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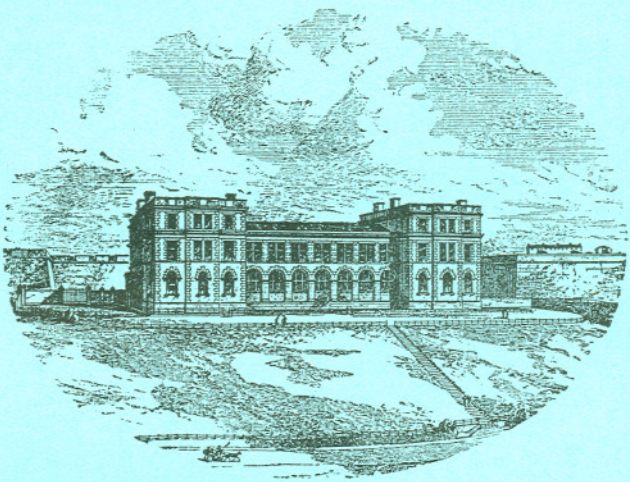

THE PLYMOUTH LABORATORY.

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Notes on Teleostean Ova and Larvae observed at Plymouth in Spring and Summer, 1909.

By

A. E. Hefford, B.Sc.

With Plates I and II.

CONTENTS.

THE observations which form the subject of the following notes deal with only part of the total material on which my studies of teleostean reproduction, pursued during the last two years, have been made; but as the other and larger part of the material consists of preserved specimens of the young (chiefly post-larval) stages of fishes collected during the four years 1906 to 1909 inclusive, it is more convenient to deal with the egg collections of the past year first and to treat the whole collection of young fry separately in a further paper.

Systematic examination of tow-nettings for pelagic fish-eggs began on February 11th, and in the early months before the steamer was in commission, owing to the exigencies of weather and time which attend the use of a small sailing-boat, samples were taken only inside the Sound or in its near vicinity. As will be seen from the analysis of the collections given in Table I, there was a break of more than a month's duration, beginning early in March. From April to the end of August the s.s. *Oithona* was available, which not only rendered collections from the open-sea areas possible, but also permitted the use of the Petersen young-fish trawl, by which large quantities of fish-eggs could be obtained. The quantities so obtained were generally much too large to admit of their individual examination, and therefore it was my practice to pick out a portion of the total eggs for careful examination and frequently for hatching in the laboratory, while the residue was scrutinized as carefully as possible so that the rarer specimens should not be omitted. After a certain amount of practice one can recognize many of the familiar species by size and other peculiarities even with the naked eye, so that after a confirmatory microscopic examination it is possible to obtain a fair knowledge as to the identity of the majority of the species present in a plankton sample, and then exceptional eggs can often—though not, of course, without exception—be discerned. In the case of tow-net samples, which were taken with coarse (24 strands to the inch) or medium (50 strands to the inch) nets at various depths from the surface to about 9 or 10 fathoms, care was taken to pick out every individual egg. The hauls were in most cases of 15 minutes' duration, so that quantitative comparison is to some degree possible. Throughout this work I have conducted my observations having in view practical fishery questions—e.g. the locating of spawning areas, the duration of the spawning period, and the relative extent of the breeding of various species of fishes in the Plymouth area—rather than details of purely biological interest, and therefore my records of the characters of eggs and larvae have had special regard to points for purpose of ready identification at the various stages of development; hence details of embryology have little place in this paper.

The ova and larvae of the majority of species occurring here are already more or less completely known, thanks to the labours of Cunningham, Holt, McIntosh, Masterman, etc., in this country, and to Ehrenbaum and other continental investigators, so that the main object of the descriptive notes which follow is to fill up gaps or to amplify those previous observations which still lack completeness. It is, perhaps, unnecessary to point out that records of such essential diagnostic characters as dimensions, additional to those which have been made on an extensive scale in investigations made in various parts of the North Sea and elsewhere, are of no little importance and value, owing to the local variation which occurs in such respects.

In glancing at the general constitution of my egg samples, as shown in Table I, perhaps the most striking feature is the vast preponderance of those belonging to unmarketable forms. The species which afforded the most numerous pelagic eggs was the rockling, *Onos* (*Motella*) *mustela*, and not far behind this in abundance come the gold-sinny or rock-wrasse (*Ctenolabrus rupestris*), the boar-fish (*Capros aper*), and the dragonet (*Callionymus lyra*). Doubtless more eggs of such important families as the Gadidae and Pleuronectidae would have been taken if more off-shore collections had been possible. One may assume that the relative abundance of planktonic eggs, if sufficiently numerous samples are taken, is a fairly reliable index to the proportionate numbers of mature fish occurring in the area under observation at the spawning period. It is therefore to be expected that samples of planktonic eggs from inshore areas should consist predominantly of those from the littoral species of rockling and wrasse.* The same cause, however, does not explain the predominance of dragonets, boar-fish, and Norwegian top-knot over such forms as whiting, dab, plaice, and sole, which are marketable fish of much importance to our local trawlers and line fishermen. The general aspect of the case is that species which are regular objects of the trawlers' pursuit are poorly represented in our egg samples. How far trawling itself is responsible for this condition of things is an open question, which in any case it is not in my province to attempt to answer here. But it is a noteworthy fact that the forms mentioned above are of such small size that they would to a great extent escape through the meshes of an ordinary trawl, and therefore stand the best chance of surviving on a well-fished ground. The result cannot be entirely attributed to local distribution of the mature fish, for the Norwegian top-knot has practically the same distribution here as the sole, thickback, "merry-sole,"

* It should be remembered that only one species out of the four Plymouth wrasses (viz. *Ctenolabrus rupestris*) produces pelagic eggs.

and dab, as well as approximately the same spawning period, while the same can be said regarding *Capros aper* as compared with the gurnards.

In the course of my laboratory observations, a point which has struck me as interesting and worthy of further definite inquiry, is the relative vitality of the eggs of various species, as indicated by the extent to which they are affected by the conditions under which they are kept while under observation, in the course of their development in the laboratory. On several occasions I have kept ova of different species in the same vessel of sea-water in order to watch the process of development and examine the hatched-out larvae. In such cases it frequently happened that one species would do well and produce healthy and vigorous larvae, while another would fare badly, and, if the embyro survived so long as to hatch out, the resulting larva would be more or less moribund from the outset and frequently crooked in shape. Notable among those whose vitality in the laboratory was considerable were the eggs and larvae of *Motella mustela*, *Callionymus lyra*, and *Ctenolabrus rupestris*, while those which most often appeared to be adversely affected were *Gadus*, *Trigla*, and especially the rare forms *Raniceps raninus* and *Serranus cabrilla*. It is to be expected that natural selection has effected that inshore—and sometimes even estuarine—forms like *Motella mustela* and *Ctenolabrus rupestris* should produce eggs which are capable of a wider range of environmental change (e.g. of temperature, to take the most obvious factor which operated in the cases under discussion) than those species which spawn in deeper water, where the surrounding conditions are of a more uniform character. In the case of *Serranus cabrilla* it is not surprising that ova produced in this neighbourhood, which must be at the extreme limit of the natural spawning area of this species, should be of less than average health. The laboratory temperature falls below that of the sea at times in winter, and in summer is generally above it. In the hot weather my vessels containing eggs were put to stand in running aquarium water for the sake of coolness. The same should be done if frost is to be feared in winter. I kept my eggs in sea-water obtained from well outside the Sound, or in aquarium water which had been treated with animal charcoal and then filtered through a "Berkefeld" filter.*

* See Allen and Nelson, "On the Artificial Culture of Marine Plankton Organisms," *Journ. M.B.A.*, Vol. VIII, No. 5, p. 432.

TABLE I.—SHOWING NUMBER AND PARTICULARS OF CAPTURE OF PELAGIC FISH-EGGS TAKEN OFF PLYMOUTH IN SPRING AND SUMMER, 1909.

No. of Sample.	Date.	LOCALITY.	Gear.	Duration of haul (minutes).	Depth (fathoms).	Ctenolabrus rupestris.	Capros aper.	Trachinus vipera.	Callionymus lyra.	Solea vulgaris.	S. variegata.	Pleuronectes flesus.	P. microcephalus.	Zeugopterus norvegicus.	Gadus merlangus.	G. minutus.	G. luscus.	Onos mustela	C. sprattus.	C. pilchardus.	Other Eggs.
1	11–II	West Channel	m	20	?	–	–	–	1	–	–	–	–	–	–	–	–	11	–	–	Gadus sp. (3).
2	17 ,,	,, ,, ...	m	15	ca. 3	–	–	–	3	–	–	–	–	–	–	–	–	5	2	–	Gadus sp. (1). [sp. (1).
3	,, ,,	,, ,, ...	c	15	ca. 1½	–	–	–	–	–	–	1	–	–	–	–	1	4	8	–	Zeugopterus punctatus (1), Gadus
4	20 ,,	Between Shagstone and Breakwater	m	15	1	–	–	–	1	–	–	1	–	–	–	–	1	ca. 50	1	–	
5	,, ,,	,, ,, ,,	c	15	3	–	–	–	–	1	–	–	–	–	–	–	–	9	1	–	Z. punctatus (1), Gadus sp. (1).
6	25 ,,	West Channel...	m	15	3½	–	–	–	1	–	–	–	–	–	1	–	–	21	1	–	Z. punctatus (3), Gadus ? luscus (3)
7	4–III	,, ,, ...	m	15	?	–	–	–	>1	–	–	3	–	–	–	–	–	>3	>6	–	Z. punctatus (3).
8	,, ,,	,, ,, ...	c	15	?	–	–	–	2	–	–	2	–	–	–	–	–	sev.	ca. 10	–	Z. punctatus (1).
9	8–IV	7 miles S.W. of Eddystone	m	15	—	–	–	–	7	–	2	–	1	–	–	–	–	–	7	9	G. ? luscus (3), G. ? minutus (1).
10	,, ,,	,, ,, ,, ...	c	15	—	–	–	–	3	–	6	–	1	–	–	–	2	–	ca. 10	sev.	Gadus sp. (1), G. ? minutus (1).
11	19 ,,	Between Mewstone and Breakwater...	m	15	3	–	–	–	6	–	–	–	–	4	–	–	–	1	–	–	
12	,, ,,	,, ,, ,, ...	c	15	ca. 7	–	–	–	2	–	–	–	1	3	–	–	–	2	–	–	Z. punctatus (1).
13	20 ,,	Off Cawsand Bay	c	15	ca. 9	–	–	–	1	–	–	–	–	6	–	–	1	8	1	–	Z. ? punctatus (1). [sp. (1).
14	23 ,,	West Channel...	c	15	ca. 4	–	–	–	–	–	–	–	–	–	–	1	–	9	–	–	Z. ? punctatus (1), Zeugopterus
15	28 ,,	Cawsand Bay	t	15	—	–	–	–	10	–	–	–	1	–	1	–	–	–	4	–	Zeugopterus sp. (2). [tus (1).
16	3–V	Off Ram's Cliff	t	15	—	–	–	–	–	1	3	–	–	–	–	–	–	3	1	–	Z. punctatus (5), Gadus ? minu-
17	7 ,,	Jennycliff Bay	t	15	—	?1	–	–	2	–	–	–	–	2	–	–	–	3	3	–	Unidentified (1).
18	11 ,,	Cawsand Bay	t	15	—	4	–	–	2	–	–	–	1	1	–	–	–	17	4	–	
19	12 ,,	Off Ram's Cliff	t	15	—	1	–	–	1	–	–	–	–	1	–	–	–	2	–	–	Z. punctatus (1).
20	18 ,,	Yealm Point, N.N.E., 1½ miles ...	c	10	4	4	–	–	–	–	–	–	–	3	–	–	–	–	–	–	
21	21 ,,	Eddystone Ground	c	15	7–10	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	
22	24 ,,	Whitsand Bay	t	15	—	5	–	2	1	–	–	–	2	1	–	–	–	3	12	–	Z. punctatus (1).
23	2–VI	Rame Head, N., 2 miles	t	15	—	11	–	–	–	–	–	–	–	1	–	–	–	–	–	–	Onos sp. (1).
24	11 ,,	Whitsand Bay	t	15	—	sev.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

No. of Sample.	Date.	LOCALITY.	Gear.	Duration of haul (minutes).	Depth (fathoms).	Ctenolabrus rupestris.	Capros aper.	Trachinus vipera.	Callionymus lyra.	Solea vulgaris.	S. variegata.	Pleuronectes flesus.	P. microcephalus.	Zeugopterus norvegicus.	Gadus merlangus.	G. minutus.	G. luscus.	Onos mustela.	C. spratfus.	C. pilchardus.	Other Eggs.
25	14–VI	Rame Head, N. by E., 2 miles ...	c	15	ca. 4	3	2	1	2	–	–	–	–	3	–	–	–	–	2	–	
26	21 ,,	West Channel...	c	10	ca. 4	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
27	21 ,,	,, ,, ...	c	?10	0	6	–	1	–	–	–	–	–	–	–	–	–	–	3	–	
28	22 ,,	Cawsand Bay	c	10	0	14	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
29	,, ,,	,, ,, ...	t	10	—	m	–	4	1	1	–	–	–	–	–	1	–	–	–	–	
30	25 ,,	,, ,, ...	t	20	—	v.m.	–	2*	1*	–	–	–	–	–	–	–	–	3*	v.m.	–	
31	28 ,,	Rame Head, N. by E., 3 miles ...	c	?	—	3	5	–	–	–	–	–	–	6	–	–	–	–	1	–	Onos ? tricirratus (1).
32	,, ,,	,, ,, ,, ...	c	15	3½	4	–	1	–	–	–	–	–	–	–	–	–	–	1	–	
33	29 ,,	Eddystone, N.W. by W., 1 mile ...	t	15	—	–	v.m.	–	1	–	–	–	–	–	–	–	–	–	–	–	Caranx trachurus (1).
34	,, ,,	,, ,, ,, ...	t	15	—	–	–	sev.	–	–	1	–	–	–	–	–	–	–	–	–	
35	2–VII	Eddystone, S. by E., 1¼ miles ...	c	12	0	4	v.m.	–	–	–	–	–	–	–	–	–	–	–	–	–	? Raniceps raninus (1).
36	,, ,,	,, ,, ,, ...	c	12	4	3	18	–	–	–	–	–	–	–	–	–	–	–	–	–	Solea lutea (1).
37	5 ,,	Eddystone, S.E., 2¾ miles	c	10	0	1	11	–	–	–	–	–	–	–	–	–	–	–	–	–	Trigla sp. (1).
38	,, ,,	,, ,, ,, ...	c	10	3	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	
39	8 ,,	Just outside Breakwater	t	10	—	–	–	sev.	1	–	–	–	–	–	–	–	–	–	m	–	Trigla sp. (1).
40	12 ,,	,, ,, ...	c	12	2	5	1	–	–	–	–	–	–	–	–	–	–	–	–	–	
41	,, ,,	,, ,, ...	c	10	0	8	3	–	–	–	–	–	–	–	1	–	–	–	2	–	Trigla sp. (1).
42	20 ,,	Eddystone, N.W., 1½ miles... ...	c	15	0	sev.	m	–	–	–	–	–	–	–	–	–	–	–	–	–	
43	,, ,,	,, ,, ,, ...	c	15	2	–	sev.	–	–	–	–	–	–	–	–	–	–	–	–	–	
44	26–VIII	Eddystone, S.W., 1½ miles	t	15	—	–	4	–	–	–	–	–	–	–	–	?1	–	–	–	–	
45	,, ,,	,, ,, ,, ...	t	15	—	–	1	1	–	–	3	–	–	–	–	?1	–	–	–	1	? Rhombus laevis (1).
46	27 ,,	Rame Head, E.N.E., 3 miles ...	t	15	—	–	4	1	–	–	–	–	–	–	–	?6	–	3	–	–	Serranus cabrilla (4). [ratus (1).
47	30 ,,	Rame Head, S.E. by E., 1 mile ...	t	15	—	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–	Raniceps raninus (4), O. ? tricir-
48	14–IX	West Channel and inside Breakwater	c	?15	>3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
49	,, ,,	,, ,, ,,	c	15	ca. 3	–	–	–	–	–	–	–	–	–	–	–	–	10	–	3	

Symbols used:—Under "Gear," m = medium tow-net, c = coarse tow-net, t = young-fish trawl.

In numbers columns, sev. = several, m = many, v.m. = very many.

* This number only observed. Probably more present in catch.

I. PELAGIC EGGS.

Ctenolabrus rupestris, L. Gold-sinny or Rock-wrasse.

HOLT (11a), p. 465, Figs. 23, 24, 28–30.
HEINCKE u. EHRENBAUM (10), p. 266, Fig.17a–d.

THIS species afforded the most numerous of the pelagic eggs taken during the months of May, June, and July. Belonging to a littoral species it was taken for the most part in near-shore tow-nettings, and was practically absent from the offshore Eddystone Grounds; but there was one notable exception to this on July 20th, when several were taken one and a half miles south-east of the Eddystone. The egg, which is easily recognized by its small size, clear homogeneous yolk devoid of an oil-globule, small perivitelline space, and embryo with slender body and uniformly distributed pigment, has been described by Holt (*op. cit.*) from the south-west coast of Ireland and from the Gulf of Marseilles, and by Heincke and Ehrenbaum from Heligoland. The size of the egg is liable to much variation. The diameters recorded for the North Sea are 0·72 to 0·94 mm., for the Mediterranean 0·70 to 0·83 mm., and for the Irish coast 0·835 mm. The diameter of my eggs ranged from 0·78 to 0·90 mm., averaging ·878 in May, ·839 in June, and ·822 in July. The first specimen was taken on the 7th of May, the last on the 20th of July. The newly hatched larva has a total length of 2·16 mm., the distance from snout to anus being 1·22 mm.

The post-larval stages have been taken in the young-fish trawl from late June onward, but they do not appear in that relative abundance which one might expect from the commonness of the ova. This is probably due to the fact that they early seek the environment of inshore rocks, which is the habitat of the adult. Holt (11d, p. 125) speaks of young examples being common on the zostera beds of Cawsand Bay and the Yealm estuary, but judging from his later publication of a drawing of a young wrasse taken at Fowey (Marseilles, 1899), and erroneously identified as *C. rupestris*, it is probable that at this time he was confusing this species with another wrasse, probably *L. maculatus*, the young of which are more commonly met with off the shores of this neighbourhood in summer. The later post-larval stages, like the early larva, are characterized by their lack of black pigment, which is limited to a large spot at the base of the posterior end of the anal fin and at the base of the caudal fin, and for the rest a little in the peritoneum, on the head and on the throat.

Serranus cabrilla, L. The Gaper.

RAFFAELE (**20**), p. 19, Tav. I, Fig. 5, Tav. II, Figs. 1 and 3.
HOLT (**11f**), p. 11, Pl. IV, Figs. 33–40.

Four eggs with homogeneous yolk and single oil-globule were taken on August 27th and six on August 30th, in each case in plankton caught by the young-fish trawl in Whitsand Bay. In both cases the eggs soon developed unhealthy symptoms, and the characters of the embryo and larva must be considered with this condition borne in mind. The diameter of the eggs ranged from 0·92 mm. to 0·97 mm. and the size of the oil-globule from 0·14 to 0·15 mm. Before the formation of the embryo the surface of the yolk presents a roughened appearance, which may be due to a slight granulation in the peri-blastic region (cf. Holt, *op. cit.*, p. 12). Just before the outgrowth of the free caudal region a few round, pale yellow chromatophores have appeared along the sides of the embyro, and smaller, somewhat inconspicuous dark stellate chromatophores are fairly uniformly distributed all over the body. As development proceeds the pigment spots increase in size, single yellow chromatophores by the anus and in the mid-post-anal region being well marked. There is a little pigment of each colour over the oil-globule, but none on the yolk-sac. The hatched-out larvae were moribund in every case. The length of the newly hatched larvae (Fig. 13) varied from 1·84 to 2·30 mm. The largest and most whole specimen measured 1·00 mm. from the snout to the posterior edge of the yolk-sac, and 1·26 mm. from snout to anus. The post-anal length of 1·04 mm. should have a trifle added to it to allow for the slight shrinkage which had taken place. The pigment has a very characteristic distribution, but varies somewhat in the size and number of the chromatophores. Black pigment is confined to the dorsal (anteriorly it may be dorso-lateral) region of the head and trunk, extending as a dorsal line to the caudal extremity. The yellow, which by transmitted light shows a greenish tint, is confined on the body itself to a few rather widely separated chromatophores of large size. In an average case there are one on the head; one behind the otic region; two in the pre-anal dorsal line; two lateral spots at the level of the posterior edge of the yolk-sac; one very large one over the anus and at the mid-post-anal point in the dorsal and ventral contours. Ramifications extend into the unpaired fins in the two latter cases. All the larvae observed showed one large dorsal mid-post-anal chromatophore, but the corresponding ventral pigment may consist of as many as four chromatophores. In the dorsal fin

there is a row of four to six large chromatophores, which usually exhibit upwardly and outwardly radiating outgrowths. The most posterior of the series is a little behind the dorsal chromatophore of the caudal region. There may be corresponding pigmentation in the anal fin, but it is not so extensive, from two to four chromatophores being the usual occurrence. The pre-anal fin may have a spot of yellow pigment near its margin, and invariably there is a small patch in its antero-dorsal angle, where the contours of yolk-sac and intestine converge. There is no pigment on the yolk-sac, but over the oil-globule there are one or two chromatophores of each colour.

Normally the yolk-sac is somewhat elongated and bears the oil-globule at its anterior end, but the position of the oil-globule shows some variation, and in two cases was only just within the anterior hemisphere.

The general form of the larva resembles that of Holt's Fig. 33 (*op. cit.*), the characteristic features apart from pigmentation being the ovoid yolk-sac with anteriorly placed oil-globule and the broad pre-anal fin membrane.

My late embryos and larvae all showed a marked tuberculated epidermis, which was doubtless a pathological condition, and may be regarded as diagnostically unimportant.

On referring to previous observations by Raffaele and Holt of Mediterranean species, one finds conspicuous characteristic features which are common to all the above and to my Channel specimens, but there are also puzzling variations which, in the case of the Gulf of Marseilles specimens, do not seem to be altogether explicable as being the result of partial observations of more than one species. Raffaele (*op. cit.*, p. 19) deals with the eggs of three species, which I give below with the dimensions :—

	Diam. of egg. mm.	Diam. of oil-globule.
Serranus (*Centropristis*) *hepatus* . .	0·78	0.145
S. cabrilla	0·90	0·15
S. scriba	0·90	0·122

He figures the larvae of *S. scriba* and *S. cabrilla* (Tav. 2, Figs. 1–4), but does not give larval dimensions nor any further indication as to the specific pigmentation than can be derived from the uncoloured drawings.

In size my eggs agree most with his *S. cabrilla*, although slightly larger. Raffaele's newly hatched *S. cabrilla* larva has the oil-globule centrally situated, while his *S. hepatus* shows it anteriorly situated. The former has large mid-post-anal dorsal and ventral chromatophores.

In the unpaired fins of the newly hatched larva there is no pigment, but a four to five days' old larva shows two large chromatophores on the dorsal and anal fins.

Holt (*op. cit.*, p. 11) examined several Serranoid eggs from the Gulf of Marseilles and found among them unusual variability. The diameter varied from 0·72 to 0·89 mm. (for the most part lying between 0·78 and 0·84 mm.), and the oil-globule from 0·14 to 0·16 mm. He found that the embryonic pigment, which first appeared before the outgrowth of the caudal rudiment (the black generally, but not always, preceding the yellow), showed considerable variation, while there appeared to be no constant relation between the variations. As to the nature of the yellow pigment (often greenish yellow by transmitted light, and very pale by reflected light) Holt's records (as well as Raffaele's) agree with my observations. Both black and yellow chromatophores are shown as a rule over the oil-globule, but never over the rest of the yolk-sac. In all Holt's observations of the newly hatched larvae the oil-globule was anterior, the pre-anal part of the body slightly longer than the post-anal, the multicolumnar notochord had its vacuoles arranged fairly regularly in two series, dorsal and ventral. Pigment was disposed along the whole length of the dorsum, and was sometimes present on the sides and intestinal region. The yellow chromatophores followed the contour of the dorsum, and post-anally there were only two spots, a dorsal and a ventral, generally well defined, marking the centre of the post-anal region. The pigment on the head varied. There was always a spot at the angle formed by the intestine and the dorso-posterior profile of the yolk-sac, and also in the region of the urocyst, and sometimes others over the intestine. It is to be noted that Holt never observed any pigment in the embryonic fins of the newly hatched larva, but after three days *black* pigment appears in the embryonic fin—a row of chromatophores in the dorsal and one chromatophore in the anal fin, while black pigment, which increases with the growth of the larva, appears along the dorsal contour of the intestine (*op. cit.*, Figs. 36 and 37). My larva, on the other hand, shows *soon after hatching* a row of *yellow* chromatophores in the dorsal fin. Otherwise it agrees with the youngest larval stages which Holt represents in Figs. 33, 34, and 35, and refers to *Serranus* (*hepatus?*). It is possible that the early appearance of yellow pigment in the dorsal fin is a characteristic of *S. cabrilla*, which distinguishes it from *S. hepatus*, the species probably observed by Holt. However, a still later stage observed by him ("alévin âgé de quelques jours"), of apparently the same species, does show large yellow chromatophores associated with the relatively diminutive black ones in the embryonic

fins, and also differs from the other larvae in having the black pigment of the body predominantly ventral instead of dorsal. A still further distinct variation is shown in an older stage with the yolk almost absorbed and the mouth open (but only 2·06 mm. long), which has much yellow and no black in the embryonic fin (*op. cit.*, Fig. 40).

With the material at his disposal and the small assistance derived from Raffaele's incomplete observations, Holt was unable to come to any definite interpretation of these unusual and irregular variations of larval pigment; and the still further difference displayed by my larvae does not add light to the problem. Holt referred them, or at least some of them, to *S. hepatus* as the most probable parent, on account of their smaller size as compared with Raffaele's, and because of the greater abundance of this species in the area from which his eggs were taken. He also admits the possibility of some *S. cabrilla* eggs being present among his specimens.

As to the specific identity of my eggs I have little doubt in ascribing them to *S. cabrilla*, which is a constant, though not common, inhabitant of Channel waters. As far as can be judged from Raffaele's incomplete records, the egg and larva agree with his *S. cabrilla* from the Bay of Naples, except that his figures show no pigment in the embryonic fin of the newly hatched larva, but only at a later stage. The dimensions of the egg and oil-globule show practical agreement. The date of the occurrence of the eggs agrees with Day's record of the spawning season of *S. cabrilla*. The only other member of the genus known to British waters is *S. gigas*, Cuv. and Val, mentioned by Day as an occasional and accidental visitor, who also states that "in warmer climates it deposits its ova in shallow water." I do not know of any description of the ova of this species. It does not seem likely, however, that it would spawn successfully here.

Caranx trachurus, L. Scad or Horse Mackerel.

Holt* (11b), p. 9; (11d), pp. 116–20 and 340.
(11f), pp. 27–31, Figs. 53–63.
Canu (3b), pp. 63–71. Pl. V, Figs. 1–6.
Heincke and Ehrenbaum (10), p. 277, Figs. 28–31.
Ehrenbaum (5c), p. 234.

Although this species was exceedingly common off the coast in the early summer months only one egg was taken. This occurred in the catch of the young-fish trawl taken near the Eddystone on 29th June. It was not closely observed till the following day, when the larva had

* See also North Sea Investigations, VI. "The Reproduction of *Caranx trachurus*," *Journ. M.B.A.*, Vol. III, N.S., pp. 190–4 (1893–5).

hatched out, but in an unhealthy condition and with the tail much bent. It was recognized by the larval pigmentation and by the totally segmented yolk, which bore anteriorly an oil-globule of 0·24 mm. diameter. The black and yellow pigment had a similar distribution to that in Holt's and Ehrenbaum's figures, but was not so strongly marked. On account of the deformity of the tail it was impossible to ascertain the total length. It measured 0·98 mm. to the posterior contour of the yolk-sac. Post-larval stages have occasionally appeared in the catches of the young-fish trawl in July and August. It would appear, therefore, that the fish spawns out in deep water, the drift of the eggs and larvae towards the coast requiring some little time. It will be noticed that my solitary egg was at the last stage of embryonic development when taken. Its unhealthiness also is in keeping with the general rule that the more the habitat of the species lies in the open sea the greater the difficulty experienced in rearing the larva in the laboratory. In spite of the abundance of scad at this time in these waters, all those I was able to examine were immature, so that I inferred that the older and spawning fishes did not approach the coasts so closely. Against this, however, it must be stated that as the result of his investigations in the North Sea, Ehrenbaum (*op. cit.*, p. 235) finds that *Caranx trachurus* favours as spawning places the shallow coastal areas from 10 to 25 m. depth, while outside the 30 m. line only few eggs were found.

Previous records of the occurrence of this egg in the Plymouth neighbourhood are confined to the observations of Holt (**11**d, p. 116), who obtained four specimens in July, 1897. The diameter of the egg was 0·81 to 0·93, and the oil-globule 0·22 to 0·23 mm.

Capros aper, Lacep. Boar-fish or Cuckoo.

The pelagic eggs of this species first appeared in tow-nettings taken on 14th June, and from the end of that month to the end of August our samples from the deeper water contained a well-marked preponderance of these eggs, which were especially numerous at the beginning of July in the neighbourhood of the Eddystone. The embryonic characters were first described by Cunningham (**4**a, p. 10), who artificially fertilized ova in August, 1897, and Holt has published descriptions and drawings of the larval stages (**11**f, p. 26, Pl. V, Figs. 43–8). Pelagic eggs taken by him varied from 0·93 to 1·01 mm. in diameter (chiefly ·97 to ·99), and contained an oil-globule of 0·15 to 0·165 mm. diameter. The average dimensions of my ova were:—diameter of egg, 0·946 mm.; diameter of oil-globule, 0·156 mm.; and the range of size was from 0·90 to 0·98 mm. for egg, and from 0·145 to

0·17 mm. for oil-globule, which was frequently of a yellowish tint. The species may be readily recognized towards the end of embryonic development by the characteristic yellow and black pigmentation. The yolk is homogeneous, the oil-globule of a yellowish tint, and the capsule marked with fine corrugations. At about the time of the outgrowth of the caudal rudiment black chromatophores appear on the head and in a line on either side of the body. A rather large Küpfer's vesicle is visible at this stage. Yellow pigment appears soon afterwards. One larva soon after hatching measured 1·40 mm. from snout to anus, and about 2·46 mm. in total length. Another had a total length of 2·02 mm., the distance from snout to end of yolk-sac being 1·08 mm. Black and yellow pigment occurs in rather large, stellate or dendritic chromatophores on the head and along the sides of the body. At about the level of the anus and in the mid-post-anal region there is a tendency for it to be more concentrated. The embryonic fins and the posterior extremity of the trunk are unpigmented.

In spite of the abundance of pelagic ova not a single larval or post-larval specimen occurred in our young-fish trawl collections. The young fish appear to seek early the deeper parts of the Channel. The only specimen recorded up to the present is one of 15¼ mm. length, taken in September, 1906, by the Danish research steamer *Thor*, to the west of the Channel Islands (**21**d, p. 5).

Trachinus vipera, Cuv.

This conspicuous and very easily identified egg occurred frequently though not abundantly in our samples from the latter part of May to the end of August. The many bright yellowish-green oil-globules and the richly pigmented embryo and yolk-sac render it a conspicuous object in the tow-nettings. The diameter lay between 1·28 mm. (in May and June) and 1·1 mm. at the end of August. Post-larval stages were frequently taken from the end of June throughout the summer.

TRIGLA. The Gurnards.

There are five species of Trigla occurring in the waters off Plymouth, and the specific identification of their pelagic eggs, which are similar in character and show considerable overlapping in dimensions, is a matter of great difficulty and often an impossibility. The only circumstances which ensure certainty of determination are when the spawning fish are captured in quantity at about the same time and in the same area as the eggs, so that an extensive comparison can be made between the planktonic eggs and those taken from the ripe fish.

Such, for example, were the conditions under which Holt (**11**b, p. 31) was enabled to identify the eggs of *T. cuculus* taken in April and May off the west coast of Ireland, and similarly Ehrenbaum (**5**c, p. 248) has made extensive measurements of planktonic and artificially fertilized ova of *T. gurnardus* in the North Sea, the main purpose in the latter case being to distinguish between grey gurnard eggs and those of the mackerel, which may to a certain extent coincide in diameter and size of oil-globule.

The following table shows the dimensions of artificially fertilized Trigla ova from four species which have previously been described by various observers:—

Species.	Observer and locality.	Month.	Diameter.	Size of oil-globule.
T. gurnardus	Cunningham (Plymouth)	April–May	1·45	0·30
,,	Holt (west coast of Ireland)	—	1·43–1·55	0·28–0·33
,,	Ehrenbaum (Helgoland)	June	1·256–1·258	0·25
,,	,, ,,	July	1·163–1·446	0·25
T. hirundo	Canu (Boulogne)	May–July	1·5–1·7	0·27–0·29
,,	Ehrenbaum (Helgoland)	July	1·193	0·24
,,	,, ,,	August	1·1–1·352	0·22
T. cuculus	Cunningham (Plymouth)	April–May	1·45	0·30
,,	Holt (west coast of Ireland)	May	1·47–1·61	0·28–0·33
T. lineata	Holt (Plymouth)	July	1·29–1·33	0·24

Besides the above four species, *Trigla lyra*, L., commonly known as the Piper, occurs off Plymouth in appreciable quantities, but its ova have never been described. A further difficulty is introduced by the great variation which is shown by the eggs of the same species observed in different regions and at different times. In spite of this, however, Canu (**3**b, p. 72) has stated that, as regards the eastern part of the Channel, the eggs of *T. hirundo* exceed in diameter those of all other members of the genus, but he does not give any actual observations to support this statement.

