; at 250 fathoms, 10.22° C., 35.37‰; at 350 fathoms, 9.91° C., 35.34‰.
One, 38 mm.

S.R. 470.—24-8-'07, 56° 16' N., 11° 27' W., soundings 770 fathoms, mid-water otter trawl at 400 to 500 fathoms. Temperature at surface 15.8 C., salinity 35.30‰; at 500 fathoms, 9.03 C., 35.35‰.
One, 36 mm.

We are indebted to Mr. Regan for naming the first specimen, and for demonstrating the characters which appear to avail at all stages to distinguish this species from the common form of our area, *A. hemigymnus*.

The Irish records add little to the knowledge of distribution, since *A. Olfersi* is already known from the coasts of Norway and Portugal, but it is interesting to note that while off the Irish coast the *Helga* collects *A. hemigymnus* in considerable number and at all stages of existence, she has only taken two rather large specimens of *A. Olfersi*.

The last-named species ranges in the Atlantic from the North Cape to the Cape of Good Hope on the eastern side, and has occurred also off the coast of North America and in mid-ocean towards Brazil. In the Pacific it is known from the Indian Ocean, Gulf of Panama, and perhaps from off China (cf. Brauer, 1906).

FAM. PARALEPIDAE.

(?) *PARALEPIS PSEUDOCOREGONOIDES*, Sarato (1887).

S.R. 440.—16-5-'07, 51° 45' N., 11° 49' W., soundings 350-389 fathoms. Trawl. Temperature at 300 fathoms, 9.93° C. Salinity 35.46‰.

One, 214 mm. (without caudal fin), found in the stomach of a silver ling (*M. abyssorum*, Nilss.).

The specimen is not in a condition for exact specific determination, but is almost certainly identical with the macerated specimens which Collett (1897) doubtfully refers to *P. pseudocoregonoides*.

Paralepis proves to be the parent of a larva which has long puzzled us. It is a very elongate form, with head and mouth suggesting *Paralepis*, and with an unusually precocious and relatively large anal fin immediately in front of the caudal. The anus, however, is very near the head (as, in adults of similar form, only in *Ipnotis*) and it retains this position until the fish reaches a size considerably greater than that at which metamorphosis in this particular might be expected to have been achieved. Recent acquisition of older stages undoubtedly assigns the larva to *Paralepis*, as we shall show in a later communication.

FAM. SCOPELIDAE.

SCOPELUS HUMBOLDTI (Bisso, Lütken, 1892).

S.R. 302.—5/6-2-'06, off Tearaght Light, Co. Kerry, 51° 54' N., 11° 54' W., soundings 460 fathoms, mid-water otter trawl at surface. Temperature 10.5° C., salinity 35.39‰.
One, 33.5 mm.

This record has already been mentioned, without particulars in a correction slip sent out with *Fisheries, Ireland, Sci. Invests* 1905, II. [1906], and in a note added to the reprint of the same paper in Pt. II. of the *Annual Report on the Sea and Inland Fisheries of Ireland for 1905* [1907], App., No. II., p. [53].

The species is known from both sides of the Atlantic and (cf. Brauer, 1906) from the Pacific. Its capture by the *Helga* extends the range northwards from the Bay of Biscay (Koehler, 1896) to Ireland. On the American side we do not know of a record reaching 37° N.

SCOPELUS sp.

S.R. 364.—10-8-'06, 51° 23' 30", 11° 47' W., 620 to 695 fathoms, ooze. Trawl. Temperature at 600 fathoms, 7.92° C.
One, 77 mm., without caudal fin.

The specimen is very much mangled, and all that can be said of it with certainty is that it is specifically different from any form known as an inhabitant of the British-and-Irish area. Probably it may belong to the section *Lampadena*, defined as a genus by Goode and Bean (1896), but of the photophores none are extant except three of a thoracic, and perhaps two of a pectoral series. They are relatively small and, even with due allowance for the condition of the specimen, may be called deciduous. The head is apparently destitute of large luminous organs. There is a narrow ovoidal luminous patch on the dorsal side of the caudal peduncle, and on the ventral side is a similar but larger patch about as long as the eye.