Out of my own collection, during the summer of 1909, I can only refer three eggs with absolute certainty to the Trigla genus. As to their specific identity I can say nothing, except that *T. lineata* appeared to be the most common species off Plymouth at the time (July) and may possibly have been the parent fish. There are few descriptions of gurnard eggs and larvae on record at present, so it may serve a useful purpose for future comparison if I briefly give here my own observations. On the 5th of July an egg was taken about $2\frac{3}{4}$ miles north-west of the Eddystone. Its diameter was 1·4 mm., and it contained an oil-globule of 0·22 mm. Observed on the same day, the blastodisc had almost half enveloped the yolk. Next day the embryo had formed;

the myotomes were very distinct, and faint dark pigment was just appearing. Less than twenty-four hours after this a short caudal rudiment had appeared, and the body was beset with both black and yellow pigment cells. In the caudal region yellow predominated, covering the dorsal surface almost entirely, while of black there were only a few round chromatophores. Over the yolk-sac there were many black and yellow chromatophores stellate and cruciform in shape, and the pellicle of the oil-globule was covered with large black dendritic chromatophores, each with many ramifying rays. The rudimentary pectoral fins occurred as relatively large flap-like outgrowths. On the fourth day, when the embryo had wholly surrounded the yolk, yellow pigment had increased in intensity, especially in the post-anal part, and had appeared on the pectoral fins. Black dendritic and pectinate pigment patches, together with yellow pigment, were visible on the embryonic fin membrane. The otocysts were relatively small, and situated so that the distance from the posterior edge of the eye to the posterior edge of the otocyst was equal to the diameter of the eye. The oil-globule had shrunk to a diameter of 0·20 mm. The egg died before hatching.

On the 8th July another egg of 1·28 mm. diameter and oil-globule 0·215 mm. was taken a short distance south of the Breakwater. The embryonic character as to pigmentation, etc., was quite similar to the above-mentioned, and fortunately this proved to be more healthy. On the 12th the larva was found to have hatched out and was then probably over twenty-four hours old, the yolk being partially absorbed. Its length was 4·5 mm., the distance from snout to anus being 1·7 mm. At this stage it has a general resemblance to a Zeugopterus larva, but the body is less elongate, the anus relatively nearer to the yolk-sac, and the well-developed and richly pigmented pectoral fins especially characterize it as Trigla. There is no well-defined "snout" and the frontal region is peculiarly square. The bean-shaped otocysts, with two very small otoliths, are placed immediately behind the eye. The oil-globule is situated at the posterior end of the yolk-sac, between which and the anus there is a short but deep pre-anal fin. The rectum lies at right angles to the longitudinal axis. Dorsal to the gut above the middle of the yolk-sac is a conspicuous spherical swim-bladder. The pigment is bright canary-yellow and black. The whole of the head, except the eyes, is diffusely covered with yellow. In the eye black is beginning to appear. A continuous dorsal series of rather diffuse yellow chromatophores runs back from the head to a point about 1·1 mm. from the posterior extremity, beyond which both marginal fins and body are quite unpigmented. A similar but less

intense line runs along the ventral contour of the trunk. Over the surface of gut and yolk-sac is a diffuse covering of pale yellow and faint dendritic black markings. The pectoral fins are intensely yellow, with black etching-like markings round the margin in radial arrangement. On the unpaired fins there are large dendritic black and yellow chromatophores, distally distributed for the most part. In the anal fin all the pigment is marginal, while in both dorsal and anal there are fine, black, pectinate markings along the edge of the fin, similar to what is seen in *Zeugopterus norvegicus*.

A third Trigla egg of 1·34 mm. diameter was taken on 12th July, 1½ miles south of Rame Head. The embryo had formed, but the oil was still in two globules of 0·23 and 0·13 mm. diameter, which joined to make a single globule next day. On the fourth day the larva hatched out. Its total length is now 4·45 mm., the pre-anal length being 1·75 mm. In general form and pigmentation it resembles the larva above described, which was observed at a somewhat older stage. It differs slightly from that, however, in having less black pigment in the dorsal and anal fins, nor is the marginal pigment of the pectoral fin as strongly marked. Next day its length has increased to 4·74 mm. and the yolk is almost absorbed. The pectoral fins are much larger and now show the marginal fringe of black very plainly. The mouth has become distinctly enlarged and already has the characteristic gurnard form. Two days later, on the 19th, the larva, with but a very small amount of yolk left unabsorbed, has lost the brilliant yellow colouring of the younger stages. It is still fairly well marked, although diffuse, over the dorsal surface of the head and trunk, but less distinct over operculum, along the sides of the pre-anal part of the trunk and on the pectoral fins. In the unpaired fins the marginal pigment is much reduced. Black pigment has increased, especially on the pectoral fins, which it now covers from margin to basal part, but the marginal fringe is still the most dense. Dendritic chromatophores occur at intervals along the margin of the dorsal fin, but are very sparse on the anal fin except in the hypural area, where there is a rich supply arising at the ventral edge of the tail and ramifying over the fin membrane. On the corresponding dorsal side there is a faint indication of the same thing. Fine dendritic chromatophores occur on the body, being most concentrated along the dorsal contour of the gut and along the ventro-lateral part of the post-anal region. Large otocysts containing relatively small otoliths are situated immediately behind the eyes. The large fan-shaped and heavily pigmented pectoral fins, and the head which is conspicuous from its well-developed jaws and operculum, give this larva a very characteristic appearance.

Callionymus lyra. Dragonet.

Although most abundant in the months of March and April and of rare occurrence during the summer, the presence of these eggs in the plankton has been recorded from 11th February to 30th August, the first and last occasion of the year on which searches for fish-ova were definitely made. The diameter of the egg varied from 0·70 to 0·91 mm., the average for February to April being 0·796, May to June 0.803, July and August, 0·74. Post-larval stages from about 3·5 to 10 mm. were exceedingly common from April to August in the young-fish trawl material.

PLEURONECTES.

The paucity of the eggs of this genus in our samples is greatly due to the fact that, by the time the systematic collection of samples was commenced, the spawning season of the species occurring off Plymouth was more or less over. Moreover, the regions favoured as spawning localities by the plaice (*P. platessa*), dab (*P. limanda*), "merry-sole" (*P. microcephalus*) are in the deep water at some distance from land, to which there is a regular off-shore migration for the colder months of the year, in which period most of the spawning of these species occurs. The flounder (*P. flesus*) is an exception. Seven eggs of this species were taken in four "hauls" in the Sound between 17th February and 4th March, and post-larvae were common in May. No plaice eggs were taken, the spawning being practically over by the end of January. Previously published observations of the occurrence of plaice eggs are confined to the records of the obtaining of one egg on 12th February and 7th March, 1902, by F. Balfour Browne (**2,** pp. 607 and 609). I myself have obtained no specimen of the pelagic post-larva, nor is there any record of such having been taken at Plymouth, due, I believe, to their off-shore spawning region. However, I hope to have more to say as to the distribution of the young Pleuronectidae in a later paper.

P. microcephalus eggs have been most frequently met with, but on five out of six occasions when this egg has appeared in my plankton samples, it has been only a single specimen. The first specimen was taken on 8th April and the last on 24th May, but before that period no off-shore tow-nettings had been collected. The diameter of the egg varied from 1·30 to 1·38 mm. A newly hatched larva measured 4·84 mm. Only one post-larva was taken—in July, off the Eddystone. In previous years, however, this stage has been more abundantly represented in our samples.

No eggs of *P. limanda* were taken, and on two occasions only (in

May and June) were post-larvae obtained. There is one record only of the occurrence of the egg of the dab in the Plymouth neighbourhood, viz. on 14th April, 1902, south of the Mewstone (**2**, p. 613), but this, again, is probably due to the dearth of samples from the off-shore areas.

Solea vulgaris, Quensel. The Common Sole.

The only remark to be made concerning the occurrence of this well-known and easily recognized egg is as to its rareness in our samples, only three specimens having come into our hands through the whole season, viz. one in February at the eastern entrance to the Sound, one in May in the Sound, and one in June in Cawsand Bay. This was probably due to the fact that no samples were collected during practically the whole of March. This month, according to Cunningham (**4**b, p. 117), represents the height of the spawning season, which extends from the middle of February to the end of April. A further cause is the fewness of our samples during this period from the deep off-shore waters where the spawning fishes appear to occur in greater numbers. Pelagic young fish have likewise been very few, less than ten being taken throughout the season from April to the end of August.

Solea lutea, Bonaparte. Solenette.

Holt (**11**a), pp. 460–4, Figs. 9, 10, 46–52.
(**11**f), pp. 87–9.
Ehrenbaum (**5**a), pp. 312–17, Figs. 31–5.

One specimen of the egg of this species was taken in a tow-net at a depth of about 4 fathoms 1¼ miles N. by W. of the Eddystone on 2nd July. It was not perfectly spherical, and measured 0·80 by 0·84 mm. The yolk contained 14 oil-globules of a pale amethyst tint. On the day of capture the embryo had developed a short caudal rudiment. Dull pale yellow pigment was present on the yolk-sac and abundant on the body, and a few black chromatophores were also visible on each. On being next examined, three days later, the larva was found to have hatched out and almost absorbed the yolk. Its total length was 3·01 mm., the distance from snout to anus being 1·03 mm. Dull yellow pigment in large dendritic chromatophores was present on the body, head, snout, and along the margin of the unpaired fins, with the characteristic large patch at the commencement of the posterior half of the tail. There are two large patches and a smaller anterior one on the anal fin. On each well-developed pectoral fin there is a large patch of pigment, which does not appear to have been mentioned by previous observers.

I have not found among my young-fish trawl collections this year any post-larval stages which I can with certainty ascribe to this species.

Solea variegata (Donov). Thickback.

CUNNINGHAM (4a), p. 23, Fig. 15.
(4b), p. 90 ; Pl. XVI, Fig. 6 ; Pl. XVII, Figs. 1 and 2.
HOLT (11d), p. 137.

This is the species of Solea which yielded the greatest total of eggs in our samples, fifteen altogether being taken for the season. Considering the relative abundance of the parent fish, previous records for Plymouth are surprisingly meagre. Cunningham first obtained a pelagic egg of 1·36 mm. diameter in July, which he identified chiefly by comparison with the ovarian egg from a ripe female taken the previous May. In his treatise on the Common Sole, 1890, he figures the newly hatched and two days' old larva, the former being 2·42 mm. in length. He describes the eggs as measuring 1·28 to 1·36 mm. in diameter, and therefore smaller than those of the common sole. It may here be mentioned that there seems to be no evidence for Ehrenbaum's statement (**5**b, p. 143) that it is larger than that of *S. vulgaris*, at least as regards the Channel specimens of the latter species (cf. **7**, p. 23), although observations in the North Sea (where *S. variegata* does not occur) have given a smaller diameter for the eggs of the common sole. Holt (*op. cit.*) records a single egg of 1·11 mm. diameter, taken in the Hand Deeps in July, which died before being completely examined; and Balfour Browne (**2**, p. 615) mentions the taking of one in the West Channel on 21st April, the diameter of which was 1·44 mm.

My earliest specimens (eight in number) were taken by tow-nets 7 miles south-west of the Eddystone on the 8th of April, but I was not able to examine them carefully until a day or two later, when most of them had hatched out. One of the eggs had a diameter of 1·36 mm. The yolk showed a superficial segmented layer and contained about forty oil-globules, more or less uniformly distributed below its surface. The embryo had developed a free caudal rudiment of moderate length. There were many round pale yellow or straw-coloured chromatophores and fewer small black ones on the body of the embyro and on the yolk-sac. The length of a larva, measured about one day, or possibly slightly more, after hatching, was 3·17 mm., from the snout to the posterior edge of the yolk-sac being 1·5 mm.

Three other eggs taken with the young-fish trawl in the Sound on the 3rd May were able to receive more attention. Their diameters

were 1·34, 1·36, and 1·30 mm. The first had between forty and fifty oil-globules, varying from 0·015 to as large as 0·12 mm.; the second possessed about fifty and possibly more oil-globules of diameter from 0·015 to as large as 0·12 mm.; the third had only thirty-four oil-globules of diameter 0·024–0·12 mm. At the commencement of the development of the caudal rudiment black and yellow pigment occurs, the former colour in rows of small chromatophores displaying stellate forms. The larva, measured during the first day after the hatching, has a total length of 2·88 mm., the distance from snout to anus being 1·38 mm. The yolk-sac is very globular in shape. Yellow is the prevailing pigment, occurring in large, stellate chromatophores over the body, embryonic fins, and yolk-sac. Large, stellate, black chromatophores are also to be seen over the yolk-sac, but they are not very intense, and they are less numerous than the yellow. Black, stellate pigment spots are also distributed along the body, chiefly on the dorsal region, but at the posterior extremity is a short series of three along the ventral contour. The most conspicuous black pigment is in a series of twenty-five large, irregular, stellate or dendritic chromatophores along the margin of the dorsal fin membrane, extending from the occipital region to about 0·4 mm. from the caudal extremity. There is a similar series along the margin of the anal fin membrane, but consisting of only six chromatophores. This specimen is practically identical with the somewhat older specimen figured by Cunningham in "A Treatise on the Common Sole," Pl. XVII, Fig. 2.

Subsequent specimens of this egg were taken on 29th June 1 mile S.E. by E. of the Eddystone (1 egg of 1·29 mm. diameter), and on 26th August in about the same area (3 eggs, 2 of which measured 1·26 and 1·3 mm. in diameter), in each case in the catch of the young-fish trawl. One or two post-larval stages were obtained in July and August from the deeper layers of water between Plymouth Sound and the Eddystone region.

Solea lascaris, Bonaparte. Sand Sole.

Holt (11a) (Species I), p. 457, Pl. XLIX, Fig. 26; Pl. L, Figs. 34, 35.
(11f) (*? Solea lascaris*), p. 84, Pl. V, Figs. 50, 51.

On 14th March, 1910, a single egg with the segmented yolk cortex typical of *Solea* and containing many oil-globules was taken in the tow-net between Plymouth Sound and the Eddystone. Examined on the 15th March, its diameter was about 1·36 mm., and the oil-globules, which numbered more than fifty, showed a characteristic arrangement. They were not aggregated closely together in opaque clusters as in

Solea vulgaris, nor distributed fairly regularly about the yolk as in *S. variegata* and *S. lutea*, but were arranged so that the majority of them formed a circle round the yolk outside the margin of the blastoderm, while there were also a number closely aggregated into a group at the vegetative poles.

Four days later (on the 19th) the larva was found to have hatched out (see Fig. 11) and was then probably in its first day of larval life. Its total length was 3·46 mm. and its pre-anal length 1·4 mm. The yolk-sac at this stage is very globular, the oil-globules being mostly in the ventral part of it. The head, body, unpaired fins and pectorals (which later become rather conspicuous), and yolk-sac are liberally sprinkled with dull, pale yellow chromatophores, from the well-marked rounded centres of which ramify dendritic outgrowths. There are black pigment spots having generally the same distribution but less numerous, especially on the yolk-sac and unpaired fins. The caudal region, where embryonic fin-rays are making their appearance, is unpigmented. Black is beginning to appear in the eyes. Two days later the yolk is reduced to about the size of the head, but still shows several oil-globules also reduced. The total length is about 3·7 mm.; from the snout to the anus about 1·52 mm. The eyes are black with greenish tints. The midbrain is well developed and the frontal region prominent—of the typical *Solea* type. The mandibular region is also well developed, but the mouth is not yet open. The gut now has a ventral bend above the posterior half of the yolk-sac. The pigment is practically unchanged, except for a concentration into marginal patches along the unpaired fins—six in the anal and nine in the dorsal fin—each patch consisting of a mass of dendritic chrome-yellow, usually with a somewhat dense black spot in the centre. The pectoral fins are large, well pigmented, and generally in active movement. The following day saw a further reduction of yolk, but there was still some left. The gut has now a pronounced U-shaped bend. The mouth is apparently about to open. The pigmentation of the unpaired fins shows further concentration into patches along the extreme margin. Yellow (dull brown by transmitted light) forms the greater part of each patch. The rest of the fins and body are also well covered with dendritic and irregular-shaped chromatophores. The frontal region is further developed and certainly constitutes a remarkable feature of the larva, but is nothing like Holt's drawing of his "Species I—*Solea* (?)" (11a, Figs. 34 and 35).

On the 23rd (viz. four days after the larva was first observed) it showed signs of ill-health and the tip of the tail had become shrunken

and crooked. There is still a portion of the yolk left, although the gut is now completely looped. The mouth is now open and conical teeth are visible in the lower jaw. The head is relatively enormous, the midbrain of considerable size and forwardly protruding. The dorsal fin membrane is very deep over the head and anterior part of the body. At this stage the specimen was killed.

A similar egg to mine was taken in July, 1890, in Clew Bay, and has been described by Holt (**11**a). The diameter was 1·38 mm., and the numerous oil-globules had a characteristic arrangement, different from that of the other known British species of *Solea* but resembling that exhibited in my specimen.

The resulting larva, however, was very different from mine, and was especially remarkable for its peculiar cephalic contour caused by a precephalic vesicular expansion of the dorsal fin. The very slight occurrence of black pigment and the limited distribution of the yellow chromatophores in the unpaired fin (*op. cit.*, Pl. L, Fig. 34) constitute another and probably more important difference between that larva and mine. The same authority obtained a second egg in the Gulf of Marseilles (**11**f, *loc. cit.*) of 1·36 mm. diameter and of similar character in regard to its numerous oil-globules, and referred to as "*? Solea lascaris*, Risso." He points out its similarity to Raffaele's "Sp. A" (**20**, p. 43, Tav. 1, Figs. 32 and 33; Tav. 3, Figs. 4–9), which, however, has a smaller egg and more black pigmentation than Holt's, in which latter character it approaches much more nearly to mine. Holt (**11**f, p. 86) is inclined to minimize the importance of this difference, remarking, "que le seul alevin que j'ai vu n'était pas né sous le beau soleil du midi, chose à prendre en compte lorsquon parle de coloration," and since the dorsal precephalic prominence is probably an abnormal and certainly not a constant character (Raffaele, for example, shows it in Tav. 3, Fig. 5 only, and McIntosh and Prince (**16**, p. 850), referring to a similar protuberance over the brain in a single specimen of *Solea vulgaris*, regard it as an abnormal feature), there is much probability that Holt's larva from the Irish egg is the same species as mine, the latter being the more normal form. Ehrenbaum (**5**b, p. 149) does refer it to *Solea lascaris*, suggesting that Raffaele's "Sp. A" on account of the smaller diameter of the egg may probably be *Solea Kleini*, Bp.

The Top-knots. (Zeugopterus.)

I follow Petersen* in referring all three Top-knots known in the Plymouth neighbourhood to the genus *Zeugopterus*. Under this heading, then, we have to consider:—

Zeugopterus norvegicus, Coll. (*Scophthalmus norvegicus*, Gthr.)
„ *punctatus* (Bl.) (*Rhombus punctatus*, Gthr.)
„ *unimaculatus* (Risso), Day. (*Phrynorhombus unimaculatus*, Gthr.)

I have named them in order of the abundance of adults, so far as is known, in the neighbourhood of Plymouth Sound. *Zeugopterus norvegicus* occurs fairly commonly on the Rame-Eddystone ground, and I learn from fishermen that it has been taken in increased abundance of late years. The other two species are more littoral, rock-haunting fish, and therefore do not lend themselves to capture in a trawl to the extent that *Z. norvegicus* does. *Z. punctatus* is not infrequently taken on the rocks between tide-marks, and sometimes finds its way into the shrimp-trawl. *Z. unimaculatus* has not come into our collections in my own experience at Plymouth, and I can only state that it *has* been known to occur here.†

Holt (**11**d, p. 128) and Balfour Browne (**2**, p. 600) have taken pelagic Zeugopterus eggs here in the spring months of 1897 and 1902, but the observations have not yielded sufficient information to enable a definite conclusion to be made as to their identity. I have been more fortunate in obtaining a large number of eggs and in having at my disposal the solution of the identity of one of the species, viz. *Z. norvegicus*, which Ehrenbaum's work at Helgoland has rendered available (**5**b, p. 210).

Below I give a list of all the Zeugopterus eggs taken in my collections in 1909. In the majority of cases they were kept until the just-hatched larva could be observed. It will be seen that they group themselves into two classes, those in Column I having a diameter of 0·75–0·90 mm. and an oil-globule of 0·095–0·15 mm., while Column II contains the larger eggs of 0·96–1·05 mm. diameter and 0·17–0·195 mm. diameter of oil-globule.

* Report of the Danish Biological Station, XII, 1902-3, p. 26.

† A specimen of *Z. unimaculatus* was, however, taken in the trawl off the Eddystone in May, 1910, after this paper was in manuscript.

I. (*Z. norvegicus*).			II. *Z. punctatus* (? all this species).		
Date.	Diameter of egg.	Diameter of oil-globule.	Date.	Diameter of egg.	Diameter of oil-globule.
19–IV	·82	·13	17–II	1·03	·19
,,	·86	·132	20–II	1·04	·17
,,	·84	·13	25–II	1·02	·195
,,	·87	—	,,	1·04	·17
,,	·87	·125	,,	1·02	·18
,,	·88	·125	4–III	1·05	·19
,,	·84	·125	,,	·99 (ca)	·17
20–IV	·90	·15	19–IV	1·01	·19
,,	·83	·13	20–IV	·99	·175 (?)
,,	·845	·14	28–IV	·99	·175
,,	·84	·125	3–V	·96	·18
,,	·85	·10	,,	·98	·18
12–V	·75	·11	,,	·98	·18
18–V	·80	·095	12–V	·99	·18
,,	·84	·12	24–V	1·01	·178
,,	·81	·13	,,	·98	·17
24–V	·86	·13	,,	·94	·175
14–VI	·82	·11	,,	·92	·175
,,	·82	·11	,,	·96 × ·98	·17
,,	·80	·12			
28–VI	·82	·125			
,,	·82	·11			
,,	·84	·12			

I have not the slightest doubt in referring all the eggs of Column I to *Z. norvegicus*. It will be noted by reference to Table I that the localities of their capture belonged in general more to the open-sea waters than is the case for the larger eggs of Column II. Most, if not all, of the latter I ascribe to *Z. punctatus*. Not only do the dimensions of the egg and oil-globule fall into two fairly distinct groups, but also, as far as could be observed, the hatched-out larvae from the smaller eggs exhibited one type of characteristic pigmentation (identified by Ehrenbaum, *op. cit.*, with *Z. norvegicus*), and those from the larger eggs another type of pigmentation, which is identical with that shown by Holt's "Species X" (**11**b, Figs. 20 and 21), referred by Ehrenbaum, with a query, to *Z. punctatus*. I do not doubt but that this is its species. There is only one other species possible and that is *Z. unimaculatus*, a much less common fish in our area. Moreover, the latter has not occurred in our collections of post-larval fishes for the years 1906, 1908, and 1909, although *Z. norvegicus* is common and *Z. punctatus*

occasionally recorded in each year for the months April, May, and June. The difficulty, if not impossibility, of distinguishing the egg of *Z. unimaculatus* by its dimensions may be seen by a comparison of measurements of the eggs of this species, which are definitely known from having been obtained from ripe females (·92–·93 mm. for unfertilized, and ·90–·99 mm. with oil-globule ·16–·18 mm. for fertilized ova *) with Column II in the above list. There is indeed one egg (marked with a ?) in the above series which I had some ground for regarding as possibly *Z. unimaculatus*. This was taken on the 20th April in Cawsand Bay. Unfortunately my recorded observations of this egg and the subsequent larva are very meagre. Just before the outgrowth of the caudal rudiment there was no pigment whatever on the embryo. The larva, which hatched out on the 24th April, had a length within the first few hours of larval life of 2·4 mm., the pre-anal length being 1·07 mm. This agrees almost exactly with Holt's newly hatched specimen from an artificially fertilized egg of *Z. unimaculatus* (**11**c, p. 46, and **11**f, Fig. 89). My brief notes upon the larva state that yellow was the predominant pigment, occurring in moderate-sized round and stellate chromatophores over body, yolk-sac and unpaired fins, except at the posterior extremity of the latter. Along the margin of the unpaired fins the pigment was dendritic. Black pigment consisted of numerous very fine dots, scattered with the yellow all over the body, fins, and yolk-sac. However, on the 27th the pigmentation had assumed the same form, which I found at the same stage in the other larvae hatched from the larger group of Top-knot eggs and which I regard as typical of *Z. punctatus*. Its identity with *Z. unimaculatus*, therefore, can be based only upon the dimensions of the egg and newly hatched larva, for which comparison there is still too little material. Of course there is the possibility of a close resemblance between the pigmentation of the later vitelligerous larval forms of the two species.

It will be noticed that my above lists indicate a somewhat different period for the occurrence of the two groups of eggs, Group I (*Z. norvegicus*) being taken from 19th April to 28th June, and Group II (*Z. punctatus*) from 17th February to 24th May. This difference is, however, probably more apparent than real, for before April I was not able to get any samples from further seaward than the entrances to Plymouth Sound, which would leave the habitat of *Z. norvegicus* neglected for the commencement of the season.

I may now give a more detailed account of the characters and especially the pigmentation of the two undoubtedly occurring species.

* Cf. Holt, **11**d, p. 128.

Zeugopterus norvegicus, Coll. Norwegian Top-knot.

The oil-globule is commonly pale green and the yolk-sac slightly rugose. Before the outgrowth of the caudal rudiment the periblastic pellicle of the oil-globule becomes visible, and fine black chromatophores appear on the embryo and yolk-sac. They are very closely set on the former but less dense and mostly stellate in form on the latter. Over the whole embryo and yolk-sac there is a pale greenish yellow tint, but no separated, coloured chromatophores are visible as yet. Yellow pigment cells soon appear on the embryo and yolk-sac, and by the end of embryonic life they become conspicuously predominant. The black chromatophores show dense, rounded centres, from which fine ramifications proceed. Some of the few yellow chromatophores on the yolk-sac are stellate, with no specially large centre. On the trunk of the embryo, just before hatching, they are large and of vague outline, and so close together as to give the effect of a diffuse tinting along the whole length of the body, except the extreme caudal end. Black pigment is fairly uniformly distributed over the body, but shows some concentration into dorsal and ventral lines. A newly hatched larva measures 2·58 mm., with a pre-anal length of 1·16 mm. The snout projects conspicuously forward over the yolk-sac, and the anus is situated some little distance behind the posterior end. Ehrenbaum (*op. cit.*) describes the position of the oil-globule as usually at the middle of the ventral side of the yolk, but I have generally found it post-median. The pectoral fins are well developed. The pigmentation is extremely rich. A diffuse yellow effect, which is evident to the naked eye, is produced by the close proximity of the large chromatophores (greenish yellow by reflected light), which are distributed over the body, fins, and yolk-sac, most densely along the dorsal and ventral contours and the upper and lower margins of the unpaired fins. Black chromatophores are more abundant, but smaller and much less conspicuous. A very characteristic feature is the stopping short of the pigmentation of the unpaired fins some little distance from the caudal extremity, so that this part of the larval tail is quite clear. The same arrest of yellow chromatophores is seen on the body itself, but small black pigment spots occur as far as the posterior extremity. A further conspicuous character of this species is the regular, fringe-like arrangement of both the black and yellow pigment along the outer margin of the unpaired fin, in the early stages of the larval development. The fringe-like effect is accentuated by the finely pectinate form of the chromatophores in this region. With the absorption of the yolk the intensity of the yellow pigment increases, although undergoing

little change in distribution. At 3 mm. length, for example, with the yolk almost absorbed, the general arrangement of pigment is as above. Head and body (except posterior extremity) appear of an almost uniform bright yellow. In the anterior half of the post-anal region the notochord shines white through the yellow, but in the posterior part the yellow is so dense as to obscure it. The coloured pigment is more concentrated on the head, along the dorsum, and about the rectum. The fringe formed by the line of closely applied dendritic or pectinate chromatophores along the margin of the unpaired fins, has a somewhat brownish tint, which is not seen on other parts of the larva. In the anal fin, the fringe begins some distance posterior to the anus. Black pigment is most dense on the ventral surface at the level of the pectoral fins and above the anterior part of the remains of the yolk-sac, where the vestige of the oil-globule now measures about 0·03 mm.

A larva in which the yolk had been fully absorbed (ca. 3 mm. long) showed less distinctness as to the marginal pigment, and a concentration—more particularly of the black chromatophores—in the pigment of the unpaired fins, about half-way between the anus and caudal extremity.

Reticulate markings and small papillae on the epidermis are commonly found both in late embryonic and in larval stages.

To summarize the main facts ascertained for *Z. norvegicus*:—The spawning season, in the Plymouth neighbourhood, extends from April to June, probably beginning somewhat earlier than the former month. The pelagic eggs have a homogeneous yolk and a single oil-globule, which is frequently of a greenish yellow tint. The average diameter of the egg is 0·854 mm. in April and 0·817 mm. in May and June, the limits lying between 0·75 and 0·90 mm. The oil-globule measures 0·095–0·15 mm., the average diameter being 0·122 mm. Embryonic yolk-sac and larval pigments are yellow (bright greenish yellow by reflected light) and black, the former predominating and being visible to the naked eye in the larva. The body and yolk-sac of the newly hatched larva are rather elongate, the total length being about 2·58 mm. (Ehrenbaum gives 2·52–2·76 mm.). The anus is situated a short distance behind the posterior edge of the yolk-sac, and at about $\frac{6}{13}$ the body length from the snout. The characteristic feature of the vitelligerous larva is the marginal pigmentation of the unpaired fins and their total lack of pigment in the caudal region.

Zeugopterus punctatus (Bl.).

Before the outgrowth of the caudal rudiment, the body of the embryo is beset with fine, black chromatophores which are chiefly, if not entirely, on the dorsal surface. A few black chromatophores of larger size are found over the oil-globule, and there may be a small number of black spots on the yolk-sac, which is beset with a moderate number of roundish, yellow chromatophores. The latter pigment occurs in smaller spots on the head and body of the embryo. At this stage the perivitelline space is somewhat large, and the oil-globule is contained in a very distinct periblastic pellicle.

With the growth of the free caudal region (Fig. 2) a marked increase in the size and number of chromatophores takes place. The yellow spots over the yolk-sac now acquire a stellate form, but on the embryo they still occur as patches disposed over the head and body. Yellow does not extend quite to the tip of the caudal extremity as the black does. The black chromatophores over the oil-globule have increased in number, and are the largest of all. Over the yolk-sac they are small and sparingly scattered. Minute black specks occur over the whole body, from anterior to posterior extremity, being most concentrated along the dorsal and ventral contours, dendritic outgrowths from which extend to the embryonic fin. The pectoral fins are relatively well developed, and rudiments of the pelvic fins are visible.

Three larvae observed soon after hatching (Fig. 9) had lengths of 2·90, 2·92, and 2·93 mm., the pre-anal lengths being respectively 1·44, 1·40, and 1·45 mm. The anus is therefore appreciably nearer the median position than in the case of *Zeugopterus norvegicus*, which otherwise it very closely resembles both in general form and in the distribution of its black and yellow pigmentation, the former occurring in mostly small, fine specks and the latter in large, stellate chromatophores. The yolk-sac is elongate and bears the much-reduced oil-globule at its posterior end. As in the above species, the marginal pigment of the unpaired fins is of most diagnostic importance. Immediately after hatching I found some resemblance to the arrangement in *Z. norvegicus*, but the "fringe" formation is not so well marked, and within one day a striking change has taken place which appears to be quite characteristic of *Z. punctatus*, at least as distinct from *Z. norvegicus*. I can, of course, make no comparison with *Z. bimaculatus*, though it is to be noted that Holt's newly hatched larva from an artificially fertilized egg of *Z. bimaculatus* showed no fringe-like occurrence of pigment along the upper and lower margins of the unpaired fins, which I observed in my larvae of both species.

The one-day-old larva (length 3·42 mm.) shows a complete modification of the marginal fringe of the early stage by its breaking up into a series of separate large pectinate and dendritic patches, eight of these patches occurring in the dorsal and five in the anal fin. This exactly resembles Holt's "Species X" (**11**b, Figs. 20 and 21), which Ehrenbaum (**5**b, p. 206) considers as probably identical with *Zeugopterus punctatus*. Besides the above-mentioned characteristic, large, marginal chromatophores, in each of the unpaired fins there is a series of fairly large stellate chromatophores, midway between these and the trunk contours, a single row in the dorsal and a double row in the anal fin. The last 0·5 mm. of the tail end is free from pigment in the fin membrane, but fine black chromatophores extend to the caudal extremity of the trunk. Yellow and black chromatophores are scattered fairly uniformly over the whole body, with a certain amount of concentration along the dorsal and ventral contours.

On the third day (Fig. 10) still further local concentration into patches has taken place, but the general form of the pigmentation remains the same. Black pigment now appears in the eye, and the prominent pectoral fins bear dendritic yellow and rounded black chromatophores. The yolk-sac—with the yolk somewhat more than half absorbed—is very elongate, so that its ventral contour is practically straight.

To summarize:—The spawning season of *Z. punctatus* in this neighbourhood extends from the middle of February to May. The pelagic eggs have a homogeneous yolk and one oil-globule. The diameter of the egg averages 1·03 mm. in February–March and 0·98 mm. in April–May, the limiting sizes being 0·92 mm. and 1·05 mm. The diameter of the oil-globule is 0·17–0·19 mm. Embryo and yolk-sac bear black and yellow pigment, the latter becoming conspicuously predominant in the late embryo and larva. Within one day after hatching, the larva exhibits characteristic stellate or pectinate and dendritic patches of yellow pigment associated with black in its unpaired fins, usually eight in the dorsal and five in the anal fin. The newly hatched larva measures 2·90–2·93 mm. (or possibly less), and the anus is only slightly (if at all) anterior to the median point.

Gadus.