The eye is much longer than the snout. The latter is blunt and abrupt, and slightly carinate in the middle line. The supra-orbital ridges are strongly developed, with a well-marked (but hardly spinous) posterior projection. There is a small backwardly directed spine above the dorsal origin of the pre-opercular keel, which is oblique and terminates ventrally at a point which is separated from the eye by a distance about equal to a diameter of the eye taken in the same line.

36 or 37 scales cross the lateral line, and in a transverse series there are four above and six below the lateral line in front of the anal fin, and five below the line at the anal fin. Though most of the scales are missing the formula is reasonably legible from the pouches. The few scales which remain are thin, cycloid, not lustrous. The dorsal fin commences at the same vertical as the ventrals and has 13 rays, the last bifid to its base. The anal commences behind the vertical from the end of the base of the dorsal, and now exhibits 10 rays, but some part of its middle is missing. Its base is about as long as the distance from its last ray to the anterior ventral ray of the caudal fin.

The subjoined dimensions may have been to some extent modified by laceration of the body, so as to present a relatively less length and greater height than in normal.

Total length without caudal fin	77 mm.
Length of head	24 "
Length of snout	2 "
Horizontal diameter of eye	8 "
Width between supra-orbital ridges	5 "
Snout to ventral end of pre-opercular keel	11 "
Snout to first dorsal ray	18 "
Snout to first anal ray	31.5 "
Length of caudal peduncle (ventral)	45 "
Length of base of dorsal fin	16.5 "
Height of body at first dorsal ray	11.5 "
Height of caudal peduncle	21 "
	10 "

Colouration brownish black.

FAM. NOTACANTHIDAE.

NOTACANTHUS ROSTRATUS, Collett (1889).

S.R. 486.—3-9-'07, 51° 37' N., 12° 1' W., 600 to 660 fathoms, stones, dredge.

One, ca. 310 mm.

S.R. 493.—8-9-'07, 51° 58' N., 12° 25' W., 533 to 570 fathoms, trawl.

One, ca. 350 mm.

S.R. 499.—11-9-'07, 50° 55' N., 11° 29' W., 666 to 778 fathoms, trawl.

One, ca., 320 mm.

S.R. 500.—11-9-'07, 50° 22' N., 11° 26' W., 625 to 666 fathoms, mosquito net on trawl. Temperature at 600 fathoms, 8.22 C., salinity 35.41‰.

One, ca., 290 mm.

S.R. 504.—12-9-'07, 50° 42' N., 11° 18' W., 627 to 728 fathoms, fine mesh net on trawl.

One, ca. 310 mm.

Collett's type was obtained on the Newfoundland Banks. The British Museum possesses an example from the Cape of Good Hope. Our specimens are undoubtedly referable to Collett's *N. rostratus*, but the synonymy of the species seems to require further consideration.

FAM. MACRURIDAE.

BATHYGADUS MELANOBANCHUS, Vaillant (1888).

Bathygadus melanobanchus, Collett (1896), Brauer (1906).

S.R. 397.—2-2-'07. 51° 46' N., 12° 5' W., 549-646 fathoms, Temperature at 500 fathoms, 8.71°C., salinity 35.37‰.

One, 290 mm.

Our specimen was named by Mr. Regan after comparison with one of Vaillant's types. In the Atlantic it has not previously been taken north of the coast of Morocco. In the area bounded by Morocco, the Canaries, and the Azores, its recorded depths are 454 to 851 fathoms. In the Pacific it is known from depths between 141 and 718 fathoms.

LYCONUS BRACHYCOLUS, Holt and Byrne (1906).

S.R. 352.—5-8-'06. 50° 22' N., 11° 40' W., soundings 800 fathoms. Mid-water otter trawl at ca. 700 to 750 fathoms. Temperature at 700 fathoms, 7.33° C.

One, 237 mm.

The net may have been nearer the bottom than the particulars given above seem to denote, since it caught some bottom-living crustacea.

We have given a full description of the specimen in *Ann. Mag. Nat. Hist.*, S. 7, xviii., pp. 423-426, but on p. 425, in the second line below the table of measurements, the specific name "*L. pinnatus*" was inadvertently written "*L. brevipinnis*."

FAM. GADIDAE.

HALARGYREUS AFFINIS, Collett (1904).

Halargyreus affinis, Collett (1905).

S.R. 400.—5-2-'07. 51° 18' N., 11° 50' W., 525-600 fathoms. Temperature at 580 fathoms, 8.35° C., salinity 35.50‰. One, 278 mm.

Collett's five types were taken at 600 to 710 fathoms, north-west of the Hebrides, bottom temperature, 8.07° C. (three), and at 410 fathoms south-west of the Färös (two). Therefore of the six specimens known to science four have come from within the British-and-Irish area.

LAEMONEMA LATIFRONS, Holt and Byrne (1908).

S.R. 489.—4-9-'07. 51° 35' N., 11° 55' W., 720 fath., trawl. Two, about 140 and 160 mm., the types described in *Ann. Mag. Nat. Hist.*, Jan., 1908.

GARGILIUS sp., Jensen, *vide* Schmidt (1906).

S.R. 439.—15-5-'07. 51° 45' 30" N., 12° 31' W. Soundings 584-723 fathoms. Triangular mosquito net at surface, 11.30 p.m. Temperature, 11.75° C. Salinity, 35.44‰. Several, small.

So far as we are aware Jensen has not yet published a description of this fish, nor given it a specific name. It was discovered by Schmidt in his 1905 cruise in search of eel larvae, apparently on 14-6-'05, at 51° N., 11° 43' W., soundings 656 fathoms. The depth of the fishing engine is not stated, but appears from the context (Schmidt, 1906, p. 177) to have probably been at some distance from the bottom. Our specimens, though quite small, are evidently of the same species as an example kindly given to us by Dr. Schmidt. It is not represented, except possibly as an insufficiently characterised larva, in any of the earlier *Helga* gatherings, and is in fact confined in record to two stations, both of which are within the Irish section of the 0-1,000 fathom zone.

FAM. BERYCIDAE.

MELAMPHAËS MEGALOPS, Lütken (1877).

Melamphaes megalops, Günther (1887), Brauer (1906).
Plectromus megalops, Goode and Bean (1896).

S.R. 439.—15-5-'07. 51° 45' 30" N., 12° 31' W. Soundings 584-723 fathoms. Triangular mosquito net at surface, 11.30 p.m. Temperature, 11.75° C. Salinity 35.44‰. One, 32 mm.

As Brauer shows, the head is nearly smooth in perfect specimens, and not covered with naked ridges and spinous processes as in Lütken's figure of the type.

The latter was obtained from the stomach of a *Coryphaena*, south of the Azores. The *Valdivia* took specimens in vertical nets in the Gulf of Guinea, Bay of Bengal, Gulf of Aden, and off the N.E. coast of Africa. The depths to which the nets were lowered varied from 1,094 to 1,914 fathoms. In the only case in which soundings are given the net was, at its deepest, about 1,676 fathoms above the bottom.

FAM. ZEIDAE.

CYTOSOMA HELGAE, Holt and Byrne (1908).

S.R. 487.—3-9-'07. 51° 36' N., 11° 57' W., 540 to 660 fath., trawl. Temperature at 500 fathoms, 8.65° C. Salinity 35.35‰. One, 244 mm., the type described in *Ann. Mag. Nat. Hist.*, Jan., '08.

FAM. GOBIIDAE.

CRYSTALLOGOBIUS sp.

S.R. 412.—15-2-'07. 53° 46' 30" N., 5° 36' W., soundings 52½ fathoms, townet 25-0 fathoms. Temperature at 25 fathoms 7.11°C., salinity 24.33‰; at surface 7.25° C., 35.33‰.

Two, about 14.5 mm. without caudal fin.

These little fishes are too much damaged to afford material for exact diagnosis of characters. They are very like *G. Nilssoni* at the same size, but seem to have the head rather smaller and the mouth shorter and more oblique. The myomeres are about 11+19, and appear to have been defined (in the perfect condition) by minute black chromatophores. Similar chromatophores appear to have been generally but rather sparingly distributed

over the body; but it is possible that what seems to be black pigment is merely adventitious dark matter of extraneous origin, adhering to the lacerated skin. The ventral fins are wanting, the pectorals short, the dorsal and anal illegible in fin-ray formula. One of the specimens is a female with ovaries filled with apparently ripe ova.