Our tow-net samples of Gadus eggs have not been sufficiently numerous to enable certain conclusions as to their identity to be made in the great majority of cases. This is not due to the absence or scarcity of members of the genus from our neighbourhood, but to the fact that the open-sea water some distance from the coast was not tow-netted till April, when the spawning season of the Plymouth gadoids is

almost over. It is a fact of common knowledge to the Plymouth fishermen that the whiting (*G. merlangus*), bib (*G. minutus*), pout (*G. luscus*), and pollack (*G. pollachius*) are to be found nearer the shore in summer and autumn than in winter and early spring, when the breeding season occurs. This habit of migrating to deeper water for the colder months of the year they have in common with the other important food fishes of the Plymouth district, such as the Pleuronectidae and gurnards. Very many more observations, both physical and biological, are necessary before definite conclusions can be made as to the real causes of these phenomena. The off-shore migration in winter and the corresponding approach to shallow water in summer may, in some cases, follow the seasonal distribution of food, but I do not think this is at most more than a partial explanation. The fact that the temperature of the water in the deeper parts of the Channel is appreciably higher than that of the more inshore parts of the Channel in the coldest months of the year, may be taken as a sufficient reason for the majority of fishes preferring to seek the outer grounds at this time. That conditions directly related to the phenomenon of spawning are involved in this migration (which certainly coincides with the ripening and liberation of the sexual products of most of the species) may be concluded from analogy with the cases already worked out under less complicated conditions, e.g. the plaice and cod, by Johs. Schmidt (21c), who has shown that these and other species show a special sensitiveness to external conditions, especially of temperature, in relation to spawning, and therefore make special and well-marked migrations.

So far I have not been able to obtain direct proof of extensive spawning of our four common Plymouth species of Gadus on the off-shore grounds because winter samples of plankton from such regions have not been collected, but the general fact may be taken for granted. With due precautions one may accept the occurrence of pelagic post-larvae, such as were captured in the young-fish trawl in April and subsequent months, as evidence giving more or less quantitative information as to the spawning times and the relative extent of the reproduction of the various Gadus species in this neighbourhood. As far as can be judged from our takings of the small fry—and evidence from the fisheries points to the same conclusion for the adults—*Gadus merlangus* is the most abundant, very many post-larvae of this species having been taken, especially in May and June. Next in abundance comes *G. minutus*, which has an almost similar period of occurrence, if anything earlier than the whiting. The early pelagic post-larval stages of the pollack have always in my experience been less common than the two foregoing, but they are very abundant, at a

size of about 5 cm., close up to the rocks on the shores of the Sound. Post-larval stages of *G. luscus*, which appears to be the least abundant of our four common representatives of the genus, are not infrequent but are never numerous, and they disappear from the samples somewhat earlier than the other three.* Other species, such as *G. morrhua* (cod) and *G. virens* (coal-fish), are known, but are very occasional spawners in this neighbourhood.

The specific identification of the pelagic ova by the form and pigmentation of embryo and larva is difficult and sometimes impossible, owing to their great similarity. Pollack, indeed, is said to show no yellow pigment at all in the embryo and early larva (**14**e, p. 171), while the other three species above mentioned as common to these waters do so to a greater or less extent. We cannot feel that we are on safe ground here, however, in dealing with individual fishes on this point, since the *G. minutus* larva is described by Raffaele from the Mediterranean and by Holt from the west of Ireland as having only black pigment, and in several cases the appearance of yellow chromatophores has been noted as an accompaniment to an unhealthy condition (cf. **11**d, p. 140).

The impossibility of separating the species with certainty by reference to dimensions of the ova is indicated by the list which I give below of measurements of eggs taken from ripe female fishes.

Species.	Diameter of Egg.	Month.	Authority.
G. minutus	0·95–1·07	—	Ehrenbaum
	1·02	April	Cunningham
	0·9906–1·0287	—	McIntosh
	1·07	—	Holt
	A little below 1 mm.	—	Raffaele
G. luscus	1·05–1·15	—	Cunningham
	1·13†	January	Holt
G. pollachius	1·14	—	McIntosh (artificially fertilized egg)
	1·13	—	Holt

* A general idea of the seasonal occurrence of the young fry may be obtained from the following particulars taken from my records for 1909 of catches of the young-fish trawl :—

G. merlangus . .	First specimens	(5–10 mm.)	taken	28th April.
,, . .	Last ,,	(9–12·5 mm.)	,,	20th July.
G. minutus . .	First ,,	(ca. 5 mm.)	,,	28th April.
,, . .	Last ,,	(26 mm.)	,,	20th July.
G. pollachius . .	First ,,	(22 mm.)	,,	24th May.
,, . .	Last ,,	(6 mm.)	,,	6th July.
G. luscus . . .	First ,,	(6 mm.)	,,	28th April.
,, . . .	Last ,,	(7 mm.)	,,	2nd June.

† This is the diameter of the largest unfertilized ovarian egg observed.

Species.	Diameter of Egg.	Month.	Authority.
G. merlangus	1·125	—	McIntosh and Prince (artificially fertilized)
	1·226–1·352	March	Heincke and Ehrenbaum (artificially fertilized)
	1·1–1·226	April	Heincke and Ehrenbaum (artificially fertilized)
	1·069–1·163	May	Heincke and Ehrenbaum (artificially fertilized)
	1·161–1·257	April	Williamson (artificially fertilized)

From this evidence we can merely state that the average size of the egg shows an increase in the order in which the species are enumerated above, but the difficulty arising from overlapping is sufficiently formidable, seeing that the largest size for *G. minutus* may be larger than that of the smallest whiting.

The size of the newly hatched larva shows variation, which may to some extent be taken as a guide to the species, but on this point, to an even greater degree than is the case with regard to the egg, the data hitherto available are very scanty and afford little satisfactory information. With some degree of certainty we may take it that the *G. minutus* larva is the smallest, but no measurement of the product of artificial fertilization is on record. Holt (**11**b) records as *G. minutus* a larva of 2·75 mm. length hatched from a pelagic egg of 1·07 mm. The *G. luscus* larva is probably bigger, and that of *G. merlangus* is certainly bigger still. Ehrenbaum (**5**d, pp. 234 and 238) gives ca. 3 mm. or somewhat smaller for the former and 3·2 to 3·5 mm. for the latter species. *G. pollachius* is so far too imperfectly known for us to state anything as to its larval dimensions. Holt (**11**d, p. 141) ascribes to this species certain pelagic ova of 1·40 to 1·45 mm. diameter taken in February, and mentions that the larva was 4·2 mm. long and had black pigment only. There seems to me to be little doubt as to the correctness of this identification, and it seems probable that further investigation of the eggs and larvae of this species will prove them to be larger in general than those of *G. merlangus*.

The dimensions of all the Gadus eggs measured during the season are as follows:—

February	Diameter	·95	·96	·97	·99	1·00	1·07	1·16 mm.
	No. of eggs	3	1	1	1	1	1	1
April and early May	Diameter	·94	1·08	1·09	1·14	1·13 × 1·17 mm.		
	No. of eggs	2	1	2	3	1		
June–August	Diameter	1·02	1·03	1·04	1·05	1·06	1·12 mm.	
	No. of eggs	1	1	2	1	1	1	

Gadus minutus and *Gadus luscus.*

On 8th April a ripe female *G. minutus* was taken in the trawl about 7 miles south-west of the Eddystone. Eleven ova from this measured 0·91–1·02 mm., the average diameter being 0·939 mm. Artificial fertilization was attempted, but development was stopped by death at the blastula stage. Eight eggs taken in the tow-nets on the same day and in the same locality had diameters of 0·94, 1·08, 1·09, 1·13, 1·14 (two eggs), and 1·13 × 1·17 mm. (the last not exactly spherical). The embryonic form of all appeared practically identical. Round and dendritic black chromatophores first appear on the embryo, and at a later stage a diffuse yellowish tint appears over both embryo and yolk-sac. Just before hatching the black chromatophores are most densely distributed in the posterior half, and there is little or none of this pigment on the head. One or two black stellate chromatophores usually appear on the yolk-sac,* to which also outgrowths from the pigment cells in the otocystic region generally extend. The head and anterior part of the embryo are covered with a diffuse greenish yellow tint; the yolk-sac occasionally shows distinct yellow chromatophores at this stage, but more usually is also diffusely tinted. Only once I noticed distinct chromatophores on the embryo before hatching. I noted no pigment on the embryonic fin at this stage. Two larvae hatched out from eggs of 1·08 and 1·09 mm. diameter measured (a) 2·65 mm., of which 1·35 mm. was the pre-anal length, and (b) ca. 2·9 mm. with a pre-anal length of ca. 1·5 mm. A third larva, (c), slightly more than twenty-four hours old, measured 2·9 mm. total length (1·2 mm. from snout to anus). This was from the egg of 1·13 × 1·17 mm. diameter. A fourth larva, (d), from the egg of 1·14 mm. diameter, measured when the yolk was absorbed, had a length of 3 mm., of which 1·28 mm. was pre-anal. The pigmentation consists of black chromatophores mostly dendritic, distributed along the dorsal and ventral contours, in the peritoneum, a little on the top of the head and about the pectoral region. In specimen (a), however, the pigment extends to the tip of the caudal region, while in (b), which has heavier pigmentation, the last 0·3–0·4 mm. of the tail is bare.

This difference, considered together with the difference of larval size, suggests a difference of species which was impossible to detect in the two eggs so similar in general character and only differing by 0·01 mm. in diameter. From which egg each larva was produced I

* This was noted on eggs which gave rise to different types of larvae, e.g. (a) and (b). See above.

am not able to state, because I had kept them together in the same vessel, regarding them as of the same species; but the very similarity of eggs makes this point a matter of indifference. The larva (a), which is 2·65 mm. long and pigmented to the caudal extremity, I regard as *Gadus minutus*. Larva (b), on the other hand, which is slightly larger (ca. 2·9 mm.) and shows heavier pigmentation, stopping short so as to leave the caudal extremity bare, I consider is very probably *G. luscus* (cf. **10**, Taf. X, Figs. 20 and 21). Larva (d) (length 3 mm. with yolk absorbed) resembles (b), the posterior 0·5 mm. of the caudal extremity being unpigmented. The small size for this stage of development does not rule out the probability of its being *G. luscus*. Larva (c) shows black pigment of less intensity, most of it occurring along the ventral post-anal contour as far as the caudal extremity and above the gut. There are only four dorsal post-anal chromatophores, and these are not nearly so strongly marked as the ventral ones. This I regard as *G. minutus*, especially on account of there being a distinct resemblance to the early post-larval forms of this species, which have been carefully described by Schmidt (**21**a and b), and which are common in my own collections. In the same way the bare-tailed larvae (b) and (d) suggest the now well-known larval pout.* As to the occurrence of yellow pigment, all four specimens showed yellow chromatophores, with more or less distinctness on body, unpaired fins, and yolk-sac, but in the post-vitelligerous specimen (d) this colour had almost vanished except from the head (cf. McIntosh, **14**c, p. 240).

Three planktonic eggs of 0·95 mm. diameter, which were taken in the West Channel (entrance to Plymouth Sound) on 11th February, may be either *G. minutus* or *G. luscus*. One-day-old larvae measured 2·95 and 2·8 mm. The black pigment consists of relatively large stellate chromatophores on the head, a dorsal series which become smaller and less closely placed towards the posterior extremity, and a much weaker ventral series consisting of about nine post-anal chromatophores and a faint line dorsal to the gut. There are small specks of yellow pigment on the body and embryonic fins, most strongly marked along the body contours and along the proximal margins of the fins, but very faint in the caudal region. The larval pigment at this stage cannot be said to show any approach to either the bib or

* While using this similarity of larval pigment to that of definitely known post-larval stages as evidence assisting to indicate the identity of a larva hatched from a Gadus egg taken in the tow-net, I think it necessary to point out that this similarity should not always be expected in the larval stages. As positive evidence it is helpful, but as negative evidence it is without value. Under certain conditions—chiefly of higher than normal temperature—I have noticed a precocity in development of pigment. The same phenomenon has been noted by Holt (cf. **11**a, p. 454).

pout type of post-larval pigment. It resembles *G. merlangus*, but the small size seems to preclude that species. A larva of similar character hatched from an egg of 1·00 mm. diameter, taken from the same locality on 25th February, measured ca. 2·75 mm. when more than a day old.

The next noteworthy capture of Gadus eggs took place late in August, an unusual time for the spawning of any members of the genus in our area. On 26th August two eggs of 1·02 and 1·06 mm. diameter were obtained in the young-fish trawl, but they died before hatching. The following day six eggs were captured of diameter 1·03–1·05 mm. In embryonic characters these resembled what I have above described as *G. luscus*. An early larva from one of them had a length of ca. 2·5 mm. A second larva which had absorbed practically all its yolk was 3·32 mm. long, of which 1·22 mm. was pre-anal. At this stage the anus was still apparently imperforate; the eyes dark blue with considerable black pigment, the mouth large with the relatively massive lower jaw slightly protruding. There is well-marked indentation behind the mid-brain and a typical large supra-cephalic ampullation, which extends as far back as the level of the anus. The pectoral fins are large and fan-like. The type of pigmentation strongly suggests *G. luscus*. Black chromatophores are distributed post-anally as very distinct dorsal and ventral lines, which stop short at a distance of ca. 0·9 mm. from the posterior extremity, so that the last part of the tail is quite unpigmented. The dorsal line arises in the occipital region and the ventral at the base of the pectoral fin, whence it continues backwards at the level of the dorsal edge of the gut. There is also black pigment at the tip of the snout, at the end of the mandible, below the throat, and a few lateral chromatophores on the trunk. In this specimen the latter were adjacent to the dorsal series, but in another they were mainly on the ventral half of the body posterior to the anus. No yellow pigment at all was observed in the late larval stages. The early larvae were very cursorily examined and I have no notes as to the presence of this colour. In the embryonic development a diffuse yellow tint was visible on the yolk-sac and about the contours of the trunk.

Gadus merlangus.

Only three eggs in all were taken, which may with probability be referred to this species. The first, taken at the western entrance to the Sound on 25th February, was 1·16 mm. in diameter, but was killed by the low temperature before hatching. The second was obtained from a haul of the young-fish trawl in Cawsand Bay on 28th April. No record was made of the size of the egg, but the newly hatched larva had a length of 3·44 mm. (pre-anal length, 1·42 mm.)

and the yellow and black pigmentation typical of *G. merlangus*. A third whiting egg was taken on 12th July, about 1½ miles south of Rame Head. The diameter was 1·12 mm. and the length of the larva within the first day 3·58 mm., the distance from snout to anus being 1·58 mm.

The fewness and infrequency of the appearance of whiting eggs in my collections are undoubtedly due to the fact that our tow-nettings have not been taken anywhere near the off-shore breeding haunts of the species at the time of their spawning season.

Onos, Risso (= Motella, Cuvier). The Rocklings.

It is an open question whether our knowledge of the occurrence of the members of this genus in the Plymouth neighbourhood is complete and exact, but certainly the presence of more than one species has complicated the task of fully identifying the rockling eggs, which have long been well known as occurring here in abundance. The most common species found here is *O. mustela*, L., and *O. tricirratus* (Bloch) is also known, while Holt (11d, p. 143) speaks of "the undoubted existence in the district of *M. cimbria* and *M. maculata*, and possibly of other forms which may require specific distinction." I have no personal knowledge of the occurrence of the two latter species, but I may mention that a form identified as *Motella fusca*, Moreau, by Garstang and Balfour Browne was taken in April, 1901, on the shores of Plymouth Sound.*

However, the problem of denoting the species of the pelagic ova commonly occurring at Plymouth, is mainly one of deciding which other species besides the abundant *O. mustela* are represented. My task of identification has been aided by the recent publication by Ehrenbaum (5c, p. 237, and 5d, p. 284) of descriptions of the ova and larvae of *O. mustela*, L., and *O. cimbrius*, L. In regard to the latter species I need only say that it does not appear to be represented in my samples of ova, nor do I know of any record of the occurrence of the adult in this district.† *O. mustela*, on the other hand, is the prevailing species, and what I was led to expect, from the abundance of the fish in Plymouth Sound, is confirmed by comparison with Ehrenbaum's description of the egg and larva of the species. He gives the average diameter of the ova of *O. mustela* as varying (off Heligoland) from 0·878 mm. in February to 0·736 in June, and the peculiar pigmentation of the late embryo and early larva as the chief diagnostic character (at least as far as distinguishes it from *O. cimbrius*), viz. the arrangement of the post-anal

* *Journ. M.B.A.*, N.S., VI., p. 626.

† A small immature specimen of *O. cimbrius* was, however, taken in Whitsand Bay on the 3rd March, 1910, which is, I believe, the first record of the species for the Plymouth neighbourhood.

black pigment into two groups, the first a short distance behind the anus, usually confined to the ventral half of the body, the second in the form of a band from the dorsal to the ventral contour, besides which there is, in the hypural region, a small patch of pigment which has outgrowths to the marginal fin. *O. cimbrius* shows only one of these post-anal pigment groups.

Onos mustela, L.

To come to the consideration of my own specimens, they can with very little exception be designated *Onos mustela*. There is, of course, the bare possibility that the eggs and larvae of some other species of rockling, which are at present unknown, may so closely resemble those of *O. mustela* as to have been indistinguishable from them by me. But even if such were the case, the number so included would be quite inappreciable against the total, which are undoubtedly *O. mustela*. These eggs occurred in my tow-net and young-fish trawl plankton samples from 11th February to 25th June, and again in August and September. The diameter varied from 0·72 to 0·83 mm., averaging 0·77 for February to March, 0·78 for April, and 0·72 for May to June. The diameter of the oil-globule varied from 0·13 to 0·18 mm. It sometimes happened that the size of the oil-globule was the reverse of being proportional to the size of the egg, i.e. the larger eggs of a sample had the smaller oil-globules, which I thought might possibly be significant of a specific difference, but observations of the resulting larvae disproved this. The oil-globule, which may be subdivided into two or three in the early stages, commonly has a more or less greenish and sometimes a cupreous tint. The yolk surface is somewhat corrugated. By the time the embryo has developed a caudal rudiment, small black chromatophores appear generally in a double line along the body, on the head, and in the pellicle of the oil-globule. They soon increase in size, and may become stellate, especially the anterior ones. Just before hatching the two characteristic post-anal groups (or "zones") of pigment are generally quite distinct. One of my smallest newly hatched larvae measured 1·88 mm. (the pre-anal length being 0·76 mm.), and the largest size I have recorded for this stage is 2·32 mm. The black pigment, which is mostly stellate and dendritic, is distributed upon the head, in the peritoneum, over oil-globule, laterally on the trunk over the anus, in the two large distinct post-anal groups above mentioned, and in the hypural region. These groups or zones are formed by the occurrence of short dorsal and ventral bars of black pigment spots, more or less fused together, from which dendritic outgrowths extend laterally. Sometimes such a bar may consist of only two or even one large

chromatophore. Ehrenbaum states that the anterior group is usually confined to the ventral half of the body, but I have very often found it possessing a well-marked dorsal bar. The extent and intensity of these bars and groups of pigment, however, are subject to some variation. With the absorption of the yolk the post-anal pigment diminishes, especially in regard to the dorsal chromatophores, and when the yolk is entirely absorbed the latter have generally—though not always—entirely disappeared, leaving three relatively small chromatophores along the ventral contour corresponding to the three previous groups. At this stage the pectoral fins are well developed; but the ventrals, which soon afterwards become such a conspicuous feature of the post-larva, are rudimentary. My *O. mustela* eggs were taken for the most part in Plymouth Sound and some in Cawsand Bay, while none were taken in more open water than Whitsand Bay, which is in keeping with the littoral haunts and the *penchant* for the vicinity of brackish water of the parent fish (cf. Holt, **11**d, p. 143).

Onos, Species A (*? tricirratus*, Bl).

Two eggs which may probably be referred to this species occur in my samples, one taken on 28th June 3 miles S. by W. of Rame Head, and the other taken on 30th August 3 miles W.N.W. of Rame Head. The identification is chiefly based upon the similarity of the larva to that of *O. tricirratus*, described by Raffaele (**20**, pp. 37 and 38, Tav. I, Figs. 26 and 27; Tav. III, Figs. 2 and 3) from an egg of 0·74 mm. diameter, which had an oil-globule of 0·218. The larva is characterized by the possession of less pigment than *O. mustela* or *O. cimbrius*. It is practically limited to one clearly defined zone of black pigment across the middle of the post-anal part of the body and a line of peritoneal pigment dorsal to the gut (*op. cit.*, Tav. III, Figs. 2 and 3). The earlier of my eggs had a diameter of 0·84 mm., and the later one 0·78 mm. The oil-globules measured respectively 0·16 and 0·145 mm. The embryonic pigment spots, which are small at their first appearance, become in the later stages relatively large in size, although few in number. The isolated mid-post-anal group of chromatophores is very conspicuous. In my second specimen I noted that this group consisted of six ventral chromatophores with three dorsal and two lateral ones, which, before hatching took place, formed a dense band around the embryo by their enlargement and partial fusion. Black appears in the eyes shortly before hatching. In both specimens only one chromatophore was to be seen over the oil-globule. The newly hatched larva from my later egg (Fig. 14) measures 2·32 mm., of which 0·94 mm. is pre-anal. That from my June egg, measured when about one day old,

had a length of 2·42 mm., from the snout to the anus being 1·0 mm. The pigmentation of the former consists of a very conspicuous mid-post-anal patch, made up of a large dorsal and a large ventral chromatophore (the latter accompanied anteriorly by a relatively small pigment spot), a small hypural patch, while pre-anally there is a group of chromatophores on the side of the body in the pectoral region, a series dorsal to the gut, one large dendritic chromatophore below the anus and extending partially over the oil-globule, and some pigment in the eye and on the head. The pigmentation of my second larva at a slightly older stage, when most of the yolk had been absorbed, differed only from the above in being somewhat more densely aggregated. Two large dendritic chromatophores—one dorsal and one ventral—with outgrowths extending laterally as far as the notochord, constituted the mid-post-anal group, a continuous line of dendritic pigment ran along the whole peritoneal region, one large dorso-lateral patch of pigment occupied that part of the trunk above the base of the pectorals, two small chromatophores were on the head, and the iris was now completely black. Holt (**11**b, Pl. VI, Fig. 53) has figured a larva ("Species III (Motella ?)") somewhat similar to this, but having an anterior group of post-anal pigment spots much resembling that of *O. mustela*, which it also approaches in having many pigment spots over the oil-globule. Ehrenbaum (**5**d, p. 278) considers this may possibly be *O. tricirratus*, Bl. The egg had a diameter of 0·72 mm. (and less) and an oil-globule of 0·17 mm., and the larva in its first day was 2·20 mm. long. My larvae certainly have a closer resemblance to Raffaele's *O. tricirratus*, Bl., than this of Holt's. I may mention, however, that Ehrenbaum (*ibid.*) warns one not to attach too much weight to Raffaele's identification of the parent fish as *O. tricirratus*, Bl., suggesting that the Naples observer did not wish to designate this species as distinguished from *O. mediterraneus* (L.), but merely referred to the common tricirrate form of the Bay of Naples, which appears to be *O. mediterraneus* (L) (= *O. tricirratus*, Brünnich), and not *O. tricirratus*, Bloch (= *Onos vulgaris*, Yarr.). I do not see, however, that there is any solid ground for doubting Raffaele's identification in this case.

Onos, Species B.

A much more problematic form of larva, which I will term "Onos, sp. B," was hatched from a rockling egg taken in the young-fish trawl 2 miles S. of Rame Head on 2nd June. The egg had a diameter of 0·68 mm., and its oil-globule 0·145 mm. When the embryo had developed a short free caudal portion, it was marked with large black pigment spots, and the stellate chromatophores in the pellicle

of the oil-globule were noted as being especially large. On the 5th of June the larva had hatched out. Its length when about one day old was 1·84 mm. (pre-anal length = 0·84 mm.). It showed the Motella characteristics as described above, except as regards the distribution of pigment in the pre-anal part of the body, which was practically wholly dorsal (see Fig. 15). From the snout to beyond the middle of the post-anal part, there was a series of black chromatophores, most of which were large and possessed outgrowths extending over the upper part of the sides of the trunk, often as far as the level of the notochord. The most posterior group of this series contributed the dorsal bar of the typical *Onos* mid-post-anal zone. The corresponding ventral bar was present, as well as the usual hypural patch, but the only other pigment consisted of a single chromatophore below the anus and a group over the posterior part of the oil-globule. The absence of pigment from the peritoneal region is remarkable, and this fact especially inclines me to the view that we may possibly be dealing here with an abnormal specimen. Apart from this the pigmentation bears some resemblance to that shown by *O. cimbrius* (Ehrenbaum, *op. cit.*). From my present knowledge of Plymouth species of rocklings, however, I will not venture to suggest a definite species. Assuming that it is normal, it is certainly not *O. mustela* nor *O. cimbrius;* and if my previously described larva (*Onos*, sp. A) is indeed *O. tricirratus*, Bl., that species is also excluded. It seems to me that my "Onos, sp. A" may with far more probability be referred to *Onos tricirratus*, Bl., than may "Onos, sp. B." Then, by a process of exhaustion—always bearing in mind, however, that our knowledge of local Onos species cannot safely be regarded as complete —we have left *Motella fusca*, Moreau (which may probably be regarded with *M. maculata* of the same authority as varieties of *O. mediterraneus*, L.). It is at least possible that "Onos, sp. B," the larva with a pre-anal dorsal row of chromatophores and no peritoneal pigment, belongs to this species.

Raniceps raninus, L. Frog-fish.

Four eggs identified with this species were taken from a young-fish trawl, mid-water haul, in Whitsand Bay on 30th August. Holt obtained eggs of the same species from tow-nettings taken at various depths off Plymouth, in June, July, and August, 1897, which he recorded as unidentified but with apparently gadoid characters (11d, p. 145). In his Irish survey the same investigator had previously met with a similar egg and had described and figured it, with the twelve-hour-old larva, as "Species VIII" (11a, p. 471, Figs. 27 and 36). He embodies his observations upon both Irish and Plymouth material in his Marseilles Museum Annals Memoir, suggesting as the possible

parent fish *Phycis blennoides*, a rare visitor to this coast and one which had probably arrived in the track of the shoals of mackerel and scad (*Caranx trachurus*), which were present in unusual abundance in the inshore waters at the time of his Plymouth observations. Since that time, there have been no observations of planktonic fish eggs in the summer months here until the present year, so that the solution of the question as to whether the eggs belonged to a constant or intermittent visitor to these shores by the plan of noting the presence or absence of the eggs in successive years, has not been possible. It so happens that the present summer (1909) has also been characterized by a greater than usual abundance of mackerel and scad in the inshore waters of the Plymouth area, but whether this condition can be correlated with the presence of these eggs is doubtful. Heincke and Ehrenbaum (**10**, p. 258) have subsequently observed the egg as regularly occurring with summer plankton off Heligoland, and since *Phycis blennoides*, the only other fish to which it could with any probability be ascribed, is never found in Heligoland waters, they have identified it with *Raniceps raninus*—a quite well-founded conclusion, although the absolutely unquestionable identification by tracing back the egg to the parent still remains unaccomplished, since the ripe female is as yet unknown. Holt's Irish specimen measured 0.775 mm. and had a colourless oil-globule of 0·14 mm. diameter. The larva about twelve hours after hatching measured 2·68 mm. Those taken by him at Plymouth at the end of June and in July measured from 0·84 to 0·91 mm. in diameter, and the diameter of the oil-globule ranged from 0·16 to 0·17 mm. In August the dimensions were 0·78 to 0·84 mm. for eggs and 0·15 to 0·17 for oil-globule, and a newly hatched larva was 2·02 mm. in length. The Heligoland eggs had a diameter of 0·755 to 0·912 and an oil-globule from 0·141 to 0·189 mm. in diameter, while the length of newly hatched larvae varied from 2·26 to 2·90 mm.

The dimensions of my specimens were as follows:—

Diameter of egg . .	0·80,	0·78 × 0·79,	0·81 × 0·84,	0·82.
„ „ oil-globule	0·145,	0·145	0·165	0·157.

Two of them were ovoidal. The yolk is homogeneous, and the oil-globule is colourless. Just before the formation of the caudal rudiment, the head and body are liberally covered with medium-sized, black chromatophores, and yellow is making its appearance along the sides of the embryo. On the yolk-sac there is pigment of both colours, which is most dense in the postero-ventral region, a feature becoming more strongly marked as development proceeds. In the two larger specimens there are black and yellow chromatophores over the oil-globule, but

they are absent from here in the two smaller eggs. Although precautions were taken to keep the temperature low by standing the jars containing ova in circulating tank-water, the eggs became infested by infusoria, whose presence is a usual accompaniment to unhealthy conditions. Development proceeded apace, however, and the next day the free caudal region had grown around the yolk, so as to almost meet the head. The bright yellow pigment of the embryo is now visible to the naked eye. It occurs in large dendritic chromatophores, which ramify and intermingle so as to produce a diffuse colouration over the whole of the pre-anal part of the trunk, and appears especially dense about the anus. There is a further band-like mass of yellow about the mid-post-anal region, and an aggregation of similar chromatophores on the yolk-sac, between the oil-globule and its posterior contour. In one specimen (diameter ·82 mm.) the oil-globule, at this stage, has a dark and smoky appearance, and is densely pigmented. In another specimen no pigment is seen over the oil-globule, and the periblastic pellicle, which is generally quite apparent at this stage, showing an interspace between it and the contained oil-globule, is not distinguishable. The epidermis of embryo and yolk-sac is covered with tiny tubercles, doubtless of pathological origin. Next day the larva had hatched out but was distinctly moribund, and died almost immediately. The total length is 2·16 mm., and it measures 1·00 mm. from snout to anus. The head projects rather considerably over the oval-shaped yolk-sac. In two of my larvae the oil-globule was almost in the centre of the yolk-sac, which was observed by Heincke and Ehrenbaum to be the case only in one instance, and may be regarded, therefore, as an abnormal and possibly pathological condition. The small otocysts are situated some distance behind the eyes. There is a slight swelling in the tubular gut above the pectoral region and the rectum ends blindly immediately behind the postero-dorsal edge of the yolk-sac. The pigmentation, which is on a generous scale, is very characteristic. Inter-ramifying yellow chromatophores form a diffuse mass of colour over the posterior part of the yolk-sac, and practically over the whole of the pre-anal part of the trunk and head, extending a little beyond the anus. Then comes a clear space followed by a band of yellow somewhat behind the mid-post-anal point. The much less conspicuous black pigment in small chromatophores which when relaxed show fine dendritic outgrowths, occurs chiefly on the dorsum in the pre-anal region and, less densely, on the head and sides. Post-anally there are about half a dozen chromatophores along each of the dorsal and ventral contours, extending further posteriorly than the yellow pigment, although the extreme end of the tail is pigmentless for about ·25 mm. Black chromatophores are

associated with yellow in the posterior hemisphere of the yolk-sac. The unpaired fins are pigmentless, except for a touch of yellow near the origin of the dorsal fin, immediately behind the otic region.

Apart from its peculiar colouring the larva has the unmistakable gadoid form. The dorsal fin membrane arises over the occipital region, reaches its greatest width above the anus, and thence tapers gradually to the caudal extremity; and similarly the greatest width of the anal fin is immediately below the anus.

On 2nd July, in a surface tow-netting $1\frac{1}{4}$ miles N. by W. of the Eddystone, an egg was taken which may possibly be identified with this species. Its diameter was ·86 mm., and its single oil-globule measured ·18 mm. The yolk was unsegmented. Just before the outgrowth of the caudal rudiment the body was abundantly besprinkled with faint dark chromatophores. The body appeared relatively wide. Next morning the larva showed a short caudal rudiment and much increase of pigment, which is now canary-yellow as well as black. Roundish chromatophores are fairly generally distributed over the anterior part of the body, but the black appears to be mostly dorsal and the yellow ventral. Post-anally the pigment is less dense. The pellicle of the oil-globule, which has a rough, wrinkled, and rather dark appearance, bears many rounded chromatophores of both colours, rather larger than those on the embryo and constitutes the most conspicuous feature of the ovum. There are a few fine, chiefly yellow chromatophores in the dorsal part of the yolk-sac. The otocysts are relatively small and the rudimentary pectoral fins appear as narrow flaps.

Clupea sprattus. Sprat.

This egg was the commonest of those belonging to food-fishes which occurred in my samples. It was found almost continuously from the middle of February to the middle of June, after which time until 12th July it appeared with less frequency; which may, however, be largely due to the fact that in the summer months most of my plankton was collected from the open sea, while the sprat appears to favour the close vicinity of Plymouth Sound or Cawsand Bay as a spawning locality in the warmer months, although not in winter and early spring. Very many eggs were taken in the young-fish trawl in June and July. The eggs, which are very characteristic from their segmented yolk, had an average diameter of 1·031 mm. for February–March, 0·973 mm. for April–May, and 0·912 for June–July. The pelagic larvae, which will be treated at greater length in a subsequent paper, were most abundant in May and June.

Clupea pilchardus. Pilchard.

My first pilchard eggs were taken on 8th April, 7 miles S.W. of the Eddystone, when several occurred in the tow-nettings. The diameter ranged from 1·63 mm. to 1·84 mm., and that of the oil-globule from 0·15 to 0·16 mm. The next specimen (of 1·6 mm. and 0·145 mm. oil-globule) was found in a young-fish trawl haul taken near the Eddystone on 26th August. More surprising was the occurrence of three eggs in a tow-netting taken inside the Sound on the 14th September. These had diameters of 1·46, 1·52, and 1·62 mm., and oil-globules of 0·145, 0·155, and 0·14 respectively. A newly hatched larva from one of them, measured after being killed in dilute formalin, had a length of 3·8 mm. I may also mention that I have found numerous pilchard eggs in samples of plankton taken in the young-fish trawl in September, 1906, on the Rame-Eddystone Grounds.