Excluding the pigmentation as doubtful, these fishes, in any characters which have been preserved, cannot be distinguished with certainty from the young of *C. Nilssoni*, but we have never seen a female, undoubtedly referable to that species, mature at so small a size.

FAM. COTTIDAE.

COTTUNCULUS THOMSONI (Günther, 1882).

Cottunculus torvus, Goode (1883).

S.R. 494.—8-9-'07. 51° 59' N., 12° 32' W., 550 to 570 fathoms, fine-mesh net on trawl.
One, 40 mm.

S.R. 506.—12-9-'07. 50° 34' N., 10° 19' W., 661 to 672 fathoms. Temperature at 600 fathoms. 8.22° C. Salinity 35.53.
One, 114 mm.

This fish occurs in deep water on both sides of the North Atlantic.

FAM. CERATIIDAE.

ONEIRODES MEGACEROS, Holt and Byrne (1908).

S.R. 497.—10-9-'07. 51° 2' N., 11° 36' W., 775 to 795 fathoms, ooze, trawl.
One, about 95 mm., the type described in *Ann. Mag. Nat. Hist.*, Jan., 1908.

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EXPLANATION OF PLATES I to V.

PLATE I.

Scorpaena dactyloptera, 410 mm. $\times \frac{1}{2}$. Outline, scales somewhat diagrammatic.

PLATE II.

Scorpaena cristulata, 504 mm. $\times \frac{1}{3}$.

PLATE III.

Fig 1. *Alepocephalus rostratus*, 553 mm. $\times \frac{1}{4}$. The scales, which are in part restored, are shown without the natural dark epidermal covering. On the bases of the dorsal and anal fins they are somewhat more pointed in outline and extend somewhat farther on to the rays than is shown in the figure.

Fig. 2. *Alepocephalus Giardi*, 590 mm. $\times \frac{1}{3}$. The scales which have been restored should be somewhat more pointed in outline.

PLATE IV.

Alepocephalus Giardi.

Fig. 1. Larva of 20.5 mm., *Helga*, CXX.

Fig. 2. Larva of 35 mm., outline, S.R. 327.

Bathytroctes rostratus.

Fig. 3. Larva of 10 mm., S.R. 193.

Fig. 4. Larva of ca. 14 mm., from two specimens, S.R. 224 and S.R. 282.

Fig. 5. Larva of 32 mm., S.R. 224.

The lines below the figures denote the natural size.

PLATE V.

Fig. 1. *Alepocephalus macropterus*, 330 mm. $\times \frac{2}{5}$, outline.

Fig. 2. *Xenodermichthys socialis*, 147 mm., outline, slightly altered from Vaillant.

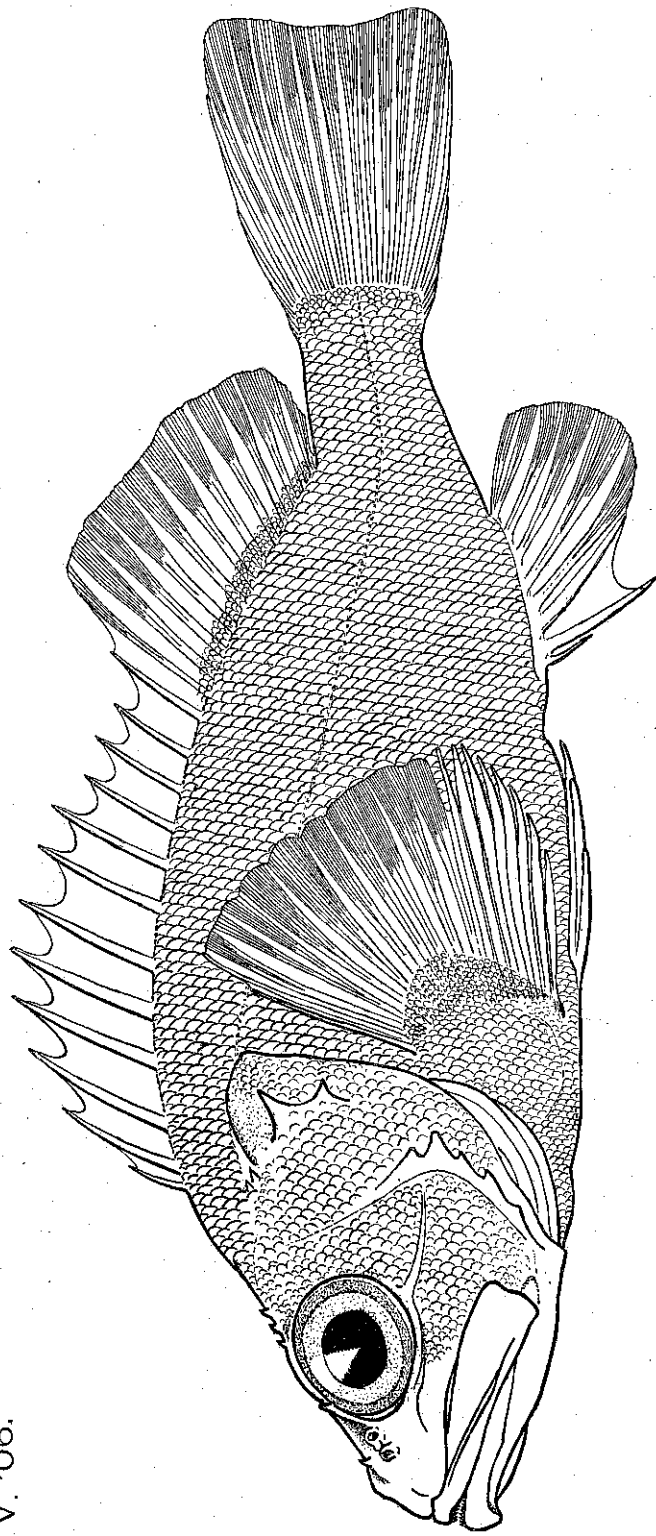
NOTE ADDED IN PRESS.

SCORPAENIDAE.

Jaquet (“Considerations sur les Scorpenides de la Mer de Nice,” *Bull. Inst. Océanog.*, No. 109, 1907 [1908]) discusses the local species of *Scorpaena* in great detail, and should be consulted as to the characters and affinities of *S. scrofa*. He is especially interested in the generic distinction between *Scorpaena* and *Sebastes*, relegating *S. dactyloptera* to the last named genus. His conclusions, however, read in conjunction with our description of the adult of *S. cristulata*, do not seem to support the exclusion of *S. dactyloptera* from the *Scorpaenae*.

V. '06.

Pl. I.