As Cunningham (**4**a, p. 44, and **4**d, p. 154) has pointed out, pilchards spawn far out at sea, and it is doubtless due to the fewness of my tow-net samples from the open-sea areas that such a small number of pilchard eggs have come under my observation this season. I may mention in passing that the pilchard fishery season in 1909 has been a decided failure in the Plymouth district as off the Cornish coast, the shoals having kept out in mid-Channel 20 miles or more from the coast, and therefore out of reach of the usual fishing craft. It should be remembered that the great majority of pilchards caught by Plymouth drifters are not spawning fish, the usual shoreward movement of this species in summer and early autumn being apparently a feeding migration. It is hardly relevant to the present subject to discuss the possible causes of the unusual distribution in 1909, nor is there completely satisfactory evidence available. We may, however, assume that the distribution of the spawners which appear to lie outside the main summer shoals may show some variation in relation to the movements of the latter. My collections certainly sampled only the fringe of the great mass of ova spawned, or those which drifted landward with the tide and currents.

B. DEMERSAL EGGS.

Labrus ? mixtus, L.

Eggs which in all probability belong to *Labrus mixtus* were found deposited among a mass of *Chondrus crispus* in a rock-pool on Wembury Reef on 17th June. The mode of occurrence is very similar to what has been described by Matthews for *Labrus maculatus* (**17**), and my first idea was that this was the species to which the "nest"

belonged, as it is the most common wrasse in the locality, which could with any certainty be regarded as the parent fish. The smaller size of the eggs, however, and certain differences exhibited by the hatched-out larvae, led me to conclude that this was not a species identical with that described by Matthews, though certainly a closely related form. Of the other wrasses (having unknown ova and larvae) which are known to occur here—*Labrus mixtus*, *Crenilabrus melops*, and *Centrolabrus exoletus*—the first is the form to which every probability points as the parent of these eggs. It is the one other species known to form a nest similar to that of *L. maculatus* (**18**, Vol. III, p. 102), and the size of the eggs is also most in agreement with this parentage. Ripe ova from *Crenilabrus melops* have been described by Holt (**11a**, p. 450) as spherical and having a diameter of 0·78 mm. *Crenilabrus exoletus*, of whose eggs I have no knowledge, is an exceedingly small fish, and is not at all likely to produce ova as large as my specimens. It is moreover a more deep-water form, and is not known to construct a nest between tide-marks.

My specimens had a spherical or somewhat ovoid shape and a thick strong capsule. Five which were measured had the following dimensions—0·92, 0·94, 0·94, 0·90 × 0·94 and 1·08 × 0·86 mm. When first observed on the 17th June the embryonic body with well-marked myomeres had formed, but no caudal outgrowth had appeared. There was a large Küpfer's vesicle. No pigment was visible. The yolk was pale buff-coloured and devoid of any oil-globule. Four days later they have reached the final stage of embryonic development (Fig. 4). The yolk is much reduced, its diameter being about four-sevenths that of the egg-capsule, and the caudal extremity has grown around so that its tip in some cases overlies the auditory region. The yolk is ochreous-yellow and shows a number of small vesicles in the mid-ventral part. In the eyes there is black pigment through which shine golden tints. The body is bestrewn with black chromatophores for about two-thirds of its length, and posterior to this there are some along the dorsal and ventral contours, but the posterior extremity is unpigmented. Yellow chromatophores occur on the anterior part of the body. The yolk-sac shows a few round black pigment spots and many yellow ones. The pectoral fins appear as semicircular flaps near the posterior edge of the yolk-sac. Small bean-shaped otocysts occur at a distance behind the eyes about equal to the diameter of the lens. Fig. 8 depicts a slightly earlier stage.

Two larvae (Fig. 8) measured within a few hours of hatching were 3·26 and 3·28 mm. in length, the pre-anal lengths being 1·80 and 1·76 mm. respectively. The yolk-sac is relatively small, and its con-

tents are clear and almost colourless. The head is rounded; the anus post-median. The dorsal fin membrane arises above the mid-brain and is widest above the anus. There is a well-marked pre-anal fin. The whole of the larval fin membrane has a minute vesicular structure, which is probably a mark of ill-health. Embryonic rays can be seen in the caudal region. The notochord has two layers of cells at least in its posterior part. The pectoral fins are well developed. The body is richly pigmented with black and yellow chromatophores, but the posterior third is conspicuously bare, except for a line of black chromatophores along the ventral contour, while black pigment is lacking above the mid-brain. The sides of the body from the occipital region to a short distance beyond the anus are almost uniformly coloured with round, stellate, black chromatophores about four or five deep. These are most closely set along the dorsal contour, and are more densely distributed above and posterior to the anus than above the yolk-sac. They are not uniformly distributed in the body segments as described by Matthews for *L. maculatus*, but except for the posterior continuation of the ventral line, as above-mentioned, and for the presence of black chromatophores over the sides of the gut, the distribution and abundance of black pigment on the body show much agreement with his specimen. The largest black chromatophores of all are to be seen on the yolk-sac. A group of about five to eight large, but not very intense, chromatophores occurs in the anal fin, immediately behind the anus; otherwise, except for outgrowths from pigment cells along the posterior ventral body margin, the larval fin membranes are entirely free from black pigment (see Figs. 8 and 8a). Yellow pigment is regularly interspersed with black along the sides of the trunk, but is absent over the sides of the gut. There are a few yellow chromatophores on the head, and a single isolated one near the margin of the anal fin, about half-way between the anus and the posterior end of the notochord. Another specimen which I examined showed a less uniform distribution of black pigment on the side of the trunk in the pre-anal region, the chromatophores tending to concentrate along the dorsal contour and above the gut. On the second day the larva had a length of 3·48 mm., the increase being practically entirely post-anal. At this point I made detailed measurements, so as to compare with Matthews' dimensions for *L. maculatus*, which I give side by side below:—

	My specimen.	Matthews' *L. maculatus*.
Tip of jaw to front of eye . .	·12 mm.	... ·10
„ „ back „ . .	·39 „	... ·37
„ „ front of ear . .	·42 „	... ·41
„ „ centre of heart . .	ca. ·54 „	... ·47
„ „ end of pigmentation .	2·2 „	„ (main pigmentation) 2·48
Total length	3·48 „	... 3,80

I also noted that my larva was distinctly more slender in dorsal view than Matthews' *L. maculatus* (*op. cit.*, Pl. XI).

The pigmentation is in general the same on the second day as on the first, but the post-anal pigment in the anal fin has slightly increased. With the total absorption of the yolk, which has taken place on the fourth day, a still further increase of this pigment is seen, the group of chromatophores behind the anus now numbering fourteen or fifteen; and there is a further extension of pigment from the ventral edge of the trunk to the proximal margin of the anal and pre-anal fin membranes. The embryonic fin-rays, in both the dorsal and ventral parts of the caudal region of the larval fin membrane, are now very evident. A specimen at this stage, after killing in dilute formalin, measured 3·5 mm.

Blennius pholis, L. The Shanny.

It is somewhat surprising that the earliest stages of this common blenny should have remained unknown for so long. McIntosh (**14**g) has published some observations upon eggs deposited in captivity. These were circular in outline, oblate spheroidal in lateral view, and each had a faintly pinkish attachment disc. The diameter was 1·181 to 1·219 mm., the vertical diameter being 0·763 and the height of the attachment rim 0·305 mm. He describes the yolk colour as dull pinkish or faint salmon and in certain lights having a dull brownish appearance.

On June 4th some eggs of *Blennius pholis* accompanied by the parent fish were taken on a stone on the Breakwater rocks. In shape they were ovoid with flattened underside (Fig. 3). The length of the capsule was 1·6 mm., the vertical height just above 1 mm. (with the attachment disc ca. 1·4 mm.). When observed they were at the last stage of embryonic development, the black eyes of the embryo rendering them very conspicuous. The yolk was of a light brown colour. The newly hatched larva (Fig. 6) is of large size—about 4·4 mm. total length and 1·8 mm. from snout to anus. Its very broad and somewhat square head gives it a tadpole-like appearance. There is a striking absence of post-anal pigment. A most conspicuous feature is the pair of large fan-like and heavily pigmented pectoral fins. These are marked with large, black and yellowish brown chromatophores, the former disposed in radial lines, the latter being most concentrated in the basal region and absent from the distal margin. Other black pigment occurs in the eyes, under the mandible where three stellate chromatophores are disposed symmetrically in triangular form, on the neck region as a single pigment spot, and in the peritoneum where there is a short double row of chromatophores. The yolk-sac, pro-

truding on each side, has a yellowish brown tint; there are pale yellow chromatophores on the head and similar pigment, but of more intensity, in the pectoral region. The thickness and opacity of the head causes the otocysts to be hardly visible. The course of the red blood corpuscles along the circulatory system from the yolk to the body of the larva can be very easily seen.

Gobius paganellus, Gm. L.

Some eggs, together with a fish of this species, were taken on a stone between tide-marks on the shore of Rum Bay on 3rd June. The ova have been described by Holt and Byrne (**13**, p. 46) as regularly fusiform in shape, about twice as high as wide and with rather sharply pointed ends; by which characters they are distinguishable from the eggs of all other British species of goby. The above-mentioned authors give 1·84 to 1·9 mm. as the length. An egg which I measured at a late embryo stage was 2·3 mm. long and 0·74 mm. wide, while a second was slightly longer. The yolk was of a greyish brown colour and was darkened by the presence of many small oil-globules. When the embryo is advanced in development, the eyes become extremely conspicuous, showing abundant black pigment and a bronze-green lustre. The oval swim-bladder with strongly marked dendritic chromatophores and some yellow pigment over the dorsal side of it is plainly visible. This is the only really conspicuous pigment on the embryo at this stage. The large bean-shaped otocysts contain relatively small otoliths.

The newly hatched larva (Fig. 7) has a total length of 4·8 mm., the pre-anal length being 2·2 mm., so that the anus is just anterior to the median. The head is somewhat rounded and the lower jaw slightly projecting. The large, oval swim-bladder is a conspicuous object midway between otocysts and anus. The gut is straight and has a slight ventral dilation below the hinder end of the swim-bladder. As in the embryo, the most conspicuous pigment is above the swim-bladder (black and yellow) and in the eyes, which are black with blue, green, and gold tints. There is a continuous row of black chromatophores from the throat to the anus along the ventral contour, the largest one with well-marked dendritic rays being below the above-mentioned bulge in the gut; the terminal one below the anus is also very pronounced. Except above the swim-bladder there is no peritoneal pigment nor any other chromatophores anterior to the anus. Post-anal ventral pigment consists of a discontinuous series of black dendritic chromatophores (about six or less in number) extending to the hypural region, the largest of which is situated in the centre of the post-anal

part and has yellow associated with it. Dorsally there is only one, relatively small, black chromatophore, accompanied by yellow, opposite the large mid-post-anal one of the ventral row. This dorsal pigment is often lacking entirely. The notochord is unicolumnar. The pectoral fins are rather large, extending to about the middle of the swim-bladder. The embryonic dorsal fin arises above their base. There is a short pre-anal fin commencing below the gastric dilation. A brownish gall-bladder is visible. At the age of five or six days the ventral post-anal pigment appears to have concentrated itself more in the central part of the post-anal region and in the hypural part, but otherwise the pigment remains as in the early stages. Embryonic fin-rays have developed in the position of the second dorsal and the anal fin and a hypural lobe has formed.

Lepadogaster bimaculatus, Donov. Doubly spotted Sucker.

The eggs and newly hatched larva of this species have previously been described by Holt (**11**a, p. 447, Pl. XLVII, Figs. 1 to 7), but as all my observations have shown certain differences from the specimens he describes it will be well to give some details from my records.

My observations were first undertaken chiefly with a view to getting a knowledge of the early post-larval forms for the purpose of comparison with pelagic Lepadogaster fry taken in our young-fish trawl. The following are brief particulars as to the capture of specimens of the eggs of this species which came under my notice in the summer of 1909:—

Date.	Locality.	Instrument of capture.	Other remarks.
8th June, 1909	Queen's Ground .	Dredge . .	Eggs encrusting inside of a *Tellina* valve. Greatest horizontal axes of egg-capsule, 1·4 × 1·2 mm.
16th June, 1909	Rame-Eddystone Ground	Otter trawl .	Eggs in *Lutraria* valve with parent fish. Greatest horizontal dimensions, 1·4 × 1·16 mm.; height, 0·70 mm.
5th July, 1909	Hand Deeps .	Dredge . .	Several batches of eggs with parent fish in valves of *Pecten opercularis* and *Lutraria*.
13th July, 1909	Hand Deeps .	Dredge . .	Eggs in *Pecten opercularis* valve. Accompanying fish a female.

On 14th June a female *Lepadogaster bimaculatus*, with spent, flaccid and membranous ovaries, was taken in a *Lutraria* valve, within which a batch of eggs *had* been deposited, but which had disappeared, leaving traces of their former presence in the form of oval impressions. The

nudibranch *Calma glaucoides* and a batch of its eggs were also occupying the valve, and it seems probable, if not certain, that the fish-eggs had been devoured by the nudibranch, which has been recorded as commonly occurring associated with Goby and Blenny eggs, and varying in colour so as to resemble the eggs which it apparently preys upon.*

Quite recently—viz. on 17th February, 1910, and after this paper was in manuscript—I have secured an early batch of *Lepadogaster bimaculatus* eggs. On this occasion I took particular care to examine the accompanying parent fish so as to make sure of its identity as distinct from *L. microcephalus*, a closely similar species first distinguished by Brook,† whose description, however, I have not yet been able to see. Ehrenbaum (5b, p. 121) gives as the distinctive fin-ray formula for *L. microcephalus* D = 5, A = 6, C = 17–19; while Day gives for *L. bimaculatus* D = 5–7, A = 4–6, C = 12. My specimen has clearly six dorsal fin-rays and not more than four or five anal fin-rays, which precludes *L. microcephalus*, while in its general appearance it resembled the common two-spotted sucker, *L. bimaculatus*. It was not possible to count the caudal rays, as it was desired to keep the specimen alive and uninjured. Two of the eggs had the following dimensions:—Oval outline of egg-capsule, as seen from above, measured in one case 1·44 × 1·24 mm. and in the other 1·54 × 1·22 mm. The height of the capsule was respectively 0·62 and 0·70 mm. The sizes closely approximate to those noted the previous summer, and in following through the development from pre-embryonic to larval stages, the characters proved to be identical, save for very slight variation in pigmentation.

The ovoidal inferiorly truncated egg-capsule and its peculiar basal attachment disc and filaments have been minutely described by Holt (*op. cit.*). I noted that as a rule the eggs in one batch showed several stages of development, indicating that they were deposited intermittently. In the earliest stages the finely granular yolk is quite colourless and translucent, and carries a single oil-globule of about 0·25 to 0·28 mm. diameter, which has a slightly darker appearance than the yolk and is at first the most conspicuous content of the egg. The embryo almost invariably occupies a horizontal position in the egg. Black pigment appears on the body soon after the outgrowth of the caudal rudiment, and soon forms a dense and continuous line along the ventro-lateral region from immediately behind the pectoral fins to within a short distance of the caudal tip. Anteriorly pigment is sparse, only a few

* See *Journ. M.B.A.*, N.S., Vol. VII, p. 280.

† Brook, G., *Proc. Roy. Phys. Soc. Edin.*, Vol. X, Pt. 1, p. 166.

chromatophores occurring about the neck region and shortly afterwards on the eyes. Yellow chromatophores (bright lemon-yellow by reflected light, brownish by transmitted light) next appear on the sides of the embryo above the dense line of black pigment above-mentioned (see Fig. 5). At about the same time black chromatophores frequently appear along the dorsal surface of the yolk-sac adjacent to the trunk of the embryo. The circulatory fluid is now of a red colour, which is plainly visible at the heart systole. Before the appearance of the yellow pigment the blood was colourless, but even then its circulation could be observed in vessels from the yolk-sac, and in the aorta and main arteries of the head. A day or two after the appearance of yellow, an increase takes place in the amount of black pigment, a double ventro-lateral line being formed on each side with the inferior pair, which are the more distinctly marked, coming together at the anus. A sprinkling of lateral chromatophores next appears, and the eyes become so dark as to be conspicuous to the naked eye. The only other black pigment in the anterior region is a pair of lines converging towards the occiput from the posterior lateral part of the yolk-sac. The yolk-sac and occipital region are covered with diffuse pale yellow.

The newly hatched larva (see Fig. 16) has a length of 4·26 mm., of which about five-eighths is pre-anal. The remnant of yolk is relatively small, as is usual with larvae from demersal eggs, and bulges out on each side of the larva. A small oval swim-bladder is present. Rounded, stellate, black chromatophores uniformly beset the sides of the trunk in fairly regular lines, which are about four deep transversely in the pre-anal and about three deep in the post-anal region. These are larger in the anterior part of the body than posteriorly. There are similar lines of yellow chromatophores (pale lemon coloured by reflected, brownish by transmitted light) slightly less numerous and at greater interval. These are more densely distributed posteriorly than anteriorly. The most dorsal row of chromatophores are yellow and these are of a larger size and greater denseness than the others. Over the straight intestine yellow pigment is generally sparse and sometimes quite lacking. The posterior portion of the tail, for about 1 mm., is quite unpigmented, as is also the median strip along the whole dorsum. The only pigment in the larval fins consists of a small group of about three to five black chromatophores in the anal fin immediately behind the anus. The snout is rounded. The large otocysts are situated immediately behind the eyes. The dorsal fin arises a little behind the level of the posterior edge of the yolk-sac. Tiny epidermal vesicles densely cover the embryonic fins, except along the margin of its most posterior part.

Two post-larvae, measured soon after the yolk had been absorbed, had lengths of 4·8 and 4·9 mm. The jaws had appreciably developed, especially the mandible, so that the earlier sub-terminal position of the mouth was changed; but otherwise they resembled the newly hatched individuals. The differences between my specimens and those recorded by Holt are in size and pigmentation. His newly hatched larvae measured 2·97 to 3·15 mm., and apparently had no yellow pigment (*op. cit.*, p. 448). His eggs were slightly smaller than mine, having a length of 1·37 mm., a breadth of 1·08 mm., and a height of 0·68 mm., and the oil-globule measured 0·24 mm. Guitel (**9**, Pl. XXV, Fig. 8) figures an early post-larval *L. bimaculatus* of uncertain age, which is about 4·6 mm. long and is pigmented somewhat similarly to those I have examined, except that the superior line of yellow chromatophores is not clearly shown on the side and the black chromatophores are lacking in the anal fin. As regards Holt's specimen, if it is the same species as those I have examined, I can only suggest that it may have been an abnormal specimen, possibly prematurely hatched under unfavourable conditions.

Lepadogaster gouani, Lacep. Cornish Sucker.

On the 17th June several batches of the eggs of this species were taken on the underside of flat stones between tide-marks on Wembury Reef. The parent fish was always to be found near, and generally close alongside the eggs, which cover several square inches of the stone with a closely applied layer. Two, three, or four stages of development may be seen in one batch of eggs. In the earliest stages the yolk is bright amber coloured, which renders the mass of ova an object of much conspicuousness and beauty. Subsequently the colours become gradually darker to orange, and finally, when the embryo is advanced, they have in the mass an olive-green appearance. The egg-capsule is oval-shaped with flattened base, of length 1·90 mm. and breadth 1·56 mm. The yolk contains a large oil-globule of 0·34 mm. diameter.

When a short caudal rudiment is developed, the embryo has a general reddish tint, and shows many stellate black chromatophores over the greater part of the body, the posterior portion, however, being unpigmented. The movement of pale reddish circulatory fluid along the vessels from the yolk to the heart is plainly visible.

The newly hatched larva has a length of 5·1 mm., the anus is post-median, and the yellowish yolk-sac protrudes on either side of the anterior abdominal region. The straight gut shows internal convolutions and a yellowish green gall-bladder is visible. The dorsal

embryonic fin arises in the occipital region, the caudal part of it being spatulate. The head is rounded and the mouth terminal, the otocysts situated immediately behind the eyes. Pigmentation is extremely rich. Black chromatophores are the most abundant, covering the sides of the trunk and gut in closely set and fairly regular longitudinal lines. The largest chromatophores are those on the dorsal surface of the head, and those along the dorsal contour are the largest and most closely set of those on the trunk. Post-anally the number of chromatophores counted transversely is four or five. About 0·8 mm. from the posterior end of the notochord, the greater part of the pigmentation ceases, but there may be a few small pigment spots over the notochord behind this point. Along the anal fin there is a line of black chromatophores, extending from immediately behind the anus to the hypural area. Mid-laterally, where the black pigment is least dense, there is an irregular line of about seven large lemon-yellow chromatophores, extending from the level of the posterior edge of the yolk-sac to a little behind the anus. Between all the other chromatophores are numerous small orange-coloured ones, with a relatively large, clear, central space, which gives them the appearance of small rings. Most of the black and yellow chromatophores also have the form of radiations from a central unpigmented spot. Small, round or stellate chromatophores of a pure red colour occur on the ventral surface of the abdomen anterior to the anus. There is no yellow or orange pigment over the sides of the abdomen, but only black, and it is perhaps worthy of note to mention that the black chromatophores of this region appear to have a different structure from those over the rest of the body, the centre of the spot in this case being pigmented instead of clear. The proximal part of the median fin membrane shows the same minute vesicular structure as was seen in *L. bimaculatus*, but the vesiculation does not extend so near to the margin.

A slightly older larva measured 5·7 mm., and was 3·2 mm. from snout to anus. At four or five days old the length is 6·3 mm., the pre-anal portion being 3·4 mm. A hypural thickening is visible. The pigmentation at this age is practically the same as in the newly hatched form, except for an increase of red pigment on the inferior parts of the body. A larva in which the yolk has been entirely absorbed shows small red chromatophores on the ventral surface of the lower jaw, on the ventro-lateral part of the opercular region, on the ventral and ventro-lateral surface of the abdomen and over the basal part of the large pectoral fins.

The pelagic post-larval stages of *L. gouani* can be easily distinguished from those of *L. bimaculatus* by their larger size at the same point in

development, and by the distinctiveness of their coloured pigment. In preserved specimens in which all but the black chromatophores have disappeared, one can at once distinguish *L. bimaculatus* by its relatively wide unpigmented strip along the dorsum, only a very narrow line being left clear between the pair of dorsal lines of chromatophores in *L. gouani*. There is also a difference in the distribution of pigment spots in the anal fin. As is to be expected, however, I have never met with the young stages of *L. gouani* in plankton taken away from the vicinity of the shore, while post-larval *L. bimaculatus* may be taken some miles out at sea.

Zeus faber, L. John Dory.

On 31st August five good-sized dories were taken in the otter-trawl 2½ miles S.W. of Rame Head. One of these was an unripe male, and three were females, which had recently spawned. From the ovary of one of the latter I obtained a dead egg, which had already undergone degeneration and was opaque and pale greenish in colour. The fifth proved to be a female approaching ripeness, and from the ovary of this I obtained a few apparently ripe eggs, which occurred free in the lumen. The great majority of the ova, however, were still small and opaque, and contained firmly in the ovigerous lamellae. The ripe eggs are large and contain a relatively small greenish yellow oil-globule (Fig. 1). The rather thick egg-capsule is marked by conspicuous corrugations, which appear to be intertwined in a very irregular manner, and also by finer striations, the former of which are doubtless merely characteristic of the ovarian condition and caused by contact with vascular tissue in the ovary. The yolk is colourless and homogeneous, the ripe egg being translucent and glassy, but not of that clear transparency which is seen in all pelagic eggs, and by transmitted light it has a slightly brownish tint, which is apparently produced by the interference of the corrugated capsule with the free transmission of light rays.

The dimensions taken from four eggs are as follows:—

	Diameter of Egg.		Diameter of Oil-globule.
(1)	2·04 × 2·14 mm.	...	0·44 mm.
(2)	2·03 „	...	0·44 „
(3)	2·05 „	...	0·28 and 0·22 mm.
(4)	1·90 „	...	0·43 mm.

In the third egg measured the oil was contained in two separate globules, which is commonly the case in an unfertilized egg. The fourth specimen measured was apparently not quite ripe.

The eggs sink in sea-water of specific gravity 1·026. Fulton (**8**), from

minute observations made upon the ripening ovarian ova of a dory caught in April, concluded that the mature eggs would prove to be large, contain one or more oil-globules and be demersal; which conclusions are confirmed by the character of my ripe eggs. Their demersal nature was indicated, even at that stage, by the comparatively dense fibrous nature of the tissue of the stroma and the follicle, by the presence of a well-defined double layer, by the character of the yolk, and by the general hardness and resistance to pressure, all these features being in contrast with ovarian pelagic eggs. One of the largest specimens examined by Fulton from the ovarian stroma measured 1·39 mm. in diameter and contained two groups of three and four oil-globules. Some other slightly smaller eggs contained a prominent straw-coloured oil-globule: thus in an egg of 1·02 mm. diameter the oil-globule measured 0·25 mm. All these were quite opaque and white by reflected light and still contained in the follicular investment.

Holt has recorded the capture of ripe females off the west coast of Ireland in July and August, and one spent in June.* Cunningham (**4**g, p. 322) also has found ripe females in August at Plymouth. The demersal character of the eggs and the relatively deep-water habitat of the spawning fishes are sufficient to account for the present lack of knowledge of embryonic development. The youngest post-larval stages yet recorded are those described by Schmidt (**21**d) from four specimens ($7\frac{3}{4}$ mm. to 19 mm. long) taken by the *Thor* in August and September, 1906 (three from various parts of the Channel and one from the Bay of Biscay); to which must be added one specimen of 14 mm. taken by the *Oithona's* young-fish trawl off Plymouth Sound on the 17th of September in the same year.

BIBLIOGRAPHY.

1. Brook, G.—a. Preliminary Account of the Development of Lesser Weever (*Trachinus vipera*). *Linn. Soc. Journ. Zool.*, XVIII (1884), pp. 274–91, Pl. III–VI.

b. On Some Points in the Development of *Motella mustela*. *Ibid.*, pp. 298–306, Pl. VIII–X.

2. Browne, F. Balfour.—Report on the Eggs and Larvae of Teleostean Fishes observed at Plymouth in the Spring of 1902. *Journ. Mar. Biol. Assoc.*, N.S., Vol. VI (1903), pp. 598–616.

3. Canu, E.—a. Ponte, œufs et larves des poissons utiles observés dans la Manche. *Annales de la Stat. Aquic. de Boulogne*, Vol. I (1893), pp. 117–32, Pl. VIII–XV.

b. *Ibid.*, Vol. II (1894), pp. 63–72, Pl. I–V.

* Report of the Council Royal Dublin Society, 1892, p. 245.

4. Cunningham, J. T.—a. Studies on the Reproduction and Development of Teleostean Fishes occurring in the Neighbourhood of Plymouth. *Journ. Mar. Biol. Assoc.*, N.S., Vol. I (1889–90), pp. 10–54, Pl. I–VI.

b. A Treatise on the Common Sole. Plymouth (1890).

c. On Some Larval Stages of Fishes. *Journ. Mar. Biol. Assoc.*, N.S., Vol. II (1891–2), pp. 68–74, Pl. III–IV.

d. The Reproduction and Growth of the Pilchard. *Ibid.*, pp. 154–7, Pl. X.

e. The Egg and Larva of *Callionymus lyra*. *Ibid.*, pp. 89–90, Pl. V.

f. The Life History of the Pilchard. *Ibid.*, N.S., Vol. III, pp. 148–53.

g. Natural History of Marketable Marine Fishes of the British Isles. London (1896).

5. Ehrenbaum, E.—a. Eier und Larven von Fischen der deutschen Bucht. I. *Wissensch. Meeresuntersuchungen, Abt. Helgoland*, II (1897), pp. 253–328, Taf. III–VI.

b. Eier und Larven von Fischen, 1 Teil. *Nordisches Plankton* (1905).

c. Ueber Eier und Jugendformen der Seezunge und anderer im Fruhjahr laichender Fische der Nordsee. *Wissensch. Meeresuntersuchungen, Abt. Helgoland*, VIII (1907), pp. 201–70.

d. Eier und Larven von Fischen, 2 Teil. *Nordisches Plankton* (1909).

6. Ehrenbaum, E., and S. Strodtman.—Eier und Jugendformen der Ostseefische. *Wissensch. Meeresuntersuchungen, Abt. Helgoland*, VI (1904), pp. 57–126.

7. Fabre-Domergue et E. Biétrix.—Développement de la Sole. Paris (1905).

8. Fulton, T. Wemyss.—The Ovaries and Ovarian Eggs of the Angler (*Lophius piscatorius*) and of the John Dory (*Zeus faber*). *Sixteenth Annual Rept. Fish. Bd. Scotl.* (1898), pp. 131–4, Pl. III.

9. Guitel, Fr.—Recherches sur les Lepadogasters. *Arch. de Zool. experim.*, 2 S., Vol. VI (1888), pp. 576–94, Pl. XXXIII–XXXV.

10. Heincke, Fr., and E. Ehrenbaum.—Eier und Larven von Fischen der Deutschen Bucht. II. Die Bestimmung der schwimmenden Fischeier und die Methodik der Eimessungen. *Wissensch. Meeresunters. Abt. Helgoland*, III (1899), pp. 131–332, Taf. IX–X.

11. Holt, E. W. L.—a. Survey of Fishing Grounds, West Coast of Ireland, 1890, I. On the Eggs and Larvae of Teleosteans. *Sci. Trans. Roy. Dubl. Soc*, Vol. IV, S. II (1891), pp. 435–74, Pl. XLVIII–LII.

b. Survey of Fishing Grounds, West Coast of Ireland, II, 1890–1901. On the Eggs and Larval and Post-larval Stages of Teleosteans. *Ibid.*, Vol. V., S. II (1893), pp. 5–121, Pl. I–XV.

c. Preliminary Notes on the Reproduction of Teleostean Fishes in the South-Western District. *Journ. Mar. Biol. Assoc.*, N.S., Vol. V (1897), pp. 41–50.

d. Notes on the Reproduction of Teleostean Fishes in the South Western District. *Ibid.*, pp. 107–55 and 333–40 (1897).

e. On the Breeding of the Dragonet (*Callionymus lyra*). *Proc. Zool. Soc.* (1898), pp. 281–315, Pl. XXVI.

f. Recherches sur la Reproduction des Poissons Osseux. *Annale du Musée d'histoire naturelle de Marseille. Zoologie*, Tome V, No. 2 (1899), pp. 1–128, Pl. I–IX.

12. Holt, E. W. L., and Scott, S. D.—A Record of the Teleostean Eggs and Larvae observed at Plymouth in 1897. *Journ. Mar. Biol. Assoc.*, N.S., Vol. V. (1897–9), pp. 156–71.

13. Holt, E. W. L., and Byrne, L. W.—British and Irish Gobies. *Report Fisheries Irel.* (1901), pp. 37–66, Pl. I and II.

14. McIntosh, W. C.—a. Further Observations on the Life History and Development of the Food and other Fishes. *9th Annual Rept. Fish. Bd. Scotl.* (1891), pp. 317–34, Pl. X–XIII.

b. Contributions to the Life History of the Food and other Fishes. *Ibid.*, *10th Rept.* (1892), pp. 273–322, Pl. XIV, XVI.

c. *Ibid.*, *11th Report* (1893), pp. 239–49, Pl. VIII–XII.

d. *Ibid.*, *12th Report* (1894), pp. 218–30, Pl. II–IV.

e. *Ibid.*, *14th Report* (1896), pp. 171–85, Pl. V.

f. *Ibid.*, *15th Report* (1897), pp. 194–211, Pl. V–VII.

g. On the Life History of the Shanny (*Blennius pholis*, L.). *Zeitsch. f. wissensch. Zool. 82* (1905), pp. 368–78, Pl. XXI.

15. McIntosh, W. C., and Masterman, A. T.—The Life Histories of the British Marine Food Fishes. London (1897).

16. McIntosh, W. C., and Prince, E. E.—On the Development and Life Histories of the Teleostean Food and other Fishes. *Trans. Roy. Soc. Edin.*, Vol. XXXV, Pt. III (1890), pp. 665–946, Pl. I–XXVIII.

17. Matthews, J. Duncan.—Note on the Ova, Fry, and Nest of the Ballan Wrasse. *5th Ann. Rept. Fish. Bd. Scotl.*, p. 245, Pl. XI.

18. Moreau, Emile.—Histoire Naturelle des Poissons de la France. Paris (1881).

19. Petersen, C. G. Joh.—On the Eggs and Breeding of our Gobiidae. *Report of the Danish Biological Station*, II. (1891), pp. 1–9, Pl. I, a–1 b.

20. Raffaele, F.—Le uova galleggianti e le larve dei Teleostei nel golfo di Napoli. *Mitteil. Zool. Sta. Neapel.*, VIII (1888), pp. 1–84, Tav. 1–5.

21. Schmidt, Johs.—a. The Pelagic Post-larval Stages of the Atlantic Species of Gadus, Pt. I. *Meddelels. fra Komm. for Havundersog. Serie Fiskeri*, Bd. I (1905), No. 4, Pl. I–III.

b. *Idem.*, Pt. II. *Ibid.*, Bd. II. (1906), No. 2, Pl. I.

c. Marking Experiments on Plaice and Cod in Icelandic Waters. *Ibid.*, Bd. II (1907), No. 6.

d. On the Post-larval Stages of the John Dory (*Zeus faber*, *L.*) and some other Acanthopterygian Fishes. *Ibid.*, Bd. II (1908), No. 9, Pl. I.

EXPLANATION OF PLATES I AND II,

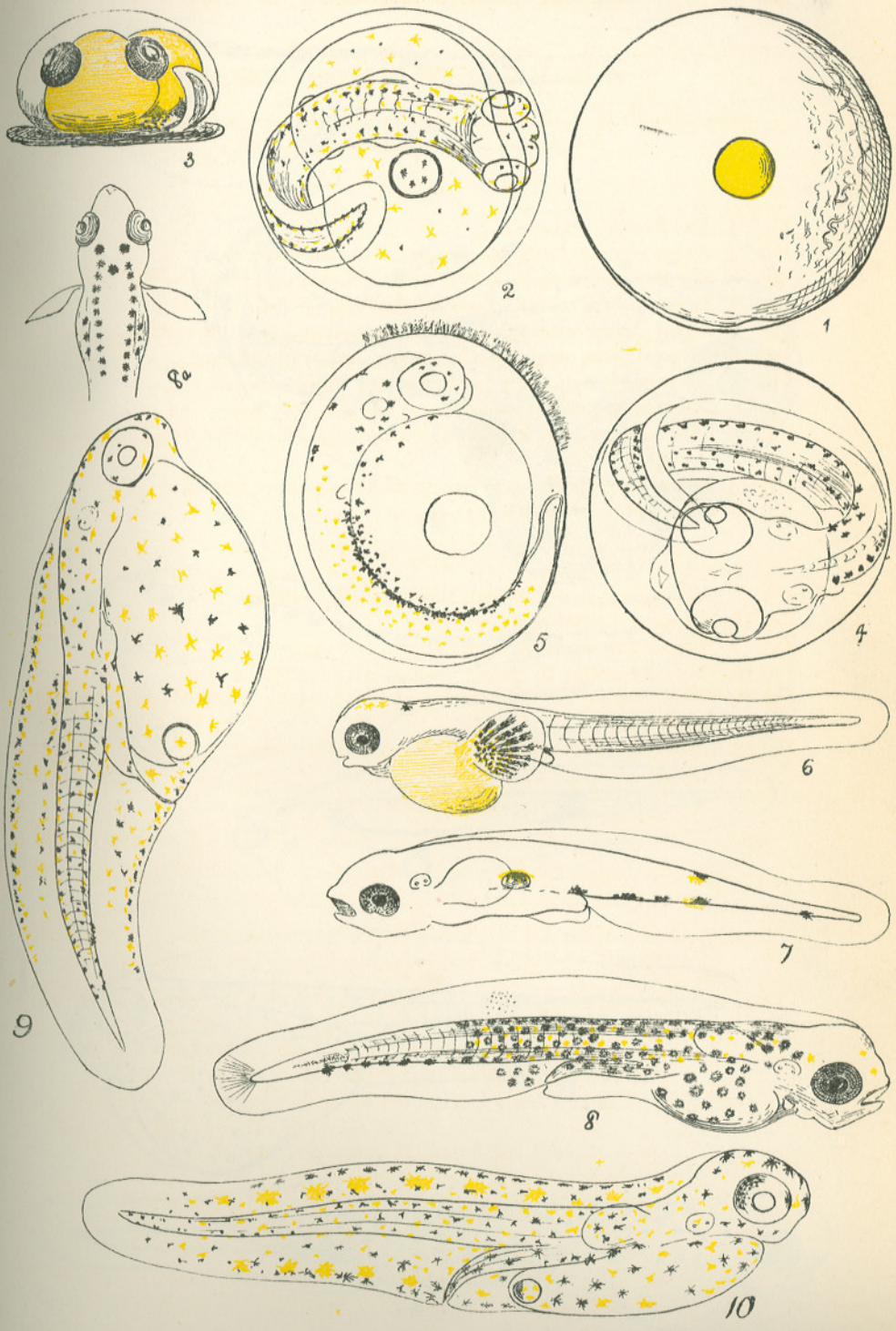
Illustrating Mr. A. E. Hefford's "Notes on Teleostean Ova and Larvae observed at Plymouth in Spring and Summer, 1909."

Plate I.

Fig. 1. *Zeus faber*, ripe ovarian egg ; diameter, ca. 2·09 mm.
Fig. 2. *Zeugopterus punctatus*, pelagic egg ; diameter, 0·99 mm.
Fig. 3. Egg of *Blennius pholis*, lateral view ; dimensions, 1·8 × 1·2 × 0·8 mm.
Fig. 4. Egg of *Labrus mixtus ;* diameter, 0·94 mm.
Fig. 5. Egg of *Lepadogaster bimaculatus ;* dimensions, 1·44 × 1·24 × 0·62 mm.
Fig. 6. *Blennius pholis*, newly hatched larva ; length, ca. 4·4 mm.
Fig. 7. *Gobius paganellus*, newly hatched larva ; length, 4·8 mm.
Fig. 8. *Labrus mixtus*, newly hatched larva ; length, 3·26 mm.
Fig. 8a. *Labrus mixtus*, sketch showing arrangement of anterior dorsal black pigment.
Fig. 9. *Zeugopterus punctatus*, newly hatched larva ; length 2·90 mm.
Fig. 10. *Z. punctatus*, larva ca. 3 days old.

Plate II.

Fig. 11. *Solea lascaris*, newly hatched larva ; length, 3·46 mm.
Fig. 12. *S. lascaris*, larva 4 or 5 days old.
Fig. 13. *Serranus cabrilla*, early larva ; length, 2·30 mm.
Fig. 14. *Onos? tricirratus*, Bl., newly hatched larva ; length, 2·32 mm.
Fig. 15. "*Onos*, species B" (? or abnormal form), newly hatched larva ; length, 1·84 mm.
Fig. 16. *Lepadogaster bimaculatus*, newly hatched larva ; length, 4·26 mm.



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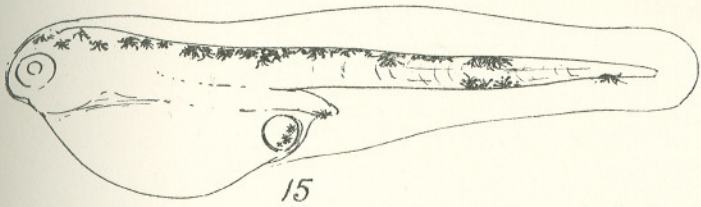

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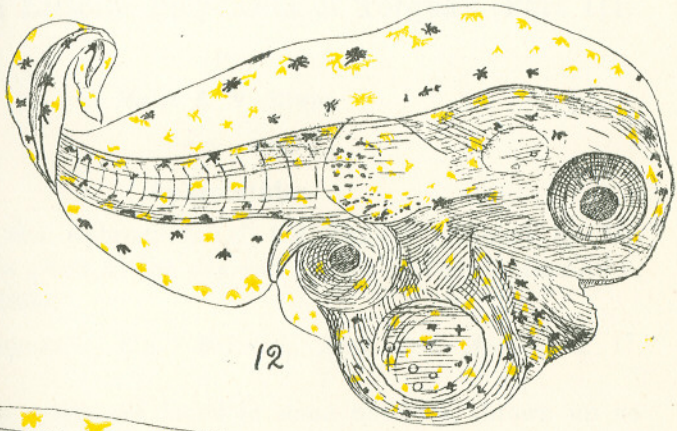

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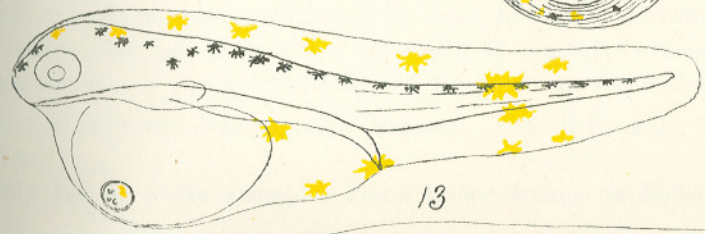

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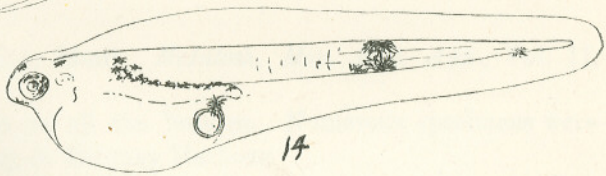

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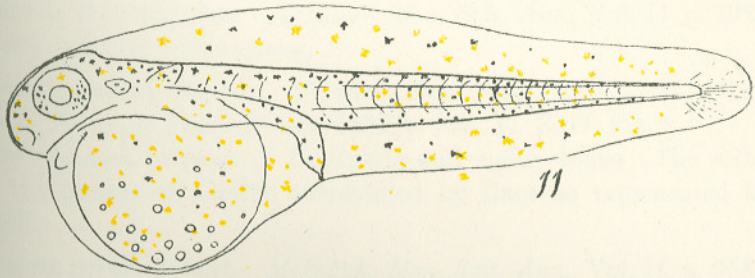

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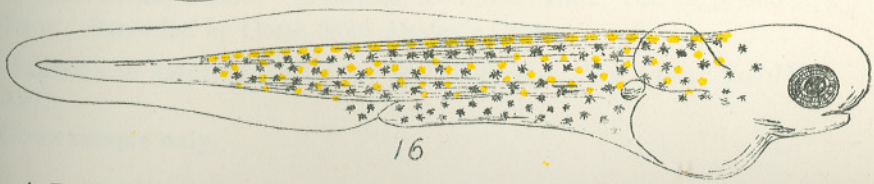

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A. E. H. del.

Notes on the Littoral Polychæta of Torquay (Part III).

By
Major E. V. Elwes.

Aphroditidæ.

A SYNOPSIS of the Aphroditidæ of the English Channel by Mr. T. V. Hodgson is given in the *Journal Marine Biological Association*, Vol. VI, No. 2, 1900.

APHRODITA ACULEATA, Lin. *McIntosh, Mon. Brit. Ann.*, Vol. II, p. 247.

This species is sometimes found in some numbers, thrown up on the shore after heavy weather, especially at Anstey Cove and Tor Abbey Sands. It is recognized by the fishermen as a "curiosity."

LEPIDONOTUS SQUAMATUS, Lin. *McIntosh, Mon. Brit. Ann.*, Vol. II, p. 274.

Only two or three examples found under stones on Babbacombe beach.

LEPIDONOTUS CLAVA, Mont. *McIntosh, Mon. Brit. Ann.*, Vol. II, p. 280.

Occasionally found on all the beaches. Numerous specimens were found on a large buoy in Torquay Harbour.

LAGISCA FLOCCOSA, Sav. *McIntosh, Mon. Brit. Ann.*, Vol. II, p. 298.

Fairly common under stones.

LAGISCA EXTENUATA, Gr. *McIntosh, Mon. Brit. Ann.*, Vol. II, p. 307. Hornell, *Fauna of Liverpool Bay*, 1892, p. 136, Pl. XIII, Fig. 8.

Very common in roots of Laminaria and under stones. The scales have the groups of papillæ surrounded by lines as represented by Hornell.

EVARNE IMPAR, Johnst. *McIntosh, Mon. Brit. Ann.*, Vol. II, p. 358.

Rare. Recorded by Gosse from Anstey's Cove.

HARMOTHÖE SPINIFERA, Ehlers. *McIntosh, Mon. Brit. Ann.*, Vol II, p. 327.

One example only.

HALOSYDNA GELATINOSA, M. Sars. *McIntosh, Mon. Brit. Ann.*, Vol. II, p. 384.

One specimen under a stone on Babbacombe beach.

POLYNOE SCOLOPENDRINA, Sav. *McIntosh, Mon. Brit. Ann.*, Vol. II, p. 389.

Not uncommon at Corbyn's Head.

STHENELAIS BOA, Johnst. *McIntosh, Mon. Brit. Ann.*, Vol. II, p. 408.

Not uncommon in the sand at Tor Abbey Sands.

SIGALION MATHILDÆ, Aud. and Edw. *McIntosh, Mon. Brit. Ann.*, Vol. II, p. 427.

This is the only one of the Torquay Aphroditidæ which has not been also recorded from Plymouth. It is fairly common in the sand at Tor Abbey Sands and Livermead.

PHOLOË MINUTA, O. Fabricius. *McIntosh, Mon. Brit. Ann.*, Vol. II, p. 437.

The most numerous of all the Torquay Aphroditidæ, inhabiting especially the Laminaria roots.

Glyceridæ.

GLYCERA CONVOLUTA, Kef. *De St. Joseph, Ann. Sci. Nat. Zool.*, Vol. XVII, 1894, p. 27.

Fairly numerous in Tor Abbey Sands and at Livermead.

GLYCERA LAPIDUM, Qfg. *McIntosh*, "On the British Glyceridæ," *Ann. Nat. Hist.*, S. 7, Vol. XV, p. 39, 1905.

One specimen in the inner harbour of Torquay and one on the Babbacombe beach.

Eunicidæ.

This family is represented at Torquay by five littoral species. For the key to the Eunicidæ of the English Channel the papers by Baron de St. Joseph, entitled "Les Annélides Polychètes des Côtes de Dinard" and "Les Annélides Polychètes des Côtes de France," the "Notes on the British Eunicidæ," by Professor McIntosh, *Annals of Natural History*, Vol. XI, p. 553, 1903, and the *Cambridge Natural History*, Vol. II, have been consulted.

LYSIDICE NINETTA, Aud. and Edw. *Johnst., Catalogue of Worms*, p. 140.

Small specimens thirty to fifty millimetres in length; extremely common amongst Laminarian roots and limestone rocks.

NEMATONEREIS UNICORNIS, Grube. *De St. Joseph, Ann. Sci. Nat.*, V, 1888, p. 207.

Fairly common in the limestone rocks at Babbacombe, but as is the case with the last species it is very rarely perfect.

STAUROCEPHALUS RUBROVITTATUS, Grube. *De St. Joseph, Ann. Sci. Nat.*, V, 1888, p. 235.

One specimen obtained at an unusually low spring tide at Corbyn's Head.

OPHRYOTROCHA PUERILIS, Clpd. and Meczn. *Cambridge Nat. Hist.*, Vol. II, p. 319, Fig. 170.

This little worm is frequently seen on the sides of glass vessels containing roots and pieces of rocks. On one occasion a small aquarium in the museum of the Torquay Natural History Society was found to be swarming with this species.

LUMBRICONEREIS LATREILLI, Aud. and Edw. *De St. Joseph, Ann. Sci. Nat. Zool.*, V, 1898, p. 276.

Three or four in rather coarse gravel on Babbacombe beach.

Sphœrodoridæ.

EPHESIA GRACILIS, Rathke. *De St. Joseph, Ann. Sci. Nat. Zool.*, XVII, 1894, p. 33. *McIntosh, Ann. Nat. Sci.*, S. 8, Vol. II, 1908, p. 528 and 540.

Two or three from Meadfoot beach.

EPHESIA PERIPATUS, Clpd. nee Johnst. *Claparède, Beob. über Anat. und Ent. wirbellosen thiere*, p. 50, *de St. Joseph, Ann. Sci. Nat. Zool.*, XVII, 1894, p. 41.

Two specimens from Corbyn's Head. According to de St. Joseph this species differs from *E. gracilis* by several characters, but he only mentions two, viz. the composite bristles and the absence of the "l'éventail de papilles" below the feet which exists in *E. gracilis*. The bristles of *E. peripatus* of the Torquay examples seem, besides being compound, to be not quite so stout and not so much bulged as those of *E. gracilis*.

Ariciidæ.

ARICIA LATREILLI, Aud. and Edw. *De St. Joseph, Ann. Sci. Nat. Zool.*, XVII, 1894, p. 85.

Several examples were dug up from the sand at Tor Abbey Sands. In this species there are about thirty bristle-bearing segments in the anterior region, while in *A. cuvieri* there are only twenty-one.

Spionidæ.

In preparing the accompanying key to the Spionidæ of the English Channel Mesnil's paper, entitled "Études de Morphologie externe chez les Annélides" and Professor McIntosh's "Notes on the British Spionidæ," *Annals of Nat Hist.*, S. 8, Vol. III, have been consulted.

Scolecolepis vulgaris, Johnst. *McIntosh, Annals of Nat. Hist.*, S. 8, Vol. III, 1909, p. 159.

At the west end of Tor Abbey Sands; rare.

Scolecolepis fuliginosa, Clpd. *McIntosh, Annals of Nat. Hist.*, S. 8, Vol. III, 1909, p. 160.

Very numerous at west end of Tor Abbey Sands and at Livermead. In December numbers were found coiled up together under stones.

Nerine cirratulus, Delle Chiaje. *McIntosh, Annals of Nat. Hist.*, S. 8, Vol. III, 1909, p. 158.

Tor Abbey Sands; not numerous.

Aonides oxycephala, Sars. *Mesnil, Bull. Sci. France et Belgique*, XXIX, 1896, p. 242.

Numerous in rather foul mud under stones at Livermead.

Polydora ciliata, Johnst. *McIntosh, Annals of Nat. Hist.*, S. 8, Vol. III, p. 169.

Very numerous in the small pools in the limestone boulders on the shore.

Polydora flava, Clpd. *McIntosh, Annals of Nat. Hist.*, S. 8, Vol. III, p. 169.

Numerous on rocks and in pools.

Spiophanes bombyx, Clpd. *McIntosh, Annals of Nat. Hist.*, S. 8, Vol. III, p. 167.

A few specimens at the east end of Tor Abbey Sands. Mesnil remarks that he found this species in company with *Echinocardium cordatum*; this sea urchin is also common on Tor Abbey Sands.

Magelonidæ.

Magelona papillicornis, Fr. Müller. *McIntosh, Annals of Nat. Hist.*, S. 8, Vol. III, p. 174.

One example at a very low spring tide on Tor Abbey Sands.

Ammocharidæ.

Owenia fusiformis, Delle Chiaje. *De St. Joseph, Ann. Sci. Nat. Zool.*, V, 1898, p. 397.

The tubes of this species are very numerous on Tor Abbey Sands; they appear to be loose in the sand, not fixed vertically, as is usual with tube-dwelling annelids in sand. They are largest in the middle, tapering towards both ends, made chiefly of small pieces of shell placed edgeways.

Cirratulidæ.

In the accompanying key to the Cirratulidæ of the Channel the classification of Caullery and Mesnil in *Les formes épitoques et l'evolution des Cirratuliens* is adopted.

AUDOUINIA TENTACULATA, Montagu. *De St. Joseph, Ann. Sci. Nat. Zool.*, XVII, 1894, p. 49.

Numerous at Meadfoot, Hope's Nose, and Tor Abbey Sands in rather foul mud; young ones about 40 mm. in length appear to live in crevices in rocks.

DODECACERIA CONCHARUM, Oersted. *Caullery et Mesnil, Annales de l'Université de Lyon*, Fasc. XXXIX, 1898, p. 11.

Very numerous in the limestone boulders at Babbacombe.

HETEROCIRRUS VIRIDIS, Lang. = *H. flavoviridis*, de St. Joseph. *Caullery et Mesnil, Ann. de l'Université de Lyon*, Fasc. XXXIX, 1898, p. 117.

Found occasionally in small pools in limestone rocks at Babbacombe.

HETEROCIRRUS CAPUT ESOCIS, de St. Joseph. *Caullery et Mesnil, Ann. de l'Université de Lyon*, Fasc. XXXIX, 1898, p. 122.

Two or three examples found in the same localities as the last species. I have not seen any British records of these two species of Heterocirrus.

Terebellidæ.

The accompanying key to the Terebellidæ is founded on the table given by Baron de St. Joseph in "Les Annélides Polychètes des Côtes de Dinard," *Ann. Sci. Nat. Zool.*, XVII, 1894, p. 180.

POLYMNIA NEBULOSA, Montagu. *De St. Joseph, Ann. Sci. Nat. Zool.*, XVII, 1894, p. 219.

Occasional specimens at Corbyn's Head and in rocks between Oddicombe and Babbacombe beaches.

POLYMNIA NESIDENSIS, de St. Joseph. *Ann. Sci. Nat. Zool.*, XVII, 1894, p. 211.

Very common in Laminaria roots, etc.

LANICE CONCHILEGA, Pallas. *De St. Joseph, Ann. Sci. Nat. Zool.*, XVII, 1894, p. 211.

Numerous on Tor Abbey Sands, especially at the east end.

Ampharetidæ.

MELINNA ADRIATICA, Marenzeller. *Sitzb. d. k. Akad. Wiss. zu Wien*, LXIX, p. 472.

Two at extreme low water at Livermead amongst Zostera roots.

Maldanidæ.

CLYMENE ŒRSTEDII (?), Clpd. *De St. Joseph, Ann. Sci. Nat. Zool.*, XVII, 1894, p. 137.

On the east side of Tor Abbey Sands; not common.

LEIOCHONE CLYPEATA, de St. Joseph. *Ann. Sci. Nat. Zool.*, XVII, 1894, p. 139.

Numerous at extreme low water in the centre of Tor Abbey Sands.

Capitellidæ.

NOTOMASTUS LATERICEUS, Sars. *De St. Joseph, Ann. Sci. Nat.*, XVII, 1894, p. 117.

Under stones, Corbyn's Head and Livermead.

Opheliidæ.

POLYOPTHALMUS PICTUS, Duj. *De St. Joseph, Ann. Sci. Nat. Zool.*, V, 1898, p. 385.

Common amongst Corallines, etc., in rock pools.

Arenicolidæ.

ARENICOLA MARINA, L. *Gamble, Quart. Journ. Micro. Sci.*, XLIII, p. 419.

Common on Tor Abbey Sands.

ARENICOLA ECAUDATA, Johnst. *Gamble, Quart. Journ. Micro. Sci.*, XLIII, p. 419.

This species seems to be very different in its habits to *A. marina*; instead of burrowing in soft mud and sand it lies under stones in gravel at Hope's Nose and Babbacombe beach.

Chlorhœmidæ.

SIPHONOSTOMA AFFINIS, M. Sars. *De St. Joseph, Ann. Sci. Nat. Zool.*, XVII, 1894, p. 96.

Under stones at Corbyn's Head.

Sabellidæ.

The accompanying key to the Sabellids of the English Channel is founded on the table given by Baron de St. Joseph in "Les Annélides

Polychètes des Côtes de Dinard," *Ann. Sci. Nat. Zool.*, XVII, 1894, p. 248.

SABELLA PAVONINA, Sav. *De St. Joseph, Ann. Sci. Nat. Zool.*, XVII, 1894, p. 267.

I was somewhat surprised to find several examples of this large worm in the inner harbour at Torquay only a few yards from the "Strand." They were living in mud and gravel which could hardly be called clean.

POTAMILLA RENIFORMIS, O. F. Müller. *Soulier, Revision des Annélides de la region de Cette*, p. 120, Fig. 4.

This species is found on the sides of the cave under the men's bathing-place at Petit Tor. This is the cave mentioned by Gosse in the *British Sea Anemones and Corals*, where he found the sea anemones *Halcampa microps* and *Edwardsia carnea*.

POTAMILLA TORELLI, Mgr. *De St. Joseph, Ann. Sci. Nat. Zool.*, XVII, 1894, p. 296.

Common in the small rock pools in the limestone rocks between Oddicombe and Babbacombe beaches.

FABRICIA SABELLA, Ehr. *De St. Joseph, Ann. Sci. Nat. Zool.*, XVII, 1894, p. 319.

A little Sabellid which appears to be referable to this species is very common in the little pools in the rocks at Babbacombe, in company with the last species, *Polydora* and *Dodecaceria*. It lives in small holes in the rocks, with a tube of mud projecting a little from the opening.

ORIA ARMANDI, Clpd. *Soulier, Revision des Annélides de la region de Cette*, 1902, p. 114, Fig. 2.

One specimen from Babbacombe rock pools. As de St. Joseph remarks, the eyes in this species quickly disappear, while in *F. sabella* they are persistent even in Balsam preparations. I have also obtained this species at Newquay, Cornwall.

JASMANEIRA ELEGANS, de St. Joseph. *Ann. Sci. Nat. Zool.*, XVII, 1894, p. 316.

Found occasionally crawling up the sides of glass vessels containing roots of Laminaria and pieces of limestone rock. It was first recorded as a British species by Miss Newbiggin in 1900.

AMPHIGLENA MEDITERRANEA, Clpd. *Soulier, Revision des Annélides de la region de Cette*, p. 109, Fig. 1.

Found under the same conditions as the last species.

Serpulidæ.

In preparing the key to the Serpulids of the English Channel the table given by Baron de St. Joseph in the *Annales des Sciences naturelles Zool.*, XVII, 1894, p. 259, and, for the genus Spirorbis, the papers by Caullery and Mesnil, "Études sur la morphologie, etc., chez les Spirorbes," have been consulted.

SERPULA VERMICULARIS, Lin. *De St. Joseph, Ann. Sci. Nat. Zool.*, XVII, 1894, p. 328.

On shells thrown up on the shore at Tor Abbey Sands.

POMATOCEROS TRIQUETER, Lin. *De St. Joseph, Ann. Sci. Nat. Zool.*, XVII, 1894, p. 353.

Extremely common on stones.

HYDROIDES NORVEGICA, Zunn. *De St. Joseph, Ann. Sci. Nat. Zool.*, V, 1898, p. 440.

On a stone at Petit Tor beach; numerous on buoys in Torquay Harbour.

SPIRORBIS BOREALIS, Daudin. *Caullery et Mesnil, Bull. Scien. de la France et de la Belgique*, XXX, 1897, p. 211.

Very common on Fucus.

SPIRORBIS SPIRILLUM, Lin. = *lucidus*, Mont. *Caullery et Mesnil, Bull. Scien. de la France et de la Belgique*, XXX, 1897, p. 198.

On *Sertularia abietina* thrown up on the shore.

Hermellidæ.

SABELLARIA ALVEOLATA, Linn. *Cambridge Nat. Hist.*, Vol. II, Figs. 131 and 135.

Very common all along the Torquay coast.

KEY TO THE GENERA OF THE EUNICIDÆ FOUND ON THE FRENCH AND ENGLISH COASTS OF THE CHANNEL.

Five prostomial tentacles.	Two frontal palps simulating stunted tentacles arising from the anterior border of the prostomium.	Two tentacular cirri on the second segment	Onuphis, Aud. and Edw.
		No tentacular cirri on the second segment	Hyalinœcia, Mgr.
	No frontal palps as above.	Two tentacular cirri on the second segment	Eunice, Cuv.
		No tentacular cirri on the second segment	Marphysa, Qfg.
Four tentacles.	Two dorsal and two ventral tentacles		Ophryotrocha, Clpd.
Three tentacles.	Branchiæ present, consisting of one filament		Amphiro, Kbg.
	No branchiæ		Lysidice, Sav.
Two tentacles.	Palps long. Denticles of upper jaw numerous, more than thirty. Feet with two branches		Staurocephalus, Gr.
One tentacle.	No branchiæ		Nematonereis, Schmarda.
No tentacles.	Compound bristles with toothed terminal pieces or simple hooked crotchets or both in some at least of the feet, in addition to simple winged capillary bristles		Lumbriconereis, Blv.
	Simple winged capillary bristles only.	Minute form parasitic in Syllids	Labrorostratus, de St. Joseph.
		Mandibles small or absent, the three anterior pairs of denticles consisting of simple hooks	Drilonereis, Clpd.
		Mandibles massive, the three anterior pairs of denticles consisting of toothed plates, or of one pair of hooks and two pairs of toothed plates	Arabella, Gr.

KEY TO THE SPECIES OF EUNICIDÆ FOUND ON THE FRENCH AND ENGLISH COASTS OF THE CHANNEL.

Genus ONUPHIS.

Tentacular cirri arise from the anterior border of the second segment. Tube flattened, made of small stones and shells	*O. conchylega*, M. Sars.

Genus HYALINŒCIÆ.

Branchiæ commence 23–26th foot. Tube translucent, quill-like. L., 100 mm.	*H. tubicola*, O. F. Müller.
Branchiæ commence on 4th segment. Brown bands on dorsum permanent in spirit. Tube of small shells and stones. L., 60 mm.	*H. Grubii*, Marenz.

Genus EUNICE.

Body with numerous olive brown bands and spots, speckled with white. Maximum number of filaments of branchiæ, sixteen. L., 120 mm.	*E. fasciata*, Risso = *Harassi*, Aud. and Edw.
Three reddish bands on the back of each segment. Maximum number of filaments of branchiæ, five, on the 30th foot. L., 60 mm.	*E. vittata*, Delle Chiaje = *limosa*, Ehlers.

Genus MARPHYSA.

Branchiæ commence on 21st foot, filaments of branchiæ, arising from nearly the same spot, forming a tuft. Maximum number of filaments, eight. L., 400 to 600 mm.	*M. sanguinea*, Montagu.
Branchiæ commence on 14th foot, forming a comb. Maximum number of filaments, about twenty-five. L., 160 mm.	*M. Bellii*, Aud. and Edw.
Branchiæ consisting of a single filament. L., 15 mm.	*M.* fallax*, Mar. and Bohr.

Genus OPHRYOTROCHA.

Small form. Segments with a girdle of cilia. L., 4 mm.	*O. puerilis*, Clpd. and Meczn.

Genus AMPHIRO.

Four eyes. Branchiæ commence on 16th segment. L., 9 mm.	*A.* Johnstoni*, Lang.

Genus LYSIDICE.

Head broad, flattened, with a median notch ; tentacles short. Red spotted with white, the 4th segment entirely white. L., 100 mm.	*L. ninetta*, Aud. and Edw.

KEY TO SPECIES OF EUNICIDÆ—*continued.*

Genus Staurocephalus.

Palps earlike, not jointed.	Back with brilliant red bands. L, 20 mm.	*S. rubrovittatus*, Gr.
Palps and tentacles jointed.	Body colourless, covered with small glands, 4 eyes. L., 18 mm. . .	*S. ciliatus*, Kef.
Palps and tentacles jointed.	Body colourless, no small glands, 2 eyes. L., 15 mm.	*S. pallidus*, Lang.

Genus Nematonereis.

Body greyish, very narrow, 1 mm. 2 eyes with short subulate tentacle arising between them. L., 200 mm.	*N. unicornis*, Gr.

Genus Lumbriconereis.

No jointed bristles in any of the feet.	Large forms.	Simple winged capillary bristles only in the anterior segments. Spines black. L., 120 mm.	*L. fragilis*, O. F. Müller.
		Simple winged capillary bristles accompanied by winged hooked crotchets in the anterior segments. Spines yellow. L., 500 mm.	*L. impatiens*, Clpd.
	Small forms.	Three winged hooked crotchets, no capillary bristles in the posterior segments. Front edge of mandibles furnished with very small double teeth. L., 21 mm.	*L.* labrofimbriata*, de St. Joseph.
		One winged hooked crotchet and one capillary bristle in the posterior segments. Supports of the maxillæ very long and narrow. L., 14 mm.	*L.* paradoxa*, de St. Joseph.
Jointed bristles present in some of the feet.		The jointed bristles in the anterior segments with very long terminal pieces. Head conical	*L. Latreilli*, Aud. and Edw. = *Nardonis*, Gr. = *Edwardsi*, Clpd. = *tingens*, Kef.
		The jointed bristles in the anterior segments with short terminal pieces. Head conical	*L. gracilis*, Ehlers.
		Head globular. Stalk of jointed bristles short and massive	*L.* coccinea*, Ren.

Genus Drilonereis.

Upper dental apparatus with five pairs of jaws. Left maxilla with several small teeth at the base. L., 20 mm.	*D.* macrocephala*, de St. Joseph.
Upper dental apparatus with four pairs of jaws. Left maxilla not toothed at the base. L., 90 mm. .	*D.* filum*, Clpd.

Genus Arabella.

Upper dental apparatus with five pairs of jaws. Lower part of the maxillæ with numerous small teeth. L., 250 to 450 mm.	*A. iricolor*, Montagu = *Maclovia gigantea*, Gr.

* Not yet recorded from the British area.

KEY TO THE GENERA OF SPIONIDÆ FOUND ON THE FRENCH AND ENGLISH COASTS OF THE CHANNEL.

A. Fifth segment not enlarged, without special strong bristles.

Head without lateral horn-like projections.	Branchiæ on the second and a number of succeeding segments.	Branchiæ on all the bristle-bearing segments, including the first		*Spio*, Fabr.
		No dorsal winged hooks.	Anal cirri present. Dorsal lamella free from branchia	*Microspio*, Mesnil.
			Anus funnel-shaped. Dorsal lamella attached to branchia	*Nerenides*, Mesnil.
		Dorsal-winged hooks in some of the segments.	Anal cirri present. Dorsal lamina free from branchia	*Aonides*, Clpd. (*sensu* Mesnil).
			Anus funnel-shaped. Dorsal lamina more or less attached to branchia	*Nerine*, Johnston.
	Branchiæ present or absent from second segment. Absent from several of the following segments. Present on the twelfth to thirteenth segment and following segments			*Pygospio*, Clpd.
Head with lateral horn-like projections.	No branchiæ. Two of the ventral bristles of the first foot much thicker than the others			*Spiophanes*, Grube.
	Branchiæ on all the bristle-bearing segments			*Scolelepis*, Blv. (*sensu* Malmgren).

B. Fifth segment enlarged, furnished with special strong bristles.

Branchiæ commence on the second segment	*Boccardia*, Carrazzi.
No branchiæ before the sixth segment	*Polydora*, Bosc.

KEY TO THE SPECIES OF SPIONIDÆ FOUND ON THE FRENCH AND ENGLISH COASTS OF THE CHANNEL.

Genus Spio.

Prostomium rounded in front, usually four eyes, winged crotchets with two points commence at thirteenth to fifteenth segment. Anal cirri, four. L., 30 mm. . . . . *S. martinensis*, Mesnil. =*filicornis*, Fabr. (?).

Genus Microspio.

Prostomium terminated by two rounded bosses, eyes four, anal cirri four. Winged crotchets commence ventrally on eighth foot. L., 10 mm. . . . . *M. atlantica*, Langh. (?).

Genus Nerenides.

Prostomium very pointed, four eyes, lamella as long as and joined to branchia. Winged crotchets with two points. L., 70 to 100 mm. . . . . **N. longirostris*, de St. Joseph.

Genus Aonides.

Prostomium pointed, four eyes in a line. About twenty pairs of branchiæ. Eight anal cirri. Winged crotchets with two points. L., 80 mm. . . . . *A. oxycephala*, Sars.

Genus Nerine.