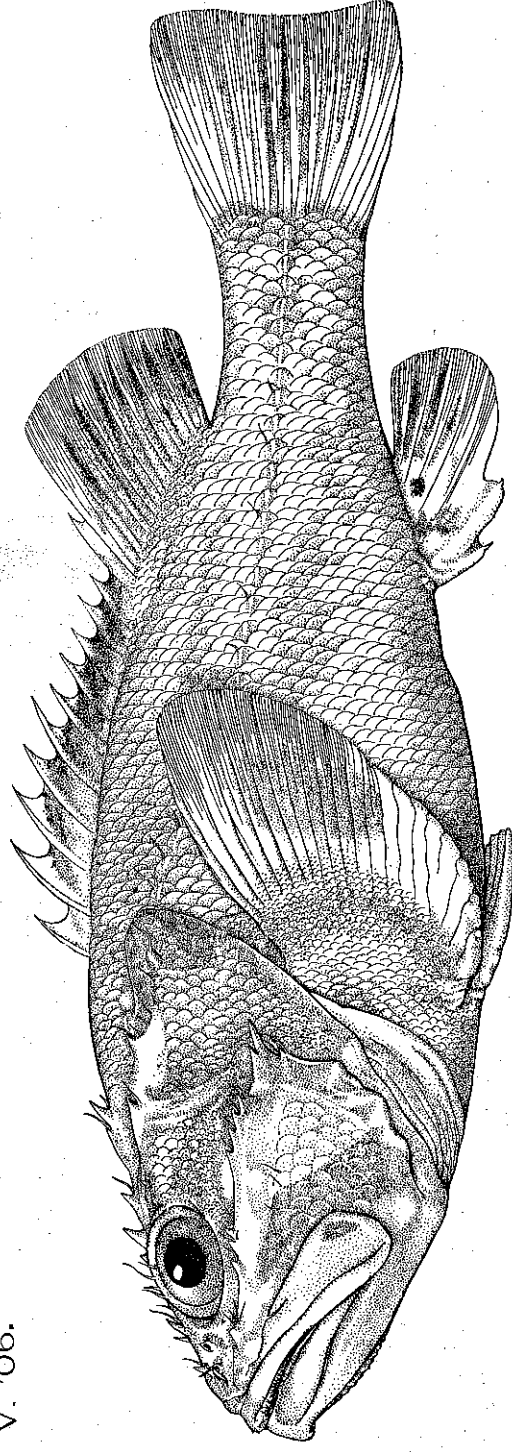


E. W. L. H. del.

Scorpaena dactyloptera.

V. '06.

Pl. II.



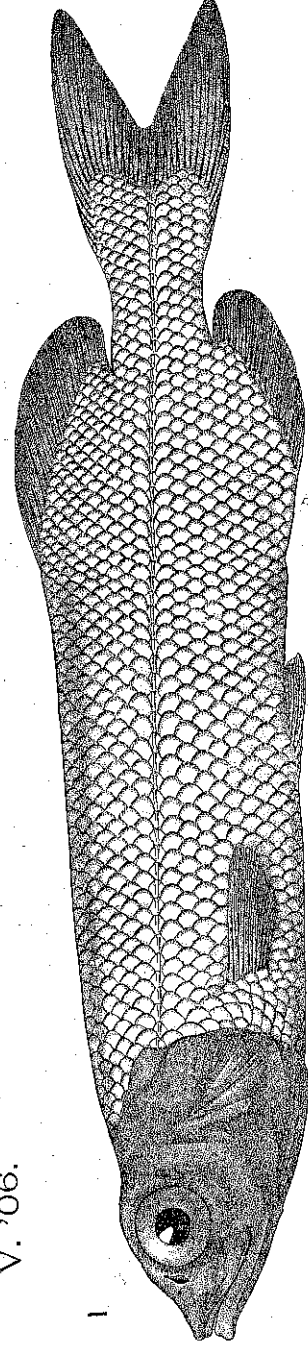
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Scorpaena cristulata.

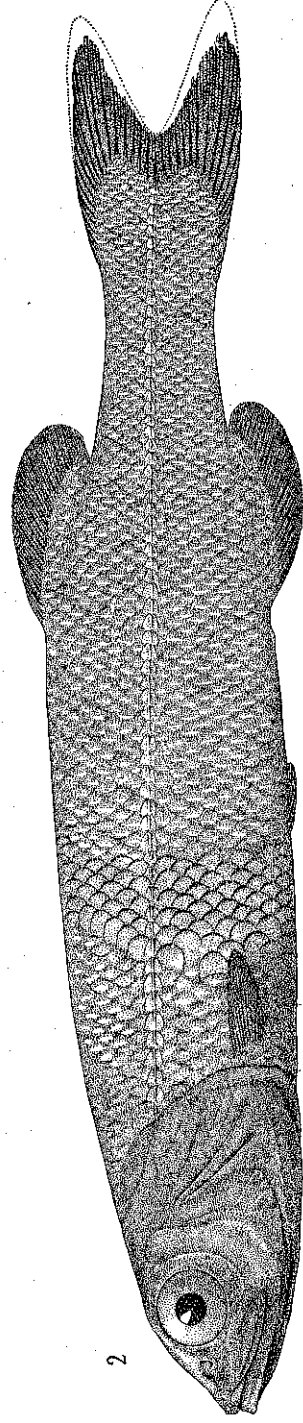
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Pl. III.