Winged crotchets with one point.
- Dorsal lamella longer than and completely attached to the branchia in the first fifty segments ending in an obtuse point. L., 160 mm. . . . . *N. foliosa*, Sars.
- Dorsal lamella attached for about three-quarters of the length of the branchia, then diverging and ending in a sharp point. L., 60 mm. . . . . **N. Bonnieri*, Mesnil.

Winged crotchets with two points. Head terminating in a sharp point; colour green. L. 70 mm. . . *N. cirratulus*, Delle Chiaje.

Genus Pygospio.

Branchiæ on second bristled segment present. Stalks of winged crotchets without a distinct swelling. L., 10 mm. . . . . *P. seticornis* (Œrsted *nec* Fabr.).

No branchiæ on second segment. Stalks with a distinct swelling. L., 10 mm. . . . . *P. elegans*, Clpd., Mesnil.

Genus Scolelepis.

Winged crotchets with three points. L., 180 mm. . . . . *S. vulgaris*, Johnston, McIntosh.

Winged crotchets with two points. Head and back marked with black pigment. L., 75 mm. . . *S. fuliginosa*, Clpd.

* Not yet recorded from the British area.

KEY TO THE SPECIES OF THE SPIONIDÆ—*continued.*

Genus Spiophanes, Gr.

Tube dweller. Number of winged crotchets, eleven to fourteen. Anal cirri, two. L., 50 mm. . .	*S. bombyx*, Clpd.

Genus Polydora.

Abnormal bristles of fifth segment with a comb-like fibrous crest. Branchiæ commence on seventh bristle-bearing segment. Dorsal bristles present on first segment. L., 8 mm.		**P. Caulleryi*, Mesnil.
Abnormal bristles ending in a single hook without lateral teeth or spines. Branchiæ commence on the eighth bristle-bearing segment. Number of winged crotchets usually three or four	Posterior segments with two or three needle-like spines. L., 20 mm.	*P. cœca*, Œrsted.
	Posterior segments without needle-like spines but with bundles of very fine bristles tapered at each end. L., 20 to 50 mm.	*P. flava*, Clpd. = *pusilla*, de St. Joseph.
Abnormal bristles with lateral teeth or projections in addition to main hook. — Stem of winged crotchets with a bulge. Branchiæ commence on seventh segment. Number of winged crotchets usually eight . . .	Posterior segments with large dorsal bristles terminating in a strong hook. L., 50 mm.	*P. hoplura*, Clpd.
	Posterior segments without strong hooks. Extremities with more or less black pigment. L., 20 mm. . . .	*P. ciliata*, Johnst.
Stem of winged crotchets without a bulge. Number of crotchets from three to five .	Branchiæ commence on the eighth bristle-bearing segment. Abnormal bristles ending in a truncated tip with nearly equal teeth, sometimes with a brush of fibres. L., 10 to 25 mm.	*P. quadrilobata*, Jac.
	Branchiæ commence on tenth segment. Abnormal bristles with a small tooth on concave side. L., 8 mm. . .	**P. Giardi*, Mesnil.
	Branchiæ commence on seventh segment. Abnormal bristles with a kind of hood on convex side, wings of hood forming two unequal points on the concave side. L., 5 mm. .	*P. armata*, Lang.

Genus Boccardia.

Fifth segment with two different kinds of large bristles. L., 15 mm. . . .	**B. polybranchia*, Hasw.

* Not yet recorded from the British area.

KEY TO THE GENERA AND SPECIES OF THE CIRRATULIDÆ FOUND ON THE FRENCH AND ENGLISH COASTS OF THE CHANNEL.

- **A transverse row of tentacular filaments (not distinctly thicker than the gill filaments) across one of the anterior segments.**
  - Tentacular filaments appear on the same segment as the first lateral gills
    - No eyes. All the bristles capillary. L., 26 to 40 mm. — **Cirratulus filiformis*, Kef.
    - Eyes present. Two kinds of bristles, capillary and crotchets. L., 125 mm. — *Cirratulus cirratus*, Müller.
  - Lateral gills appear on one or more of the segments in front of the segment which carries the tentacular filaments — No eyes. L., 200 mm. — *Audouinia tentaculata*, Aud.
- **A pair of tentacular filaments (distinctly thicker than the gill filaments) present.**
  - Gill filaments (few, four to eight pairs). Tentacular filaments inserted below gill filaments. L., 25 mm. — *Dodecaceria concharum*, Œrsted.
  - More than eight pairs of gill filaments. Tentacular filaments inserted above gill filaments.
    - Crotchets and eyes present.
      - Crotchets truncate at apex. Capillary bristles present in all the neuropods. L., 16 mm. — *Heterocirrus caput esocis*, de St. Joseph.
      - Crotchets bifid. No capillary bristles in neuropods after the third segment — *Heterocirrus viridis*, Lang = *flavoviridis*, de St. Joseph.
    - Crotchets and eyes absent. Bristles all capillary — **Tharynx* (*Heterocirrus*) *Marioni*, de St. Joseph.

* Not yet recorded from the British area.

KEY TO THE GENERA AND SPECIES OF THE MALDANIDÆ ON THE FRENCH AND ENGLISH COASTS OF THE CHANNEL.

Funnel of anal segment with numerous teeth or cirri.	No small papillæ on posterior segments . .	Back of head with several indentations. Teeth of anal funnel equal or unequal. The three segments preceding the anal segment without bristles. Breadth, 8 mm. L., 150 mm.	*Clymene* (*Euclymene*) *lumbricoides*, Qfg.
		Back of head not indented. Teeth of anal funnel very unequal, sometimes with one long ventral cirrus. The two segments preceding the anal segment without bristles. Breadth, 1 mm. L., 80 mm. . . .	*Clymene* (*Euclymene*) *Œrstedi*, Clpd.
	Papillæ arranged in two longitudinal rows in posterior segments . .	Anal funnel with teeth of equal length. Crotchets of first three bristle-bearing segments ending with three little teeth and one large tooth directed upwards	**Johnstonia clymenoides*, Qfg.
Anal segment without teeth or cirri.		Anal segment cup-shaped, with a central conical anus. Twenty-five to twenty-nine bristle-bearing segments. Breadth, 3 mm. L., 200 mm.	*Leiochone clypeata*, de St. Joseph.
		Anal segment with a concave leaf-like appendage, on the surface of which the anus opens. Twenty-two bristle-bearing segments. Breadth, 3 mm. L., 130 mm.	**Petaloproctus terricola*, Qfg.

* Not yet recorded from the British area.

KEY TO THE SPECIES OF TEREBELLIDÆ FOUND ON THE FRENCH AND ENGLISH COASTS OF THE CHANNEL.

- **Capillary bristles with very fine saw-like teeth near the end. Three or two pairs of gills.**
  - Capillary bristles in the thoracic region only. Uncini with six rows of transverse teeth which are numerous in the upper rows.
    - Each gill consists of a tuft of unbranched filaments. Three pairs of gills. Capillary bristles in seventeen segments. Tentacles with brown marks. L., 80 mm. . . . . → *Amphitrite cirrata*, O. F. Müller.
    - Each gill consists of a main stem with numerous branches.
      - Capillary bristles in twenty-four segments. Three pairs of gills. Tentacles white. L., 200 mm. . . . . → *Amphitrite Johnstoni*, Mgr.
      - Capillary bristles in seventeen segments. Three pairs of gills. Tentacles orange. L., 230 mm. . . . . → *Amphitrite Edwardsi*, Qfg.
      - Capillary bristles in seventeen to twenty segments. Two pairs of gills. Tentacles white, body very red in front. Uncini in front part of abdomen in double rows. Eyes present. L., 100 mm. . . . → *Amphitrite gracilis*, Grube.
  - Capillary bristles throughout the body. Uncini with three or four rows of three to six teeth. Tentacles red. Eyes present. L., 55 mm. . . . . → *Terebella* (*Lepræa*) *lapidaria*, L.
- **Capillary bristles with smooth tips in seventeen segments. Three pairs of branched gills.**
  - Uncini with two transverse rows of one, two, or three teeth.
    - The eighth to seventeenth bristle-bearing segments with a double row of uncini interlocking half-way. Body red or brown, spotted with white. Tentacles white or reddish. Eyes present. L., 200 mm. . . . . → *Polymnia nebulosa*, Mont.
    - The eighth to seventeenth bristle-bearing segments with a single row of uncini. Body red or brown. Tentacles bright orange. Eyes present. L., 50 mm. . . . . → *Polymnia nesidensis*, Delle Chiaje.
    - The eighth to seventeenth segments with a double row of uncini placed back to back. Lower thoracic shields intensely red. Tube fringed at the ends with strings of sand. L., 100 to 270 mm. . . . . → *Lanice conchilega*, Pallas.
  - Uncini without transverse rows of teeth, comb-like, with four to six teeth; the terminal divisions of the gills very fine and numerous . . . . . → *Loimia medusa*, Sav.

KEY TO THE SPECIES OF TEREBELLIDÆ—*continued.*

Capillary bristles with smooth tips in fifteen to seventeen segments; two (rarely three) pairs of branched gills.	Uncini with two transverse rows, with three to five teeth. The eighth to seventeenth segment with a single row of uncini. Body red, spotted with white. Tentacles dark red, short. Eyes present. L., 50 mm. . . .	*Nicolea venustula*, Mont. =*zostericola*, Oerst. (?).
	Uncini with three to five transverse rows of three to twelve teeth, and a very long projection at the posterior angle of the base. Gills brush-like, with spirally arranged branches. Body and tentacles reddish. L., 75 mm. .	*Pista cristata*, Müller.
Capillary bristles with smooth tips in sixteen segments; one pair of branched gills.	Uncini with three transverse rows of three to six teeth. Body red, spotted with brown. Tentacles red, sometimes spotted with brown. L., 60 mm.	*Scione maculata*, Dalzell.
Capillary bristles with smooth tips in numerous (over thirty) segments. Uncini with two transverse rows of two to three teeth. Gills, consisting of simple filaments, arranged in rows.	Body orange, without any pattern on the skin. Tentacles spotted with red. Gills on two segments. L., 120 mm.	*Thelepus cincinnatus*, Fabr.
	Body marked in a pattern with white lines. Gills on three segments. L., 160	*Thelepus setosus*, Qfg.
Capillary bristles with smooth tips in eighteen segments. One gill, consisting of four comb-like plates arising from a single peduncle.	Crotchets with a long stalk in front part of body. Uncini, in posterior part, comb-like. L., 60 mm.	*Terebellides Stroemi*, Sars.

KEY TO THE SPECIES OF TEREBELLIDÆ—*continued.*

Capillary bristles with smooth tips in fifteen segments. Gills, three pairs, each gill consisting of a single filament.		Crotchets with a long stalk in front part of body. Uncini in posterior part. Body orange. Tentacles violet. L., 30 mm.	*Trichobranchus glacialis*, Mgr.
No gills and no blood-vessels.	Capillary bristles smooth. None of them winged.	Number of segments with capillary bristles about twenty-eight to sixty. Uncini appear at ninth bristle-bearing segment. Six pairs of nephridia. L., 30 to 100 mm.	*Polycirrus caliendrum*, Clpd.
	Body and tentacles orange.	Number of segments with capillary bristles about twenty-eight to forty. Uncini appear at seventh to ninth bristle-bearing segment. Three pairs of nephridia. L., 80 to 100 mm.	*Polycirrus aurantiacus*, Grube.
	Capillary bristles smooth. Some of them slightly winged.	Conspicuous red blood. No uncini in the first twelve bristle-bearing segments. Six pairs of nephridia. L., 16 mm.	**Polycirrus hæmatodes, Clpd.*
		Entirely colourless. Uncini appear at the seventh to tenth bristle-bearing segment. Three pairs of nephridia. L., 16 mm. . . .	**Polycirrus tenuisetis*, Langhs.
	Capillary bristles denticulated.	Colourless, or very slightly tinged with yellow. Number of segments, with capillary bristles, about fifteen	**Polycirrus denticulatus*, de St. Joseph.

* Not yet recorded from the British area.

KEY TO THE GENERA AND SPECIES OF THE SABELLIDÆ FOUND ON THE FRENCH AND ENGLISH COASTS OF THE CHANNEL.

A. Ventral bristles of the thorax of two different kinds, namely simple winged capillary bristles and uncini.

Peristomium produced to form a collar.	Gill filaments arising from a spiral base.	The two parts of the branchial crown unequal. Dorsal bristles of the thorax of one kind. L., 260 mm.			*Spirographis Spallanzii*, Viv.
		The two parts of the branchial crown equal. Dorsal bristles of the thorax of two kinds. L., 130 mm.			*Bispira voluticornis*, Mont.
	Gill filaments not forming a spiral.	No eyes near the end of the gill filaments.	Dorsal bristles of the thorax of one kind. No eyes.	Tube of mud. Gill filaments long, 40 mm. L., 200 mm. . . .	*Sabella pavonina*, Sav.
			Dorsal bristles of the thorax of two kinds, namely narrow winged bristles and shorter spathulate bristles.	Eyes on the lower part of some of the gill filaments. L., 75 mm. .	*Potamella reniformis*, Müller.
				No eyes on gill filaments. Two eyes on peristomium, and six or eight on anal segment . No otocysts. L., 20 mm.	*Potamilla Torelli*, Mgr.
				No eyes on gill filaments. Two eyes on peristomium, and six or eight on anal segment . Two otocysts. L., 20 mm.	*Potamilla incerta*, Lang.
		Eyes near the end of gill filaments. Tube of sand, small stones, and fragments of shells. L., 100 mm.			*Branchiomma vesiculosum*, Mont.
Peristomium without a collar.	Eyes in peristomium and anal segment. Two otocysts in first bristled segment. Gill filaments five on each side. Number of segments about forty. L., 8 mm. . .				*Amphiglena mediterranea*, Clpd.

KEY TO THE GENERA AND SPECIES OF THE SABELLIDÆ—*continued.*

B. Ventral bristles of the thorax of one kind, namely, either uncini or crotchets with a long stalk.

- **Ventral bristles of thorax uncini** — Each gill filament carries a number of eyes. Two clublike dorsal appendages arise from near each pair of eyes. L., 30 mm. . . . . → *Dasychone bombyx*, Dalyell.
- **Ventral bristles of thorax crotchets with a long stalk.**
  - Gill filaments not connected by a fine membrane.
    - Dorsal bristles of thorax of one kind, namely, capillary bristles with long tapering ends
      - Uncini in abdomen. Secondary branches of gills of unequal length reaching the same level.
        - Crotchets in abdomen with a long stalk. Gill filaments five on each side. No long secondary branches to the filaments. L., 6 mm. → *Haplobranchus æstuarinus*, Bourne.
        - Gill filaments three or four on each side. Peristomial collar present. Eyes in anterior and anal segments. Bristle-bearing segments in abdomen, six to seven. L., 6 mm. → *Oria Armandi*, Clpd.
        - Gill filaments three on each side. No peristomial collar. Eyes in anterior and anal segments. Bristle-bearing segments in abdomen, three. L., 3 mm. . . . . → *Fabricia sabella*, Ehr.
    - Dorsal bristles of thorax of two kinds, namely, bristles with long tapering ends, and others with short spathulate ends . . → Gill filaments eight to twelve on each side. Secondary branches short, of equal length. Two eyes in anterior segments. Number of segments, thirty-five to forty. L., 15 mm. → *Jasmaneira elegans*, de St. Joseph.
  - Gill filaments connected by a fine membrane reaching nearly to their tips.
    - No eyes on peristomium. Gill filaments not enlarged near the ends, mud-dweller, tube gelatinous. Large worm. L., 220 mm. . . → *Myxicola infundibulum*, Renier.
    - Eyes present on peristomium. Gill filaments enlarged near their tips; inhabits oyster shells . . . . . → *Myxicola Dinardensis*, de St. Joseph.

KEY TO THE GENERA AND SPECIES OF THE SERPULIDÆ OF THE FRENCH AND ENGLISH COASTS OF THE CHANNEL.

Uncini with many teeth, the last tooth longer, broader, and blunter than the others. Tube spiral.

Operculum on the right of the median dorsal line.	No brood pouch in operculum.	Tube semi-transparent. Common on *Sertularia abietina*. Ten to sixteen bristle-bearing segments in the abdomen	*Spirorbis spirillum*, L. = *lucidus*, Mont.
		Tube opaque on lobsters and crabs. Sixteen to twenty bristle-bearing segments in the abdomen	*Spirorbis sinistrorsus*, Mont. = *armoricanus*, de St. Joseph.
	Brood pouch in operculum.	Operculum resembling a barrel. No sickle-shaped bristles in the third bristle-bearing segment	*Spirorbis corrugatus*, Mont.
		Operculum smooth. Sickle-shaped bristles in the third bristle-bearing segment . Hepatic pigment violet .	**Spirorbis Pagenstecheri*, Qfg.
		Hepatic pigment red .	**Spirorbis pusillus*, de St. Joseph.
Operculum on the left of the median dorsal line.	No brood pouch in operculum. Operculum not strongly convex at end.	Four bristle-bearing segments in the thorax	**Spirorbis Malardi*, Caullery and Mesnil.
		Three bristle-bearing segments in the thorax. No teeth or excrescence on operculum .	*Spirorbis borealis*, Daudin.
		Teeth or excrescences present on operculum	*Spirorbis cornu arietis*, Phil.
	Brood pouch in operculum. Operculum strongly convex at end.	Top of operculum with serrated edges	**Spirorbis militaris*, Clpd.
		No serrated ridges, a smooth rim round the operculum . . .	*Spirorbis granulatus*, L. *nec* Lang.

* Not yet recorded from the British area.

KEY TO THE GENERA AND SPECIES OF THE SERPULIDÆ—*continued.*

Uncini deeply hollowed out at back with very numerous and very small teeth, terminated by a stout spine. Tube not spiral	No operculum. No sickle-shaped bristles present in the thorax. L, without gills, 20 to 45 mm.	*Protula tubularia*, Mont.
	Operculum globular, transparent. Some sickle-shaped bristles with winged stalks present in thorax. L., 8 to 15 mm.	*Apomatus similis*, Mar. and Bohr.
Uncini with about fourteen teeth, last tooth broader, blunter, and larger than the others. Tubes very slender, intertwining	Two opercula at the end of stems with secondary branches. Ends of gills not enlarged. L., 5 mm.	*Filograna implexa*, Oken.
	No operculum. Ends of gills club-shaped and hollowed out. L., 6 mm.	*Salmacina Dysteri*, Huxley.
Uncini with eight or nine teeth, the last tooth hollowed out underneath like a gouge	Tube adherent usually with three ridges, the centre ridge projecting in a sharp tooth over the orifice. Operculum with two projections on the stem, flat at the top or conical, with or without one to three spines	*Pomatoceros triqueter*, L.
Uncini with five to seven teeth, the last tooth stronger than the others, but pointed like them	Operculum funnel-shaped, margin crenate. Gills about thirty on each side. Number of teeth in uncini of thorax five. L., 20 to 50 mm.	*Serpula vermicularis*, L.
	Operculum funnel-shaped with a circle of spines, with thorns on their spines arising from the centre. Number of teeth in uncini of thorax seven. Gills about fifteen to seventeen on each side. L., 20 mm.	*Hydroides norwegica*, Gunn.

Some Notes on the Genus Cumanotus.

By

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In 1908 Sir Charles Eliot published in the *Journ. Mar. Biol. Assoc.*, Vol. VIII, No. 3, a paper "On the Genus Cumanotus"; in that paper he showed that *Coryphella beaumonti*, discovered and named by him in 1906,* was to be referred to the above genus, which had been first established by myself in 1907 from a study of the Norwegian *C. laticeps*, described at the same time as a new species.†

Sir Charles Eliot also called attention to the striking resemblance of the two forms, and remarked that their identity was not improbable, though he assumed that there might be some differences in the denticulation of the jaws and the lateral teeth of the radula.

Through the kindness of Sir Charles Eliot and of Mr. De Morgan, Acting-Director of the Plymouth Laboratory, I have procured two specimens of *C. beaumonti* for comparison with the Norwegian *C. laticeps*, with a view to determine the distinguishing characters of the two forms.

In exterior appearance they are quite alike, and I have found no difference of a specific value in their habitus. The proportions of the body are nearly the same, as is evident from the following measurements (in *mm.*):—

	C. beaumonti.	*C. laticeps.*
Length of body	14	13
Breadth „ „	5·5	5·3
„ „ head	4·2	4
Length „ rhinophores . . .	4·3	4·3
„ „ a few papillae in the 5th row	3·7	4

The height of the body was somewhat greater in *C. beaumonti* than in *C. laticeps*, which probably depends on their varying states of preservation.

* "Notes on Some British Nudibranchs," l.c., Vol. VII, No. 3, 1906.

† "Northern and Arctic Invertebrates, III, Opisthobranchia," *K. Sv. Vet.-Akad. Handl.*, Bd. 41, No. 4, 1907.

In both forms the soft parts fully agree in shape. On the head there are situated two small conical tentacles of the same size and position in both, connected by a low cutaneous fold. The rhinophores are close to each other, and are united at the base. The foot is extended, forming two pointed angles at the frontal sides, and is expanded laterally and posteriorly to a cutaneous border.

The arrangement of the dorsal papillae is also of the same character in both. They are set in about 12 transverse rows, the 3 foremost ones being placed in front of the rhinophores. The rows are in two groups, a pre-anal and a post-anal one, the first embracing 6 rows; the anus is situated dorso-laterally, immediately in front of the 7th row.

As to the number of papillae, this has been easy to determine in *C. beaumonti*, for all the papillae there were intact; in *C. laticeps*, on the other hand, they had fallen off to a great extent, and the statements here given are therefore deduced from the markings. One specimen of each form was examined.

The number of papillae was as follows:—

	C. beaumonti.	*C. laticeps.*
In the 1st row	2	3
„ 2nd „	4	6
„ 3rd „	7	8
„ 6th „	9	9
„ 7th „	8	6
„ 8th „	6	6
„ 9th „	4	4
„ 10th „	4	4

The unimportant difference which was present in the two specimens examined may be quite individual, and any attempt at deducing specific characters is therefore excluded.

Anatomically the papillae are of the same structure, for in both forms they are furnished, at the tips, with a saccus cnidophorus, which is connected with the liver process by means of a narrow, winding canal.

Of all the characters distinctive of the genus Cumanotus, the shape of the female copulatory organ is the most peculiar. To the sides of the bursa copulatrix there are attached two circular pads with a papillated margin, and these papillae are of the same number, 12, in both forms. Such difference in dimensions as was observable in homologous parts is to be explained by their different stages of maturity.

Thus exteriorly the soft parts show an entire conformity, and from them consequently no specific characters are obtainable. There only

remains the inner anatomy to be dealt with; but here I considered it unnecessary to compare the whole organization of the two forms in detail, and I have accordingly only examined the organs that are primarily of specific value, viz. the radula and the mandibulae.

The rows of the radula in *C. beaumonti* vary in number from 16 to 24, according to Eliot; in *C. laticeps* I have found about 17. The teeth are furnished in both forms with long, slightly curved cusps. The form and the denticulation of the median tooth do not present any differences. The lateral teeth are denticulated only on the inner sides. In the latest formed part of the radula, I have found the number of denticles of the laterals circa 25 in *C. beaumonti* and 18 in *C. laticeps*; in the older part above 25 and about 22 respectively. This slight difference is of no consequence, especially as the form and curvation of the lateral teeth are the same in the two specimens examined.

There remains only one more character to consider, the structure of the mandibulae, but here too I have found entire agreement. Their form and colour correspond, as do those of the whole bulbus pharyngeus too. The mandibulae are lengthened, roundly quadrangular, and denticulated in the anterior margins. In the denticulation there exists but a slight difference, the denticles seeming to be placed at somewhat greater intervals in *C. laticeps* than in the other. As to the shape of the denticles, I have found them in both forms to be somewhat irregular, uni-, bi- or tricuspidate, the more complicated ones being situated in the upper or anterior part of the jaw margin, a part which is most worn. The denticles are arranged in one row only at the margins. Two specimens of each were examined. In these mandibular characters also the forms agree wholly with one another.

It has consequently not been possible to find out any specific distinguishing points between the two forms; in all the characters they are alike. I therefore consider their identity to be proved. Nor are there any good reasons for their severance as varieties; it is hardly probable either that any would be obtainable from the characters of the living animal, though the colouring might doubtless be subject to some variation, as is usual with the Nudibranchs.

As a result of the above comparison, I consider the genus Cumanotus to consist of one species only, viz. *C. beaumonti* (Eliot, 1906), and regard my own species, *C. laticeps*, Odhner, 1907, as a synonym. *C. beaumonti* consequently has a wide distribution, being obtained in England as well as in Northern Norway. Further investigations will certainly show its occurrence also in the intermediate districts.

Kodioides borleyi, n.sp.

By

Chas. L. Walton.

In his Report on the Actiniaria of the Norwegian North-Atlantic Expedition, D. C. Danielssen erected the genus *Kodioides* to receive the remarkable form which he named *K. pedunculata*, a single specimen of which was dredged at Station 35, July 5th, 1876, in 1050 fathoms, Lat. 63° 17′ N., Long. 1° 27′ W., the bottom being Biloculina Clay. The detailed description will be found in the section "Actinida," Vol. V, pp. 77–82, Pl. VI, Figs. 3–4; XXII, 8–11; and XXIII, 1–4. The genus is there characterized as follows: "The body encrusted, piriform, with a long bare stem terminating in a pedal disc. Two series, containing a few retractile tentacles. 12 pairs of septa, of which 6 pairs perfect. Suckers on the encrusted portion of the body. No gullet-groove. Mesodermal, annular muscles. Acontia."

During a visit to Lowestoft last summer, Mr. J. O. Borley handed to me for examination 2 specimens of an Actinian obtained some time previously by the s.s. *Huxley*, Voyage XXX, Station 23, Lat. 53° 46′ N., Long. 4° 52′ E., N.N.W. of Terskelling. Depth, 20 fathoms. Bottom, mud. Conical dredge. Two specimens. A very short examination convinced me that I had before me specimens referable to the genus *Kodioides*. The species, however, is evidently distinct, as might be expected, *K. pedunculata* being obtained in the cold area, from 1050 fathoms, between the Faroë Islands and Norway; and these from 20 fathoms, and comparatively close to the Dutch coast.

It is unfortunate that no description was made while the animals were living, but Sea Anemones are difficult to deal with; indeed, it is frequently impossible to do so under bad-weather conditions and during the pressure of fishery work. Danielssen mentions the difficulties he experienced with *K. pedunculata*. Further, when I examined the specimens they were by no means in the best condition, being somewhat decayed.

Specimen (*a*).—Measurements, etc., were as follows: Animal strongly contracted:—

Total length, 48 mm. Length of body, 21 mm.; breadth, 16 mm. Length of stalk, 25 mm.; breadth, just below body, 5 mm.; lower portion, 3 mm.

Pedal disc irregular in outline, breadth, 15 mm. (on the average); thickness, 3 mm. On the body were remains of a slight coating of mucus and sand grains, and a thick coating of mud adhered to the pedal disc. The ectoderm was much decayed, but remains of what appear to have been suckers could be made out.

The body was considerably wrinkled. Stem bare and smooth. The upper surface of the pedal disc and base of stem showed numerous fine lines. There was a considerable tumid excrescence on the lower portion of the body, much decayed, and probably due to injury received in the dredge. Neither the oral disc nor tentacles were visible.

Specimen (*b*).—Total length, 32 mm. Body wrinkled and thickly coated with sand at the summit. Pedal disc irregular in outline, much smaller than in (*a*); under surface bare and much ridged and folded. This individual was only partially contracted, and showed the tentacles and portions of the oral disc. Oral disc strongly ridged, but owing to decay the number and details could not be made out; mouth also not visible for the same reason.

Tentacles (partially contracted) short, stout, and obtuse, in 3 or 4 series, about 90 in number; but they were difficult to enumerate, and in several places a number had been injured or destroyed.

Colours.—Mr. Borley informed me that when alive the body was yellowish white, longitudinally striped with dull red. Tentacles, dull red (?). Nothing remained when examined but a dull uniform pinkish shade. Horizontal and vertical section with a razor disclosed a state of decay, amidst which little could be recognized; I can only say that no siphonoglyph could be found in either (*a*) or (*b*), and that the mesenteries in (*a*) were about 24 pairs fully developed, and a similar number incomplete.

The general appearance of both specimens is very similar to Danielssen's figures and description of *K. pedunculata*, as also are the measurements; the features that cause me to consider these examples as a separate species being the marked difference in the number of mesenteries and tentacles. I here repeat the generic characteristics as given by Danielssen, so altered as to include the present species :—

The body encrusted, piriform, with a long bare stem, terminating in a pedal disc. Tentacles few or many, in two or more series, retractile. 12 or more pairs of mesenteries, half of their number perfect.

Suckers on the encrusted portion of the body. No siphonoglyph.

Mesodermal, annular muscles. Acontia.

Specific characters.—*K. pedunculata:* mesenteries, 12 pairs, tentacles 24.

K. borleyi: mesenteries and tentacles numerous.

It is to be hoped that further specimens may be obtained before long, which would enable a thorough anatomical examination to be made and the true affinities of this remarkable genus determined, as the condition of the specimens here described was not sufficiently good to permit of any observations as to acontia and many other points of interest.

In view of the peculiar form of these anemones, it may be of interest to quote Danielssen's remarks concerning *K. pedunculata:* "The weather was very stormy at the time, and the vessel had a constant heaving and rolling movement, which in a great degree obstructed the investigations. I was, however, fortunate enough to obtain the animal drawn in the live state, and to jot down some observations in regard to its exterior; but as it constantly kept itself pretty much shrunk together, although I had had it for several days in the glass vessel for observation, I could determine nothing in respect of the tentacles, only so much did I observe, viz. that the stem sometimes kept itself quite erect and at other times became bent, whilst the body expanded and contracted—movements which were participated in by the stem in such manner that when the body contracted the stem became attenuated, and when the body expanded the stem became tumified."

Marine Biological Association of the United Kingdom.

Report of the Council, 1909-10.

The Council and Officers.

Four ordinary meetings and one special meeting of the Council have been held during the year at which the average attendance has been thirteen. A Committee of the Council visited and inspected the Plymouth Laboratory.

The Council desire to express their thanks to the Councils of the Royal Society and of the Linnean Society, in whose rooms their meetings have been held.

The work in connection with the International Fishery Investigations, which the Council has been carrying out during the last seven years for His Majesty's Government, has now been taken over by the Board of Agriculture and Fisheries.

The Plymouth Laboratory.

The Laboratory, including the pumps and engines used for circulating sea-water through the tanks, has been maintained in an efficient state. An air-circulation from a pump worked by the gas engine has been rearranged in such a way that an abundant supply of pure air is now available for use in small aquaria and experimental tanks.

The Boats.

The steam trawler *Huxley*, which has been used for work in connection with the International Investigations, has been sold.

The *Oithona* was again fitted out for summer work at the Plymouth Laboratory, Captain J. Tucker, who has been in charge of the *Huxley*, being in command.

The winter collecting has been done as usual with the sailing boat *Anton Dohrn*.

The Staff.

Messrs. Borley, Todd, Wallace, Hefford, Atkinson, and Wollaston and Miss Lee have accepted service under the Board of Agriculture and Fisheries in connection with the International Investigations.

Mr. E. W. Nelson is accompanying Captain Scott to the Antarctic as biologist.

Mr. L. R. Crawshay has resigned the post of Assistant-Director owing to ill-health, and Mr. A. J. Mason-Jones has accepted an appointment as lecturer in biology at the Plymouth Technical Schools.

An arrangement has been made by which the services of Mr. D. J. Matthews will be partly retained by the Association. The Council are glad to say that Mr. Matthews, Mr. Crawshay, and Mr. Mason-Jones continue to work at the Laboratory.

The Director, Dr. E. J. Allen, has delivered a course of twenty-four lectures on Marine Biology and Fishery Investigations at the Imperial College of Science and Technology, South Kensington. During his absence Mr. W. De Morgan acted as Deputy-Director.

Occupation of Tables.

The following Naturalists have occupied tables at the Plymouth Laboratory during the year:—

Prof. Svante Arrhennius, Stockholm (Experimental Embryology).
W. De Morgan, Plymouth (Hybridization of Echinus).
G. H. Drew, B.A., Plymouth (Experimental Pathology).
J. S. Dunkerly, B.Sc., London (Protozoa).
Prof. F. W. Gamble, F.R.S., Birmingham (Colour Physiology).
E. S. Goodrich, F.R.S., Oxford (Fishes).
G. H. Grosvenor, M.A., Oxford.
Miss Harrison, Oxford (Experimental Embryology).
M. D. Hill, M.A., Eton (Alcyonium).
C. Killian, Freiburg (Laminaria).
D. G. Lillie, Antarctic Expedition.
Prof. Jacques Loeb, California (Experimental Embryology).
W. Nicoll, M.D. (The Entozoa of Marine Fishes).
Miss Poole, Oxford (Development of Tectibranchiata).
Carr Saunders, M.A., Oxford (Development of Tectibranchiata).
C. Shearer, M.A., Cambridge (Histriobdella and Dinophilus).
Geoffrey Smith, M.A., Oxford (Bacteriology of Crabs).
E. R. Speyer, Oxford (General Zoology).
R. Whitehouse, M.Sc., Birmingham (Fishes).
Miss Gerarda Wijnhoff, Utrecht (Nemertines).
W. Woodland, D.Sc., London (Gobius).
Miss Yonker, Utrecht (General Zoology).

In addition to the above, nineteen students attended the Laboratory during the Easter vacation, when Mr. G. H. Grosvenor conducted the usual course of instruction in Marine Biology.

The Library.