1



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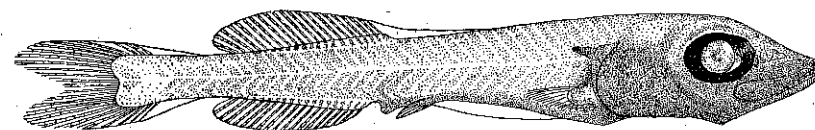
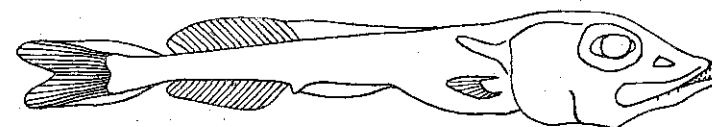
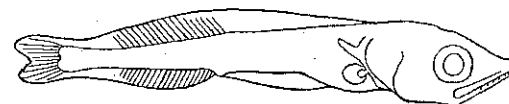
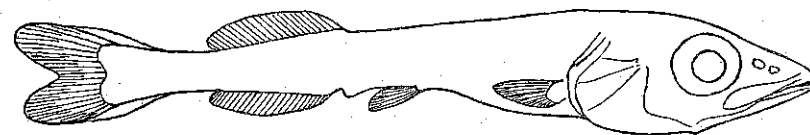
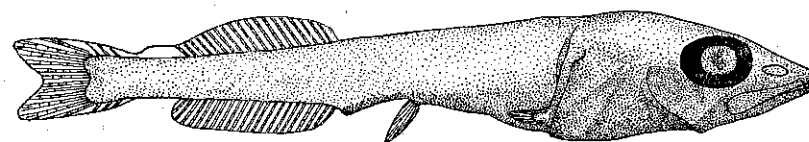


1. *Alepocephalus rostratus*.
2. *Alepocephalus Giardi*.

G. M. W. del.

V. '06.

Pl. IV.

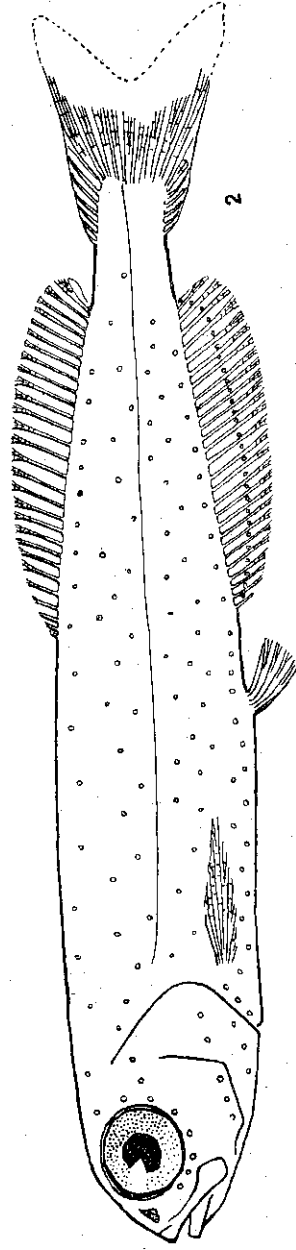
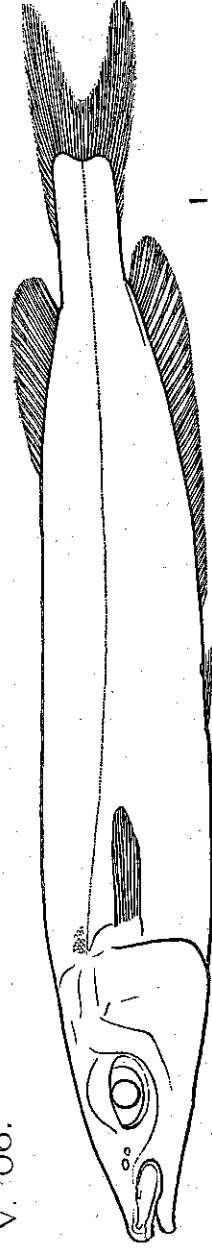


L. W. B. del.

1, 2, Alepocephalus Giardi.
3-5. Bathytroctes rostratus.

V. '06.

Pl. V.



1. E. W. L. H. } dei.
2. L. W. B. }

1. *Alepocephalus macropterus*.
2. *Xenodermichthys socialis*.