The thanks of the Association are due for the following books and current numbers of periodicals presented to the Library during the past year:—

Académie Imp. des Sciences de St. Pétersbourg. Bulletin.
American Museum of Natural History. Bulletin.
—— Memoirs.
American Microscopical Society. Transactions.
American Philosophical Society. Proceedings.
Armstrong College. Calendar.
Australian Museum. Memoirs.
—— Records.
—— Report.
Bergens Museum. Aarsberetning.
—— Aarbog.
—— Skrifter.
—— An Account of the Crustacea of Norway, etc. By G. O. Sars.
Bermuda Biological Station for Research. Contributions.
Bernice Pauahi Bishop Museum, Honolulu. Occasional Papers.
—— Memoirs.
Board of Agriculture and Fisheries. Annual Report of Proceedings under the Salmon and Freshwater Fisheries Acts.
—— Annual Report of Proceedings under Acts relating to Sea Fisheries.
—— Monthly Return of Sea Fisheries, England and Wales.
—— Report of Proceedings of Annual Meeting.
—— Report on the Research Work of the Board in relation to the Plaice Fisheries of the North Sea.
Boston Society of Natural History. Proceedings.
Bristol Naturalists Society. Proceedings.
British Museum. Catalogue of the Books, Manuscripts, Maps, and Drawings in the British Museum (Natural History).
—— Catalogue of the Fresh-water Fishes of Africa in the British Museum (Natural History).
Brown University. Contributions from the Biological Laboratory.
Brooklyn Institute of Arts and Sciences. Science Bulletin.
Bulletin Scientifique de la France et de la Belgique.
Bureau of British Marine Biology. Contributions.
California Academy of Sciences. Proceedings.
Cambridge Natural History. Crustacea and Arachnids.
Carnegie Institution of Washington: Scope and Organization.
—— Dept. of Marine Biology. Annual Report of the Director.
—— Inheritance in Canaries, by C. B. Davenport.
—— The Variation and Correlations of Certain Taxonomic Characters of Gryllus.
Ceylon Marine Biological Laboratory. Reports.
College of Science, Tokyo. Journal.
College voor de Zeevisscherijen. Verslag van den Staat der Nederlandsche Zeevisscherijen.
Colombo Museum. Director's Report.
—— Spolia Zeylanica.
Commissioners of Inland Fisheries, Rhode Island. Annual Report.
Conchological Society of Great Britain and Ireland. Journal of Conchology.
Conseil perm. internat. pour l'Exploration de la Mer. Bulletin Trimestriel des Résultats acquis pendant les Croisières Périodiques.

Conseil perm. internat. pour l'Exploration de la Mer. Bulletin Statistique.
—— Publications de Circonstance.
—— Rapports et Procès-Verbaux des Réunions.
Cuerpo de Ingenieros de Minas del Peru. Boletin.
Dept. of Agriculture, Buitenzorg. De Hulpmiddelen der Zeevisscherij op Java en Madoera in Gebruik.
Dept. of Agriculture, Cape of Good Hope. Marine Investigations in South Africa.
Dept. of Agriculture, etc., Ireland. Reports.
—— Scientific Investigations.
Dept. of Commerce and Labor, U.S.A. Pamphlets.
—— Report of the Commissioner of Fisheries.
Dept. of Fisheries, New South Wales. Annual Report.
Dept. of Marine and Fisheries, Canada. Annual Report.
Dept. of Trade and Customs, Melbourne. Report by Director of Fisheries on Fishing Experiments carried out by the F.I.S. *Endeavour*.
Deutscher Seefischerei-Verein. Abhandlungen.
—— Mitteilungen.
Falmouth Observatory. Meteorological and Magnetic Reports.
La Feuille des Jeunes Naturalistes.
Field Museum of Natural History. Annual Report.
—— Publications.
Finnlandische Hydrographisch-Biologische Untersuchungen.
Fisheries Society of Japan. Journal.
The Fisherman's Nautical Almanac. By O. T. Olsen.
Fishery Board of Scotland. Annual Report.
Fiskeri-Beretning, 1908–9.
Government Museum, Madras. Report.
Illinois State Laboratory of Natural History. Bulletin.
Imperial Cancer Research Fund. Third Scientific Report.
Institut de Zoologie, Montpellier. Travaux.
Instituto Oswaldo Cruz. Memorias.
R. Irish Academy. Proceedings.
Kommission zur wissenschaftlichen Untersuchung der Deutschen Meere, etc. Wissenschaftliche Meeresuntersuchungen.
Kommissionen for Havundersögelser, Copenhagen. Meddelelser, series Fiskeri Hydrografi, Plankton.
Kgl. Bayerischen Biologischen Versuchsstation in München. Berichte.
Kgl. Danske Videnskabernes Selskab. Forhandlinger.
—— Oversigt.
—— Skrifter.
Kgl. Norske Videnskabernes Selskab. Skrifter.
La Nuova Notarisia.
Laboratoire Biologique de St. Pétersbourg. Bulletin.
Laboratoire Russe de Zoologie, Villefranche-sur-Mer. Die Mollusken des Baikal-Sees ; by W. A. Lindholm.
Lancashire Sea Fisheries Laboratory. Report.
Lancashire and Western Sea Fisheries. Superintendent's Report.
Leland Stanford Junior University. Publications.
Liverpool Biological Society. Proceedings and Transactions.

Lunds Universitets Årsskrift.
Manchester Microscopical Society. Annual Report and Transactions.
Marine Biological Association of the West of Scotland. Notes from the Millport Marine Biological Station.
—— Report.
Marine Biological Laboratory, Woods Holl. Biological Bulletin.
Marine Dept., New Zealand. Report.
Mededeelingen over Visscherij.
Meteorological Office. Monthly Pilot Charts, North Atlantic and Mediterranean.
—— Monthly Pilot Charts, Indian Ocean and Red Sea.
—— Annual Report of the Committee.
—— A Barometer Manual for the Use of Seamen.
—— Codex of Resolutions adopted at International Meteorological Meetings, 1872–1907.
R. Microscopical Society. Journal.
Musée Oceanographique de Monaco. Bulletin.
Museo de La Plata. Revista.
Museo Nacional, Buenos Aires. Anales.
Museum of Comparative Zoology, Harvard College. Bulletin.
—— Memoirs.
—— Report.
The Museums Journal.
National Sea Fisheries Protection Association. Report of Proceedings at a Conference at Gt. Yarmouth of Representatives of the Fishing Industry, 1909.
Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne. Transactions.
Naturforschende Gessellschaft in Basel. Verhandlungen.
Neapel. Mitteilungen aus der Zoologischen Station.
Nederlandsche Dierkundige Vereeniging. Verslag.
—— Tijdschrift.
New York Academy of Sciences. Annals.
New York Zoological Society. Bulletin.
—— Report.
—— Report of the Director of the Aquarium.
New Zealand Institute. Transactions and Proceedings.
Norges Fiskeristyrelse. Aarsberetning vedkommende Norges Fiskerier.
North Sea Fishery Investigations. Northern Area. Third Report.
Northumberland Sea Fisheries Committee. Report on Scientific Investigations.
Oberlin College. Laboratory Bulletin.
—— The Wilson Bulletin.
—— Notes on *Dinichthys terrelli*, Newberry, with a Restoration. By E. B. Branson.
Owens College, Manchester. The Suctoria. By S. J. Hickson.
—— *Dendrosoma radians*, Ehrenberg. By S. J. Hickson and J. T. Wadsworth.
—— The entry of Zooxanthellae into the Ovum of Millepora, and some particulars concerning the Medusae. By J. Mangan.
—— Studies on Polychaete Larvae. By F. H. Gravely.
Oxford University Museum. Catalogue of Books added to the Radcliffe Library.

Physiographiske Forening. Christiania. Nyt Magazin for Naturvidenskaberne.
Plymouth Institution. Report and Transactions.
Pomona College. Journal of Entomology.
Quarterly Journal of Microscopical Science. (Presented by Sir E. Ray Lankester, K.C.B., F.R.S.)
Rijksinstituut voor het Onderzoek der Zee. Helder. Jaarboek.
—— Verhandelingen.
Royal Society of Edinburgh. Proceedings.
—— Transactions.
Royal Society of London. Philosophical Transactions.
—— Proceedings.
—— Reports to the Evolution Committee.
—— Year-Book.
Royal Society of Victoria. Proceedings.
Selskabet for de Norske Fiskeriers Fremme. Norsk Fiskeritidende.
Senckenbergische naturforschende Gesellschaft, Frankfurt. Bericht.
Smithsonian Institution. *Ammodiscoides*, a New Genus of Arenaceous Foraminifera. By J. A. Cushman.
—— The Isopod Crustacean *Acanthoniscus spiniger* Kinahan redescribed. By H. Richardson.
—— Description of a new Isopod of the Genus Jaeropsis from Patagonia. By H. Richardson.
—— Revision of the Crinoid Family Comasteridae, with Descriptions of new Genera and Species. By A. H. Clark.
—— On a Collection of Recent Crinoids from the Philippine Islands. By A. H. Clark.
—— Four New Species of the Crinoid Genus Rhizocrinus. By A. H. Clark.
—— Descriptions of Seventeen New Species of Recent Crinoids. By A. H. Clark.
—— Report on Barnacles of Peru, collected by Dr. R. E. Coker and others. By H. A. Pilsbry.
—— Isopods collected in the North-West Pacific by the U.S. Bureau of Fisheries steamer *Albatross* in 1906. By H. Richardson.
—— Fresh-water Sponges collected in the Philippines by the *Albatross* expedition. By N. Annandale.
—— The Polychaetous Annelids dredged in 1908 by Mr. Owen Bryant off the coasts of Labrador, Newfoundland, and Nova Scotia. By J. P. Moore.
—— Fresh-water Sponges in the Collection of the U.S. National Museum. By N. Annandale.
—— Description of a New Terrestrial Isopod from Guatemala. By H. Richardson.
—— The Snapping Shrimps (Alpheidæ) of the Dry Tortugas, Florida. By H. Coutière.
—— Cœlenterates from Labrador and Newfoundland. Collected by Mr. Owen Bryant, from July to October, 1908. By H. B. Bigelow.
—— Report on Isopods from Peru. Collected by Dr. R. E. Coker. By H. Richardson.
—— Freshwater Sponges, collected in the Philippines by the *Albatross* Expedition. By N. Annandale.

Smithsonian Institution. The Phylogenetic Inter-relationships of the Recent Crinoids. By A. H. Clark.
—— On a Collection of Recent Crinoids from the Philippine Islands. By A. H. Clark.
Societa di Naturalisti Napoli. Bollettino.
Societas pro Fauna et Flora Fennica. Acta.
—— Meddelanden.
Société Belge de Géologie, etc. Bulletin.
Société Centrale d'Aquiculture et de Pêche. Bulletin.
Société l'Enseignement des Pèches Maritimes. Bulletin Trimestriel.
Société d'Océanographie du Golfe de Gascogne. Rapports.
—— Organ Sensoriel Nouveau et Histologie des Muscles de la Larve de *Tetrarhynchus papillifer* n.sp. By E. Poyarkoff.
Société Suisse de Pêche et Pisciculture. Bulletin.
Société Imp. Russe de Pisciculture et de Pêche. Vyestnīk R'ibopom'shlennostī.
Société Zoologique de France. Bulletin.
—— Mémoires.
South African Museum. Annals.
—— Report.
Station de Pisciculture et d'Hydrobiologie, Toulouse. Bulletin Populaire.
Svenska Hydrografisk-Biologiska Kommissionens. Resultaten af den Internationella Hafsforskningens.
Kgl. Svenska Vetenskaps-Akademien. Arkiv för Botanik.
—— Arkiv för Zoologie.
—— Handlingar.
Torquay Natural History Society. Journal.
Transvaal Museum. Annals.
—— Report.
Tufts College. Studies.
United States Bureau of Fisheries. Bulletin.
United States National Herbarium. Contributions.
United States National Museum. Bulletin.
—— Proceedings.
—— Report.
R. Universita di Napoli, Museo Zoologico. Annuario.
University of California. Bulletin.
—— Publications. Zoology, Physiology, Botany.
University of Pennsylvania. University Bulletins.
—— Contributions from the Zoological Laboratory.
University of Toronto. Studies.
Kgl. Vetenskaps Societeten, Upsala. Nova Acta.
Worshipful Company of Fishmongers. Experiments and Observations on the Vitality of the Bacillus of Typhoid Fever and of Sewage Microbes in Oysters and other Shellfish. By E. Klein.
Zoological Society of Japan. Annotationes Zoologicae Japonenses.
Zoological Society of London. Proceedings.
—— Transactions.
Zoological Museum, Copenhagen. The Danish Ingolf-Expedition.
Zoologisches Museum, Berlin. Bericht.
—— Mitteilungen.

Anon. Boletim do Museu Goeldi (Museu Paraense) de Historia Natural e Ethnographia.

Dr. J. Hjort. Report on Norwegian Fishery and Marine Investigations.

Mrs. Mundy. The Anatomy, Habits, and Psychology of *Chironomus pusio*, Meigen (the early stages), with Notes on various other Invertebrates, chiefly Chironomidae, 1880–1908. By A. T. Mundy.

Mr. E. W. Nelson. Vertikale Wasserbewegung und quantitative Verteilung des Planktons im Meere. By A. Nathansohn.

—— The Natural History of the British Diatomaceae. By A. S. Donkin.

—— Zur Physiologie der Diatomeen. By O. Richter.

—— Sur la Division Cellulaire du *Biddulphia mobiliensis*. By H. Paragallo.

—— The Value of Pure Water. By G. C. Whipple.

—— The Water Supplies of the New York Metropolitan District, with Special Reference to their Purification. By G. C. Whipple.

—— The Cleveland Typhoid Fever Epidemic of 1903–4. By G. C. Whipple.

—— Disinfection as a means of Water Purification. By G. C. Whipple.

—— Observed Relations between Oxygen, Carbonic Acid, and Algae Growths in Weequahic Lake, Newark, New Jersey. By H. B. Baldwin and G. C. Whipple.

—— Catalogue of the Diatomaceae. By F. Habirshaw.

—— Zur Morphologie und Physiologie der *Euglena gracilis* Klebs. By H. Zumstein.

—— Recherches Expérimentales sur la Physiologie, la Morphologie, et la Pathologie des Diatomées. By P. Miquel.

—— Principles of Microscopy, being a Handbook to the Microscope. By A. E. Wright.

Dr. C. Shearer. The Morphology of *Dinophilus Conklini* n.sp. By J. A. Nelson.

—— Ulteriori Osservazioni intorno agli animali ficofagi ed alla disseminazione delle Alghe. By A. Piccone.

Mr. A. O. Walker. Sixteen "L.M.B.C. Memoirs."

To the authors of the Memoirs mentioned below the thanks of the Association are due for separate copies of their works presented to the Library:—

Arhennius, Svante. The Life of the Universe.

Ashworth, J. H. Polychaeta of the Coasts of Ireland. 1. Arenicolidae and Scalibregmidae.

Bather, F. A. Some Common Crinoid Names, and the Fixation of Nomenclature.

—— Fossil Representatives of the Lithodomous Worm *Polydora*.

—— The Type of *Cidaris*.

—— Business Devices for the Museum Curator.

—— Some Fossil Annelid Burrows.

Birge, E. A. An Unregarded Factor in Lake Temperatures.

—— On the Evidence for Temperature Seiches.

—— Notes on Cladocera. IV.

Borley, J. O. Report on the Vitality of Trawl-caught Plaice.

Browne, E. T. Coelentera v. Medusae.

Bulloch, W., and Craw, J. A. On a New Porcelain Filter.

Bulloch, W., Craw, J. A., and Atkin, E. E. On the Relative Efficacy of the Doulton, Berkefeld, and Brownlow Filters.

Cligny, A. Note sur la Production des Rogues.

Craw, J. A. On the Grain of Filters and the Growth of Bacteria through them.

Davenport, C. B. Eugenics: The Science of Human Improvement by Better Breeding.

—— The Mutation Theory in Animal Evolution.

—— The Imperfection of Dominance and some of its Consequences.

De Morgan, W. On the Species Upogebia stellata and Gebia deltura.

De Schokalsky, J. Le niveau des lacs de l'Asie centrale russe et les changements de climat.

—— Le Lac de Ladoga au point de vue termique.

— Les Travaux des Officiers Hydrographes Russes dans l'Ocean Arctique et en Sibérie.

De Schokalsky, J., and Schmidt, P. J. Aperçu sur les Explorations Scientifiques des Mers et des Eaux douces de l'Empire Russe.

De Toni, G. B. Alghe.

—— Intorno al Ceramium pallens Zanard ed alla variabilità degli Sporangii nelle Ceramiaceæ.

—— Henri van Heurck.

—— F. R. Kjellman.

—— Sullo straordinaris sviluppo nel Lago di Como di un' Alga Dannosa alla Pesca.

Downing, E. R. The Ovogenesis of *Hydra fusca*.—A Preliminary Paper.

—— The Connections of the Gonadial Blood Vessels and the Form of the Nephridia in the Arenicolidae.

Dreuw, H. Dermatohistologische Technik der Unna' schen Färbemethoden fur den Praktiken.

Drew, G. H. Some Notes on Parasitic and other Diseases of Fish.

—— The Reproduction and early Development of *Laminaria digitata* and *Laminaria saccharina*.

—— Some Points in the Physiology of Lamellibranch Blood-Corpuscles.

Ducloux, E. H. La Enseñanza de la Química en la Universidad Nacional de La Plata.

Dunkerly, J. S. Notes on the Choanoflagellate Genera *Salpingoeca* and *Polyoeca*, with Description of *Polyoeca dumosa*, sp.n.

Ehrlich, P. Über die neuesten Ergebnisse auf dem Gebiete der Trypanosomenforschung.

Eliot, C. Report on the Nudibranchs collected by Mr. James Hornell at Okhamandal in Kattiawar in 1905–6. With a Note on the Presence of Symbiotic Algae in Melibe Rangii, by J. Hornell.

—— Notes on a Collection of Nudibranchs from Ceylon.

Fowler, G. H. Biscayan Plankton collected during a Cruise of H.M.S. *Research* in 1900. The Ostracoda.

Giemsa, G. Beitrag zur Färbung der *Spirochäte pallida* (Schaudinn) in Ausstrichpräparaten.

Goodey, T. A Further Note on the Gonadial Grooves of a Medusa, *Aurelia aurita*.

Grove A. J. The Anatomy of *Siphonophora rosarum*, Walk. The "Green-Fly" Pest of the Rose-Tree.

Gurney, R. On the Fresh-water Crustacea of Algeria and Tunisia.

Halpenny, J., and Thompson, F. D. On the Relationship between the Thyroid and Parathyroids.

Hartmeyer, R. Zur Terminologie der Familien und Gattungen der Ascidien.

—— Zur Terminologie der Didemnidae.

Harvey, H. W. The Action of Poisons upon Chlamydomonas and other Vegetable Cells.

Heath, A. Notes on Marine Polyzoa collected during the year June, 1908–May, 1909.

Hodgson, T. V. Crustacea IX. Isopoda.

Hornell, J. Report to the Government of Baroda on the Marine Zoology of Okhamandal in Kattiawar.

Hornell, J., and Southwell, T. Description of a New Species of Pinnoteres from *Placuna placenta*.

Horst, R. On Fresh-water Nereids from the Botanical Garden at Buitenzorg, belonging to *Lycastis hawaiiensis*, Johnston.

—— Three overlooked Chrysopetalidae.

—— Sur la synonymie d'*Eucarunculata grubei*, Mal. et Deh., et *Pherecardia lobata*, Horst.

—— De Anneliden der Zuiderzee.

Hoyle, W. E. A Catalogue of Recent Cephalopoda. Second Supplement, 1897–1906.

—— The Luminous Organs of some Cephalopoda from the Pacific Ocean.

—— A List of the Generic Names of Dibranchiate Cephalopoda, with their type species.

—— Mollusca : Cephalopoda.

Issel, R. Ricerche intorno alla biologia ed alla morfologia dei Crostacei Decapodi I. Studi sui Paguridi.

Koefoed, E. Croisière Océanographique accomplice a bord de la Belgica dans la Mer du Grönland, 1905. Poissons.

Kofoid, C. A. On *Peridinium steini*, Jörgensen, with a note on the nomenclature of the Skeleton of the Peridinidae.

—— The Morphology of the Skeleton of *Podolampus*.

—— Mutation in Ceratium.

Lane, H. H. Some Observations on the Habits and Placentation of *Tatu novemcinctum*.

—— A Suggested Classification of Edentates.

Lee, R. M. Report on the Lowestoft Sailing Trawler Records, 1903–6.

Lillie, D. G. Notes on the Larger Cetacea.

Lo Bianco, S. Notizie biologiche riguardanti specialmente il periodo di maturità sessuale degli animali del Golfo di Napoli.

Man, J. G. de. Diagnoses of New Species of Macrurous Decapod Crustacea from the Siboga Expedition.

—— Note sur quelques espèces du Genre *Alphaeus* Fabr., appartenant au groupe Brevirostris.

—— Description of a New Species of the Genus Alpheus Fabr. from the Bay of Batavia.

Maréchal, J., and De Saedeleer, A. Le premier developpement de l'Ovocyte I chez les Rajides.

Mayer, A. G. The Research Work of the Tortugas Laboratory.

McClendon, J. F. The Ophiurans of the San Diego Region.

—— Correction of the Name of an Ophiuran.

McIntosh, W. C. The Darwinian Theory in 1867 and Now.

Meek, A. The Encephalomeres and Cranial Nerves of an Embryo of Acanthias vulgaris.

Moore, J. P. Polychaetous Annelids from Monterey Bay and San Diego, California.

—— The Polychaetous Annelids dredged by the U.S.S. *Albatross* off the coast of Southern California in 1904. I.

—— The Polychaetous Annelids dredged in 1908 by Mr. Owen Bryant off the coasts of Labrador, Newfoundland, and Nova Scotia.

Nordgaard, O. Beretning om Forsk med Utklaekning av Guldflyndre (*Pleuronectes platessa*, Lin.) ved Trondhjems Biologiske Station I Aarene 1908 og 1909.

Norman, A. M. The Polyzoa of Madeira and neighbouring Islands.

—— The Celtic Province: Its Extent and its Marine Fauna.

Norman, A. M., and Brady, G. S. The Crustacea of Northumberland and Durham.

Orton, J. H. On the Occurrence of Protandric Hermaphroditism in the Mollusc *Crepidula fornicata*.

Outes, F. F. Les scories volcaniques et les tufs éruptifs de la série Pampéenne de la République Argentine.

Patience, A. On the Genus Phoxocephalus.

Potts, F. A. Observations on the Changes in the Common Shore-crab caused by Sacculina.

—— Some Phenomena associated with Parasitism.

Punnett, R. C., and Cooper, C. F. On some Nemerteans from the Eastern Indian Ocean.

Ransom, B. H. The Taenioid Cestodes of North American Birds.

Rathbun, M. J. New Crabs from the Gulf of Siam.

Reuss, H. Ueber die Schädlichkeit der Kohlensäure für Fische.

Rignano, E. La Mémoire Biologique en Énergétique.

—— Un Botaniste Mnémoniste.

—— Das Biologische Gedächtnis in der Energetik.

Sauvageau, C. Sur le Développement échelonné de l'*Halopteris* (*Stypocaulon*, Kütz) *scoparia*, Sauv., et remarques sur le *Sphacelaria radicans*, Harv.

—— Letter ouverte a M. le Prof. J. B. De Toni au Sujet des Huitres de Marennes et de la Diatomée Bleue.

Scharff, R. F. The File-Fish in Irish Waters.

Senior, H. D. Teleosts with a Conus Arteriosus having more than one row of Valves.

—— The Conus Arteriosus in *Tarpon atlanticus* (Cuvier and Valenciennes).

—— Note on the Conus Arteriosus of Megalops Cyprinoides (Broussonet).

—— The Development of the Heart in Shad (*Alosa sapadissima*, Wilson). With a Note on the Classification of Teleostean Embryos from a Morphological standpoint.

Sexton, E. W. On the Amphipod Genus Trischizostoma.

Sexton, E. W. Notes on some Amphipoda from the North Side of the Bay of Biscay. Families Pleustidae and Eusiridae.
Shepherd, C. E. The "Asteriscus" in Fishes.
Shipley, A. E. British Association for the Advancement of Science, Winnipeg, 1909. Address to the Zoological Section.
—— *Anthrobothrium crispum.*
—— The Thread-Worms (Nematoda) of the Red Grouse (*Lagopus scoticus*).
—— The Ectoparasites of the Red Grouse (*Lagopus scoticus*).
—— The Tape-worms (Cestoda) of the Red Grouse (*Lagopus scoticus*). With a Note by Wm. Bygrave.
—— Internal Parasites of Birds allied to the Grouse.
—— On the Relation of Certain Cestode and Nematode Parasites to Bacterial Disease.
—— Charles Darwin.
Southern, R. Notes on the Genus Enchytraeus. With Description of a New Species.
—— Oligochaeta of Lambay.
—— A New Irish Gephyrean.
—— Contributions towards a Monograph of the British and Irish Oligochaeta.
Southwell, T. Report on the Anomura of Okhamandal in Kattiawar.
Townsend, C. H. Observations on Instantaneous Changes in Colour among Tropical Fishes.
Vincent, S. The Ductless Glands.
Walker, A. O. Amphipoda Hyperiidea of the *Sealark* Expedition to the Indian Ocean.
—— Crustacea collected by the late Mr. R. L. Ascroft and Mr. Harvey in the North of the Bay of Biscay.
—— Note on *Neopleustes bicuspis* (Kroyer) and *N. monocuspis* (Sars).
—— Note on the Occurrence of *Hippolyte gracilis* (Heller) in the British Area.
Wallace, W. Report on the Size and Age of Plaice at Maturity in the North Sea and English Channel.
Webster, W. Choline in Animal Tissues and Fluids.
Wedderburn, E. M. Dr. O. Pettersson's Observations on Deep Water Oscillations.
—— Temperature Oscillations in Lakes and in the Ocean.
Wedderburn, E. M., and Watson, W. Observations with a Current-Meter in Loch Ness.
Whitehouse, R. H. The Caudal Fin of Fishes (Preliminary Paper).
Wolfenden, R. N. Scientific and Biological Researches in the North Atlantic.
Woodruff, L. L. Studies on the life cycle of Paramecium.
—— Further Studies on the life cycle of Paramecium.

General Work at the Plymouth Laboratory.

A report by Dr. Allen and Mr. Nelson on the experiments which they have carried out at the Laboratory on the artificial culture of marine plankton organisms has been published in the Journal of the Association. In this paper it is shown that plankton diatoms can be grown, under laboratory conditions, in persistent cultures

containing a single species, and that pelagic larvæ can often be reared through their metamorphosis by keeping them in sterile sea-water and feeding them on such diatom cultures.

Mr. G. H. Drew has been working at the Laboratory during the year on the diseases of fishes, and has also been studying the question of abnormal growths in other marine animals. Mr. Drew has recently been elected a Beit Memorial Fellow for medical research, and is thus able to devote his whole time to a continuation of these studies.

The work of collecting and identifying the larvæ and young stages of fishes has been continued by Mr. A. E. Hefford during the year, and the results now tabulated for publication include collections from 1906 to 1909. The study of embryonic and early larval stages has been made upon tow-netted pelagic eggs kept under observation in the Laboratory. The MS. and coloured drawings for a report on this part of the work for 1909 are ready for publication, to which is added an appendix describing the larval stages of *Solea lascaris*, completely observed for the first time this spring. Many larval and post-larval forms have been added to the Museum collection.

A short report on experiments upon the influence of low temperatures on the turbot has been sent to the New Zealand Government, who asked for the information with a view to acclimatizing the turbot in New Zealand.

Specimens of marine animals and plants have, as usual, been supplied to many museums and colleges in all parts of the world for teaching purposes, as well as to many individual workers for the purposes of research. Parties of boys and girls from a number of Plymouth schools have been admitted from time to time to the Aquarium free of charge.

The International Fishery Investigations.

The following is a summary of the work done, and of the conclusions arrived at by the scientific staff working under the direction of the Council.

Section I.—NORTH SEA WORK.

A. WORK AT SEA.

From June 1st, 1909, to the end of October, when she was finally laid up, the *Huxley* made four voyages, in the course of which 42 hauls of the commercial trawl were made, while smaller gear was used at 67 stations. The total number of voyages made by the *Huxley* during the participation of the Association in the International Investigations is

112; and her employment on North Sea fishery research having now terminated, the total number of hauls made from her decks in connection with this work in the North Sea may be stated. It is as follows:—

Commercial Gear: Otter trawl, 569; Beam trawl, 920. Total, 1489 hauls.

Small Gear: Shrimp trawl, 134; Agassiz trawl, 173; Todd's trawl, 47; Dredge, 177; Conical dredge, 599; D-net, 8; Oyster dredge, 3; Petersen's Young-fish trawl, 113.

Hensen net, 65; Brood nets, 40; Garstang net, 34; other tow-nets, 120. Total, 1513 hauls.

The total number of stations at which small gear has been used is 1337, but as on many occasions more than one net was used at a station, the number of hauls is higher, reaching, as shown above, 1513. In addition to the operations of the *Huxley* in the open sea, data have been collected from time to time, as has been stated in previous reports, concerning the shallower coastal waters. With the co-operation of the Eastern Sea Fisheries District Committee in the Wash, and by the employment of the Association's steamer *Oithona* in Bridlington Bay, in the Suffolk bays and estuaries, and in the Thames, it has been possible to collect valuable information concerning all of the more important English inshore areas, that concerning the Wash being the most extensive. Sixty-four hauls of the small Otter trawl were made from the *Oithona*, while the use of the Shrimp trawl, shore nets, Conical dredge, and other gear brings the total number of hauls from this vessel in the North Sea up to 102.

Fish Measured.—As in former years, the total catch of fish was again measured this year on nearly all occasions: owing to the devotion of a considerable time to the collection of fish eggs and larvæ, the number measured is, however, somewhat less than during 1908–9. The details as to the number of plaice, haddock, and other species dealt with are as follows:—

Year.		Plaice.	Haddock.	Others.		Totals.
1902–9	...	174,785	50,323	366,400	...	591,508
1909	...	4,978	335	13,318	...	18,631
		179,763	50,658	379,718		610,139

Marking Experiments.—During the investigations 16,104 plaice, together with 713 soles and 552 other fish, have been marked and liberated by the Association, Of these, 4605 plaice (28 per cent), 57 soles (8 per cent), and 113 (20 per cent) other fish have been recovered.

The marking experiments made after March, 1909, were intended to cast light on the movements of plaice east of the Dogger Bank, when at a larger size than those marked in the majority of the experiments carried out on the Eastern Grounds. In the month of July 317 plaice were accordingly marked in Clay Deep and the vicinity.

The following table gives the particulars as to the number of plaice recaptured during the period considered:—

Year of Liberation.	Recovered from Ordinary Marking Experiments.	Recovered after transplantation to Dogger Bank.	Devon Bays.
Prior to June 1, 1906 ...	—	2	—
June 1, 1906, to May 31, 1907	2	20	—
„ 1907 „ 1908	33	99	—
„ 1908 „ 1909	400	355	81
„ 1909 to Mar. 31, 1910	98	—	—
	533	476	81

There have thus been recaptured during the period 1090 plaice. One more of the 23 plaice transplanted from the White Sea on the steam trawler *Princess Louise* has also reached the Laboratory, making 13 of these fish in all.

Vitality Experiments.—The plaice from 16 hauls of the commercial trawl have been subjected to the tests of vitality which have already been described.* In the majority of these experiments some fish were placed in the tanks immediately after capture, others after exposure on deck of one hour. This furnishes information as to the condition of the fish after a period corresponding roughly to that which small plaice would lie on the decks of a commercial trawler before being returned to the sea. It also enables a comparison to be made between the proportion surviving under these conditions and the proportion which would survive if they were at once returned to the sea.

Collection of the Eggs and Larvæ of Fishes.—A voyage was made in June, 1909, for the systematic collection of fish eggs and larvæ in the Southern Bight. The stations were fixed along a series of lines traversing the area several times, an interval of ten miles separating successive stations: at each station a haul of the Hensen net, two hauls of the Petersen small-fish trawl (one near the surface and one near the bottom), and a haul of the Todd trawl were made. The lines of the operation stretched from the Leman Banks to the Haak's Light Vessel, thence to Lowestoft, and so in succession to the Maas, Galloper, North

* *Internat. Invs. Mar. Biol. Assoc. Report, II*, Pt. II, Cd. 4641, p. 1.

Hinder, and Sandette Light Vessels. D-nets and obliquely hauled tow-nets were also used in the course of the voyage.

DRIFT BOTTLES.—In February, 1910, in co-operation with Mr. Bidder, drift bottles were put out along a line stretching E.N.E. from Spurn. One hundred bottom drifters and two hundred and sixty-six surface drifters were put overboard in all, the first at 5 miles and the last at 88 miles from land. This experiment being conducted in an area hitherto untouched in similar investigations, but which is known to be a plaice-spawning ground, should yield results of considerable interest.

The Association is indebted to Messrs. Wilson for granting all facilities for the work, and especially to Capt. French of the s.s. *Zero* for very valuable assistance rendered during the voyage.

B. LABORATORY WORK.

Reports are, or will shortly be, in the press dealing with the Transplantation Experiments, the Marking Experiments, the Age and Growth of Plaice, the Invertebrate Fauna, the Eggs of fishes collected during last June, the Bottom Deposits, the experiments with small-meshed nets covering the commercial trawl, and the Grimsby Trawlers' Records. The materials on which these reports are based have been summarized, and the chief conclusions of many of them mentioned, in previous reports. Some others may be added here.

TRANSPLANTATION EXPERIMENTS.—The reports on these experiments take the form of a review of all the results of English experiments carried out between 1904 and 1908. Thirteen of these experiments, dealing with 3942 fish, consisted in the transference of plaice from the coastal grounds of the North Sea to the southern parts of the Dogger Bank. Half the plaice transplanted were between 20 and 23 cm. in length on liberation; from which it will be seen that for the purposes of estimation of growth and percentage recaptured, and of the study of migration, the majority of the experiments must have been closely comparable. By the end of June, 1909, with which month the period covered by the reports ends, nearly a thousand of the plaice had been returned.

The two most noteworthy features of the growth in length of the plaice recovered were the undoubted growth which was found to have occurred on the Bank during the winter months and the ample confirmation afforded of the high estimates of a year's growth derived from the first experiments of the series.* Thus the average growth of the

* Garstang. Expts. in Transplantation, etc. First Report, Southern Area.

plaice recovered in the March following liberation exceeded that of the fish recaptured in the previous October by over 3 cm. (males 3·1 cm., females 3·9 cm.) in the case of those recaptured on the Bank, and by 1·7 cm. in the case of all recoveries irrespective of position of capture. The first year's growth in length is given in the following table:—

Average growth in cm. during one year, drawn from the experiments of 1904–8.

	Total Recoveries.		Recoveries on the Bank.	
	Range of average during the period.	Average of all years combined.	Range of average during the period.	Average of all years combined.
Male	8·7–16·8	12·2	9·8–14·0	11·8
Female	11·0–16·2	14·2	13·1–16·8	15·3
Both sexes combined	9·5–15·4	13·3	10·9–16·8	14·8

Where sufficient data exist for trustworthy comparisons, this growth is found to be never less than twice and frequently from two and a half to three times that prevailing on the coastal grounds from which the plaice were taken. Only a few fish are available for an estimation of growth during *two* years following liberation, but the growth for this period appears to be about 20 cm.

The condition of the transplanted plaice, as indicated by the relation between the weight and the cube of the length of the fish, shows a steady improvement until August, a slackening in September, and a marked increase in October, these relations existing in both the first and second years of liberty. The weight of the plaice retaken after a year was found to have increased to from 4·5 to 5·75 times that possessed on liberation: this increase is, in round terms, rather over three and a half times the increment which would probably have resulted in the same period on the coastal grounds.

Since the value of plaice increases with their size, the increase in value of the transplanted plaice is yet more remarkable. If the most detailed statement of the prices of plaice of different lengths, those drawn up by Johansen for plaice of the Kattegat, be accepted as accurate for the North Sea, it would appear that these plaice when transplanted had a value of £4: within a year £7 worth had been recovered, while those presumably at liberty were of £42 value. Had the plaice remained on the coastal ground, on the same calculation, their total value at the end of the year, assuming none were retaken during the year so that all enjoyed a year's growth, would be but £18. The estimated increase in value in two years is based on more meagre data. It indicates, however, that the value of the plaice retaken within this period was nearly three and a half times (341 per cent) that of all the plaice liberated, while the probable worth of those still at liberty was still greater.

The most marked movement suggested by the position of capture of the transplanted plaice was a spawning migration to the Flamborough Off Ground. As is frequently the case, a greater proportion of the males than of the females appear to travel, more males than females leaving the bank.

Seventy-three per cent of the recaptures were known to be made by English steam trawlers, while of the seventeen per cent which were returned from the Grimsby pontoon or fish markets probably the majority were recovered by the same class of vessel; only seven per cent are known to have been retaken by foreign fishing vessels.

MARKING EXPERIMENTS.—Among the facts brought out by examination of the records of the plaice-marking experiments the following may be mentioned.

The recaptures of plaice marked either on the Flamborough Off Ground or among the Leman Banks were with exceedingly few exceptions confined to a definite tract of ground which follows the main direction of the English coast. Its northern boundary may be said to be 54° N. lat. In the Southern Bight its eastern boundary is 3° E. long., and north of this it is a line trending north-west to the south-western extremity of the Dogger Bank. Practically no plaice were recaptured to the west of a line drawn from Flamborough Head to a few miles east of Cromer. Except in the late spring or early summer very little trawling takes place in this region, and this may account in part for the infrequency of recoveries; but the ground is the typical rough area of the North Sea, and unsuitable for plaice.

On the Flamborough Off and neighbouring grounds the plaice of immature size are markedly stationary, seldom travelling more than a few miles from the point of liberation before they are caught. The mature plaice, on the other hand, travel considerable distances within the above-mentioned limits, in what is clearly a spawning migration. Spawning plaice are taken on the Flamborough Off Ground and in the south of the Southern Bight; spent plaice at these and intermediate positions. The number of mature, spawning, or spent males taken in the Southern Bight is in distinct excess over that of the females, while the reverse is markedly the case on the Flamborough Off Ground. If spent fish are left out of consideration, the above excess of mature males remains; that of females on Flamborough Off Ground remains also, but is very slight. It is thus somewhat uncertain whether a greater proportion of the males than of the females take part in a southward spawning migration, or whether the sexes both move southwards, but the females returning earlier are caught farther to the north than the males.

In the Southern Grounds it is indeed apparent that the females move northwards at an earlier date than the males, the females predominating among the fish of mature size marked near Smith's Knoll, off the Norfolk coast, while the males are in excess in marking experiments farther south.

Experiments on the Eastern Grounds show the annual movements offshore in the summer and inshore in the spring which have already been remarked by many investigators. Practically none of the fish recaptured, however, were of mature size. It is hoped that the experiments of 1909 will cast some light on the movements of mature plaice in this locality.

An observation involving deductions of considerable importance has been made on the fish trawled for marking. The fish are found to differ as to the appearance of the eyes, which are in some cases markedly bright, in others dull. In four experiments particulars of the recoveries of the fish so distinguished have shown that the plaice with bright eyes were recaptured in far greater proportion than the rest. The percentage of the former recovered ranged from 49–54, that of the latter during the same period from 23–34. The eyes therefore would appear to afford a test of the condition of the fish. The high proportion captured in the case of the bright-eyed plaice was fully maintained in two other cases in which only fish of that kind were marked.

The many experiments in which no distinction was made between these classes of plaice uniformly show a lower percentage of recaptures. Thus in forty-nine experiments made during spring in the course of the International Investigations, the percentage recovered only exceeded 40 per cent in five cases, whereas in an experiment made in a worse fishing season 50 per cent of the bright-eyed plaice were retaken in a less number of years. These facts suggest that previous experiments of the intensity of fishing drawn from marking experiments, high though they undoubtedly seemed, were too low. The percentages of recoveries during a year met with among these selected bright-eyed plaice somewhat recall indeed the proportions of Mr. Bidder's bottom-drift bottles returned from fishing vessels.

Eggs and Larvæ of Fishes.—The cruise of the *Huxley* in June, 1909, yielded some important additions to our knowledge of the eggs of many fishes. The eggs occurring in the greatest quantities were those of Mackerel, Sprat, Horse-Mackerel, and Solenette, and the cruise may be said to have considerably advanced our knowledge of the spawning of these species of fish in the Flemish Bight. The great numbers of the eggs of these species which were taken indicate that

for these fish June must be a period of intense spawning. In the report on the cruise charts are given showing the distribution of these eggs in the region investigated. Useful results were also obtained from the qualitative hauls—those with the Petersen young-fish trawl and Todd's trawl. The great catches of eggs made with these nets have rendered it possible to obtain clearer views as to the morphological differences between various species which have hitherto been much confused. This has been the case, for instance, with the eggs of Turbot and Greater Weever, Mackerel and Grey Gurnard and Brill. In the report photographs are given showing characteristic differences in these species, and also a mathematical method for distinguishing them, founded on the measurement of groups of eggs and the contained oil-globules. The report contains also a Table of all the catches made with the Hensen net, a discussion of the observations made on the spawning of the sole in the Wash in 1904, and in an appendix, some notes on the Constant of the Hensen net. The distribution of fish larvæ has not been treated, but valuable results should accrue, particularly in the case of the sole-larvæ, from the examination of the great numbers taken with the Petersen trawl. These far exceed any catches hitherto made, and almost every stage of development is represented.

C. FISHERMEN'S RECORDS.

A report on the results obtained from the records of certain Grimsby trawlers has been completed and is now in the press. It contains a detailed analysis of 13,246 hauls made by the skippers of these trawlers, during the period 1904 to 1907, in the central and southern parts of the North Sea, which hauls have been allotted, according to their position, to twenty-three different areas.

The catches of seven species of food fishes are examined, viz. of plaice, soles, turbot, brill, cod, haddock, and whiting, and as far as possible the seasonal and yearly fluctuations of each of these species have been determined for each area. These are measured by monthly averages and illustrated by a series of curves. The importance of each size group (large and small) to the total is considered, and the comparative distribution of each species of fish over the region has been estimated and depicted by charts. The spawning periods and regions are also investigated as far as the records allow.

The final results bring out a striking contrast in the seasonal and geographical distribution of the round and the flat fishes. Plaice, soles, turbot, and brill are all found in their greatest numbers on the eastern grounds and in the areas adjacent to them. In these areas

cod and haddock are very scarce, but these species appear to be very abundant on the Dogger Bank and on the grounds north and north-east of it, where the prime fish are very rarely found and plaice are comparatively scarce.

The round fish appear on the inshore and southern grounds in the autumn and winter only, at the time when the flat-fish appear there in very small numbers, and they are almost entirely absent from these same grounds in the late spring and summer, when soles and turbot are numerous.

The yearly fluctuations are variable in their trend, but show on the whole a decline throughout the period for most of the species. The investigation is complicated by the fact that the fluctuations in some areas are complementary to those in others. Compared with records of catches of fish taken ten and twenty-five years before these, they show a very considerable diminution.

An appendix dealing with the factors connecting the rates of fishing per day's absence, per voyage, per haul and per hour, and another giving a short analysis of 1908 records, complete the report.

Section II.—HYDROGRAPHY.

During the latter half of the year 1909 the hydrographic programme was the same as in February and May. The special observations during the quarterly cruises were confined to the area lying to the westward of the meridian of Plymouth, and surface samples were collected every fortnight on board cross-channel steamers and a few lightships.

It was not possible to make a hydrographic cruise in February of the present year, but the collection of surface samples was continued up to March 31st, when the English share of the International Investigations was transferred to the Board of Agriculture and Fisheries. A report on the mean conditions in the English and Bristol channels at the times of the quarterly cruises is in preparation.

Published Memoirs.

The following papers, either wholly or in part the outcome of work done at the Laboratory, have been published elsewhere than in the official publications of the Association :—

Drew, G. H.—*Some Notes on Parasitic and Other Diseases of Fish.* Parasitology, vol. 2, No. 3, 1909. *Second Series*, vol. 3, No. 1, 1910.

—— *Some Points in the Physiology of Lamellibranch Blood-Corpuscles.* Quart. Journ. Micr. Sci., vol. 54, 1910, pp. 605–21.

—— *The Reproduction and Early Development of Laminaria digitata and Laminaria saccharina.* Annals of Botany, vol. 24, 1910, pp. 177–90.

DUNKERLY, J. S. *Note on Our Present Knowledge of the Choanoflagellata.* Journ. Quekett Micro. Club, April, 1910, pp. 19–24.

ISGROVE, A. *Eledone.* L.M.B.C. Memoirs. XVIII. 1909.

SEXTON, E. W. On the Amphipod genus *Trischizostoma.* Proc. Zool. Soc., 1908, pp. 370–402.

—— *Notes on some Amphipoda from the North Side of the Bay of Biscay. Families, Pleustidae and Eusiridae.* Proc. Zool. Soc., 1909, pp. 848–79.

Donations and Receipts.

The receipts for the year for the ordinary work of the Association include the grants from His Majesty's Treasury (£1000), and the Worshipful Company of Fishmongers, paid in advance during the financial year 1908–09 (£400), Special Donations (£264), Annual Subscriptions (£85), Rent of Tables in the Laboratory (£61), Sale of Specimens (£429), Admission to Tank Room (£139).

The following is a list of the Special Donations:—

	£	s.	d.
Sir John Murray, K.C.B., F.R.S. . .	100	0	0
E. J. Schuster, Esq. . . .	50	0	0
A. E. Shipley, Esq., D.SC., F.R.S. . .	50	0	0
W. I. Beaumont, Esq. . . .	25	0	0
Edgar Schuster, Esq., D.SC. . . .	25	0	0
A. O. Walker, Esq. . . .	10	0	0
Mrs. Weldon	3	3	0
F. F. Blackman	1	1	0
	264	4	0

Vice-Presidents, Officers, and Council.

The following is the list of gentlemen proposed by the Council for election for the year 1910–11:—

President.

Sir E. RAY LANKESTER, K.C.B., LL.D., F.R.S.

Vice-Presidents.

The Duke of ABERCORN, K.G., C.B.
The Duke of BEDFORD, K.G.
The Earl of ST. GERMANS.
The Earl of DUCIE, F.R.S.
The Earl of STRADBROKE, C.V.O., C.B.
Lord AVEBURY, F.R.S.
Lord WALSINGHAM, F.R.S.
The Right Hon. A. J. BALFOUR, M.P., F.R.S.
The Right Hon. JOSEPH CHAMBERLAIN, M.P.
The Right Hon. AUSTEN CHAMBERLAIN, M.P.
G. A. BOULENGER, Esq., F.R.S.
A. C. L. GÜNTHER, Esq., F.R.S.
Sir JOHN MURRAY, K.C.B., F.R.S.
Rev. Canon NORMAN, D.C.L., F.R.S.
EDWIN WATERHOUSE, Esq.

Members of Council.

G. L. Alward, Esq.
W. T. Calman, Esq., D.Sc.
Prof. A. Dendy, D.Sc., F.R.S.
Sir Charles Eliot, K.C.M.G.
G. Herbert Fowler, Esq., Ph.D.
Prof. F. W. Gamble, D.Sc., F.R.S.
S. F. Harmer, Esq., Sc.D., F.R.S.
Commander M. W. Campbell Hepworth, C.B., R.N.R.
E. W. L. Holt, Esq.
J. J. Lister, Esq., F.R.S.
Prof. E. W. MacBride, F.R.S.
P. Chalmers Mitchell, Esq., D.Sc., F.R.S.
Edgar Schuster, Esq., D.Sc.
Prof. D'Arcy W. Thompson, C.B.

Chairman of Council.

A. E. Shipley, Esq., D.Sc., F.R.S.

Hon. Treasurer.

J. A. Travers, Esq., Tortington, Arundel.

Hon. Secretary.

E. J. Allen, Esq., D.Sc., The Laboratory, Citadel Hill, Plymouth.

The following Governors are also members of the Council:—

G. P. Bidder, Esq., M.A.
Hugh C. Smith, Esq. (Prime Warden of the Fishmongers' Company).
Bryan Durant, Esq. (Fishmongers' Company).
Sir Richard Martin, Bart. (Fishmongers' Company).
Prof. G. C. Bourne, D.Sc., F.R.S. (Oxford University).
A. E. Shipley, Esq., D.Sc., F.R.S. (Cambridge University).
Prof. W. A. Herdman, D.Sc., F.R.S. (British Association).

STATEMENT OF RECEIPTS AND PAYMENTS

FOR THE YEAR ENDING 31ST MAY, 1910.

Dr. *Statement of Receipts and Payments for*

	£	s.	d.	£	s.	d.
To Balance from last year, viz. :—						
Cash at Bank	713	10	3			
Cash in hand	14	2	3			
	727	12	6			
Less Loan due to Bank	500	0	0	227	12	6
,, Current Income :—						
H.M. Treasury	1,000	0	0			
Annual Subscriptions	85	0	0			
Rent of Tables	61	9	0	1,146	9	0
,, Extraordinary Receipts :—						
Donations, per Report				264	4	0
,, Charter of Steamboats :—						
S.S. *Huxley*, for period 25th June, 1909, to 31st March, 1910				662	9	2
,, Sale of s.s. *Huxley* :—						
W. Crampin	2,400	0	0			
Less Commission on Sale	60	0	0	2,340	0	0
				£4,640	14	8

Examined and found correct.

(Signed) N. E. Waterhouse. Arthur Dendy.

P. Chalmers Mitchell. L. W. Byrne.

29th June, 1910.

	£ s. d.	£ s. d.
By Current Expenditure :—		
Salaries and Wages—		
Director	200 0 0	
Assistant Director	196 13 4	
Naturalist	175 0 0	
Salaries and Wages, and Compensation paid	718 14 5	
	1,290 7 9	
Less Compensation recovered from Employers Liability Assurance Corporation	27 8 9	1,262 19 0
Travelling Expenses		35 1 2
Library		133 6 1
Journal	72 1 9	
Less Sales of Journal	9 4 4	62 17 5
Buildings and Public Tank Room—		
Gas, Water, and Coal	110 13 9	
Stocking Tanks and Feeding	43 3 1	
Maintenance and Renewals	96 3 1	
Rent of Land, Rates, Taxes, and Insurance	36 3 4	
	286 3 3	
Less Admission to Tank Room	139 2 5	147 0 10
Laboratory, Boats, and Sundry Expenses—		
Stationery, Office Expenses, Printing, etc.	155 11 8	
Glass, Apparatus, and Chemicals 171 2 11		
Less Sales 83 1 3	88 1 8	
Purchase of Specimens	65 15 11	
Maintenance and Renewals of Boats, Nets, Gear, etc., exclusive of s.s. *Huxley* 196 2 9		
Less Sales 5 10 3	190 12 6	
Insurance of Steamers—		
S.S. *Huxley* 139 16 6		
S.S. *Oithona* 22 14 6	162 11 0	
Coal and Water for Steamers, excluding s.s. *Huxley*	76 0 6	
	738 13 3	
Less Sale of Specimens	429 10 3	309 3 0
By Bank Interest		9 0 10
„ Extraordinary Expenditure :—		
Purchase of s.s. *Huxley*—		
Balance of Mortgage, including interest and charges paid to Mr. G. P. Bidder		1,937 16 6
By Balance, including balance of Special Grant of £500 received last year, applicable to the year ending 31st May, 1911 :—		
Cash at Bank	1,033 12 2	
Cash in hand	9 17 8	
	1,043 9 10	
Less Bank Loan	300 0 0	743 9 10
This Balance is apportioned as follows :—		
General Account 543 9 10		
Repairs and Renewals 200 0 0		
743 9 10		
		£4,640 14 8

NOTE.—Under the terms of a Deed, dated 9th November, 1907, and made between the Association and Mr. G. P. Bidder, a sum of approximately £750, in respect of the sale of the s.s. *Huxley*, was on the 31st May, 1910, held for such purposes as Mr. Bidder should designate. This sum has since been handed over to Trustees nominated by Mr. Bidder.

Marine Biological Association of the United Kingdom.

LIST

OF

Governors, Founders, and Members.

1ST JULY, 1910.

* Member of Council. † Vice-President. ‡ President.

Ann. signifies that the Member is liable to an Annual Subscription of One Guinea.

C. signifies that he has paid a Composition Fee of Fifteen Guineas in lieu of Annual Subscription.

I.—Governors.

The British Association for the Advancement of Science, *Burlington House, W.* £500
The University of Oxford £500
The University of Cambridge £500
The Worshipful Company of Clothworkers, 41, *Mincing Lane, E.C.* £500
The Worshipful Company of Fishmongers, *London Bridge, E.C.* £9405
Bayly, Robert (the late) £1000
Bayly, John (the late) £600
Thomasson, J. P. (the late) £970
G. P. Bidder, Esq., *Cavendish Corner, Cambridge* £1400

II.—Founders.

1884 The Corporation of the City of London £210
1884 The Worshipful Company of Mercers, *Mercers' Hall, Cheapside* .....£341 5*s.*
1884 The Worshipful Company of Goldsmiths, *Goldsmiths' Hall, E.C.* £100
1884 The Royal Microscopical Society, 20, *Hanover Square, W.* £100
1884 The Royal Society, *Burlington House, Piccadilly, W.* £350
1884 The Zoological Society, *Regent's Park, London, N.W.* £100
1884 Bulteel, Thos. (the late) £100
1884 Burdett-Coutts, W. L. A. Bartlett, 1, *Stratton Street, Piccadilly, W.* £100
1884 Crisp, Sir Frank, Treas. Linn. Soc., 17, *Throgmorton Avenue, E.C.* ... £100
1884 Daubeny, Captain Giles A., *The Vicarage, Tottington, Bury, Lancs.* ... £100
1884 Eddy, J. Ray, *The Grange, Carleton, Skipton* £100
1884 Gassiott, John P. (the late) £100
‡1884 Lankester, Sir E. Ray, K.C.B., F.R.S., 29, *Thurloe Place, South Kensington, S.W.* £100

1884 The Rt. Hon. Lord Masham (the late) £100
1884 Moseley, Prof. H. N., F.R.S. (the late) £100
†1884 The Rt. Hon. Lord Avebury, F.R.S., *High Elms, Bromley, Kent* £100
1884 Poulton, Prof. Edward B., M.A., F.R.S., *Wykeham House, Oxford* £100
1884 Romanes, G. J., LL.D., F.R.S. (the late) £100
1884 Worthington, James (the late) £100
1885 Derby, the late Earl of £100
1887 Weldon, Prof. W. F. R., F.R.S. (the late) £100
1888 Bury, Henry, M.A., *Mayfield House, Farnham, Surrey* £100
1888 The Worshipful Company of Drapers, *Drapers' Hall, E.C.* £315
1889 The Worshipful Company of Grocers, *Poultry, E.C.* £120
1889 Thompson, Sir Henry, Bart. (the late) £110
1889 Revelstoke, The late Lord £100
1890 Riches, T. H., B.A., *Kitwells, Shenley, Herts* £230
1902 Gurney, R., *Ingham Old Hall, Stalham, Norfolk* £105
1909 Harding, Colonel W., *The Hall, Madingley, Cambridge* £100
†1910 Murray, Sir John, K.C.B., F.R.S., *Challenger Lodge, Wardie, Edinburgh* £100

III.—Members.

1897 Adams, W. R., 16, *Milestone Road, Cintra Park, Upper Norwood, London* ..... Ann.
1900 Aders, W. M., 3, *Hall Road, London, N.W.* ..... Ann.
1884 Alger, W. H., 8, *The Esplanade, Plymouth* ..... *C.*
*1895 Allen, E. J., D.Sc., *The Laboratory, Plymouth* ..... Ann.
*1889 Alward, G. L., *Enfield Villa, Humberstone Avenue, Waltham, Grimsby* Ann.
1892 Assheton, R., M.A., *Riversdale, Grantchester, Cambridge* £20
1902 Baker, R. J., 3, *Ash Villas, Collings Park, Mannamead, Plymouth* ..... Ann.
1884 Balfour, Prof. Bayley, F.R.S., *Royal Botanic Gardens, Edinburgh* ..... *C.*
1908 Ballard, Edward, *Greenfield, Hoole Village, Chester* ..... Ann.
1884 Bayliss, W. Maddock, D.Sc., F.R.S., *St. Cuthberts, West Heath Road, Hampstead* ..... Ann.
1884 Bayly, Miss, *Seven Trees, Plymouth* £50
1884 Bayly, Miss Anna, *Seven Trees, Plymouth* £50
1884 Beaumont, W. I., B.A., *The Laboratory, Plymouth* ..... Ann.
1885 Beck, Conrad, 68, *Cornhill, E.C.* ..... *C.*
1887 Beddard, F. E., F.R.S., *Zoological Society's Gardens, Regent's Park, N.W.* Ann.
1884 Beddington, Alfred H., 8, *Cornwall Terrace, Regent's Park, N.W.* ..... *C.*
†1907 Bedford, His Grace the Duke of, K.G., *Endsleigh, Tavistock* ... *C.* & Ann. £10 10s.
1903 Bidder, H. F., 10, *Queen's Gate Gardens, London, S.W.* ..... Ann.
1910 Bidder, Mrs. M. G., *Cavendish Corner, Cambridge* ..... Ann.
1910 Borley, J. O., M.A., 43, *Parliament Street, London, S.W.* ..... Ann.
*1884 Bourne, Prof. Gilbert C., M.A., F.R.S., *Savile House, Mansfield Road, Oxford* ..... Ann.
1910 Bowkett, Sidney, *Claygate, Surrey* ..... Ann.
1898 Bowles, Col. Henry, *Forty Hall, Enfield* ..... Ann.
1910 Bradford, J. Rose, M.D., D.Sc., F.R.S., 8, *Manchester Square, London, W.* Ann.
1910 Bridgman, F. J., *Royal College of Science, South Kensington, S.W.* ..... Ann.
1902 Brighton Public Library (Henry D. Roberts, Chief Librarian) ..... Ann.
1886 Brooksbank, Mrs. M., *Leigh Place, Godstone, Surrey* ..... *C.*

1884 Brown, Arthur W. W., 62, *Carlisle Mansions, Carlisle Place, London, S.W.* *C.*
1910 Brown, F. J., 10, *Belmont Road, Ilfracombe* ..... Ann.
1893 Browne, Edward T., B.A., *Anglefield, Berkhamsted* ..... Ann.
1910 Brown, Mrs. E. T., *Anglefield, Berkhamsted* ..... Ann.
1897 Byrne, L. W., B.A., 7, *New Square, Lincoln's Inn, London, W.C.* ..... Ann.

*1908 Calman, Dr. W. T., *British Museum (Natural History), Cromwell Road, S.W.* ..... Ann.
†1884 Chamberlain, Rt. Hon. J., M.P., 40, *Prince's Gardens, S.W.* ..... Ann.
1884 Christy, Thomas Howard, 199, *Bramhall Lane, Stockport* ..... *C.*
1910 Clarke, G. B. R. Kitson, *Meanwoodside, Leeds* ..... Ann.
1887 Clarke, Rt. Hon. Sir E., K.C., 5, *Essex Court, Temple, E.C.* £25
1885 Clerk, Major-General H., F.R.S., "*Mountfield,*" 5, *Upper Maze Hill, St. Leonards-on-Sea, Sussex* £21
1886 Coates and Co., *Southside Street, Plymouth* ..... *C.*
1885 Collier Bros., *Old Town Street, Plymouth* ..... *C.*
1900 Cooper, W. F., B.A., *Ashlyns Hall, Berkhamsted* ..... Ann.
1909 Crawshay, L. R., M.A., *The Laboratory, Plymouth* ..... Ann.

1910 Darbishire, A. D., M.A., *Imperial College of Science and Technology, South Kensington, S.W.* ..... Ann.
1885 Darwin, Francis, F.R.S., 13, *Madingley Road, Cambridge* ..... *C.*
1885 Darwin, W. E., *Ridgemount Bassett, Southampton* £20
*1908 Dendy, Prof. A., F.R.S., *Binfield, Weybridge* ..... Ann.
1884 Dewick, Rev. E. S., M.A., F.G.S., 26, *Oxford Square, Hyde Park, W.* ... *C.*
1885 Dixey, F. A., M.A. Oxon., *Wadham College, Oxford* .....£26 5*s.* and Ann.
1906 De Morgan, W. C., *c/o National Provincial Bank, Plymouth* ..... Ann.
1910 Dobell, C. C., *Imperial College of Science and Technology, South Kensington, S.W.* ..... Ann.
1910 Drew, G. H., B.A., *The Laboratory, Plymouth* ..... Ann.
1890 Driesch, Hans, Ph.D., *Philosophenweg* 5, *Heidelberg, Germany* ..... *C.*
†1889 Ducie, The Rt. Hon. the Earl of, F.R.S., *Tortworth Court, Falfield, R.S.O.* £5015*s.*
1884 Dunning, J. W., 4, *Talbot Square, London, W.* .....£26 5*s.*
1884 Dyer, Sir W. T. Thiselton, M.A., K.C.M.G., F.R.S., *The Ferns, Witcombe, Gloucester* ..... *C.*

*1898 Eliot, Sir C. N. E., K.C.M.G., C.B., *Endcliffe Holt, Endcliffe Crescent, Sheffield* ....Ann. £5
1906 Elliott, Sir Thomas H., K.C.B., *Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W.* ..... Ann.
1908 Elwes, Maj. Ernest V., *Glendower, St. Albans Road, Babbacombe* ..... Ann.
1893 Enys, John Davies, *Enys, Penryn, Cornwall* ..... Ann.
1885 Ewart, Prof. J. Cossar, M.D., *University, Edinburgh* £25

1894 Ferrier, David, M.A., M.D., F.R.S., 34, *Cavendish Square, W.* ..... Ann.
1884 Fison, Sir Frederick W., Bart., 64, *Pont Street, London, S.W.* ..... *C.*
1897 Foster, Richard, *Windsworth, Looe, R.S.O.* ..... Ann.
*1885 Fowler, G. Herbert, B.A., Ph.D., *The Old House, Aspley Guise, Bedfordshire* ..... Ann.
1884 Fox, George H., *Wodehouse Place, Falmouth* ..... Ann.
1884 Fry, George, F.L.S., *Carlin Brae, Berwick-on-Tweed* £21

1892 Galton, F., F.R.S., 42, *Rutland Gate, S.W.* ..... Ann.
*1907 Gamble, Prof. F. W., D.Sc., F.R.S., 38, *Frederick Road, Edgbaston, Birmingham* ..... Ann.
1906 Gardiner, Prof. J. Stanley, M.A., F.R.S., *Caius College, Cambridge* ..... Ann.
1907 Garstang, Prof. W., D.Sc., 2, *Ridge Mount, Cliff Road, Headingly, Leeds* Ann.
1885 Gaskell, W. H., F.R.S., *The Uplands, Shelford, Cambridge* ..... *C.*
1901 Giles, Col. G. M., 3, *Elliot Terrace, Plymouth* ..... *C.*
1885 Gordon, Rev. J. M., *St. John's Vicarage, Redhill, Surrey* ..... Ann.
1884 Grove, E., *Norlington, Preston, Brighton* ..... Ann.
1899 Guinness, Hon. Rupert, *Elveden, Thetford* ..... £35 15*s.*
†1884 Günther, Dr. Albert, F.R.S., 2, *Lichfield Road, Kew Gardens* ..... Ann.
1900 Gurney, E., *Sprowston Hall, Norwich* ..... Ann.

1884 Halliburton, Prof. W. D., M.D., F.R.S., *Church Cottage*, 17, *Marylebone Road, London, W.* ..... Ann.
1909 Hamilton, Dr. G. C., 21, *Finsbury Circus, London, E.C.* ..... Ann.
1884 Hannah, Robert, 82, *Addison Road, Kensington, W.* ..... *C.*
*1885 Harmer, S. F., D.Sc., F.R.S., *British Museum (Natural History), Cromwell Road, S.W.* ..... *C.*
1889 Harvey, T. H., *Cattedown, Plymouth* ..... Ann.
1888 Haselwood, J. E., 3, *Lennox Place, Brighton* ..... *C.*
1884 Haslam, Miss E. Rosa, *Ravenswood, Bolton* £20
1884 Head, J. Merrick, F.R.G.S., J.P., *Pennsylvania Castle, Isle of Portland, Dorset* ..... Ann.
1884 Heape, Walter, *Greyfriars, Southwold, Suffolk* ..... *C.*
1910 Hefford, A.E., B.Sc., 43, *Parliament Street, London, S.W.* ..... Ann.
*1908 Hepworth, Commander M.W. Campbell, C.B., R.N.R., *Meteorological Office*, 63, *Victoria Street, London, S.W.* ..... Ann.
*1884 Herdman, Prof. W. A., F.R.S., *The Zoology Department, The University, Liverpool* ..... Ann.
1884 Herschel, Col. J., R.E., F.R.S., *Observatory House, Slough, Berks.* ..... *C.*
1889 Heywood, Mrs. E. S., *Light Oaks, Manchester* ..... *C.*
1910 Hicks, F., *Zoological Laboratory, King's College, London, W.C.* ..... Ann.
1884 Hickson, Prof. Sydney J., M.A., D.Sc., F.R.S., *Ellesmere House, Wilenslow Road, Withington, Manchester* ..... Ann.
1910 Hill, Dr. Alex., *Royston, Herts* ..... Ann.
1907 Hill, Prof. J. P., *The Zoological Laboratory, University College, London. W.C.* ..... Ann.
1897 Hodgson, T. V., 54, *Kingsley Road, Plymouth* ..... Ann.
*1905 Holt, E. W. L, 46, *Lower Baggot Street, Dublin* ..... Ann.
1909 Hoyle, W. E., M.A., D.Sc., *National Museum of Wales, City Hall, Cardiff* Ann.

1891 Indian Museum, *Calcutta* ..... Ann.
1888 Inskip, Capt. G. H., R.N., 22, *Torrington Place, Plymouth* ..... Ann.

1885 Jackson, W. Hatchett, M.A., D.Sc., F.L.S., *Pen Wartha, Weston-super-Mare* ..... Ann.

1897 Lanchester, W. F., B.A., *Den of Gryffe, Kilmacolm, near Glasgow* ..... *C.*
1885 Langley, Prof. J. N., F.R.S., *Trinity College, Cambridge* ..... *C.*
*1895 Lister, J. J., M.A., F.R.S., *St. John's College, Cambridge* ..... Ann.

1885 Macalister, Prof. A., F.R.S., *St. John's College, Cambridge* ..... Ann.

1884 MacAndrew, James J., *Lukesland, Ivybridge, South Devon* ..... Ann.
*1910 MacBride, Prof. E. W., M.A., D.Sc., F.R.S., *Royal College of Science, South Kensington, S.W.* ..... Ann.
1900 Macfie, J. W. Scott, *Rowton Hall, Chester* ..... *C.*
1902 Major, Surgeon H. G. T., 24, *Beech House Road, Croydon* ..... *C.*
1889 Makovski, Stanislaus, *Saffrons Corner, Eastbourne* ..... Ann.
1885 Marr, J. E., M.A., F.R.S., *St. John's College, Cambridge* ..... *C.*
1902 Martin, C. H., *The Hill, Abergavenny* ..... Ann.
1906 Masterman, A. T., D.Sc., *Board of Agriculture and Fisheries (Fisheries Division)*, 43, *Parliament Street, London, S.W.* ..... Ann.
1910 McClean, W. N., 63, *Evelyn Gardens, South Kensington, S.W.* ..... Ann.
1884 McIntosh, Prof. W. C., F.R.S., *Nevay Park, Meigle, N.B.* ..... *C.*
1884 Michael, Albert D., *The Warren, Studland, nr. Wareham, Dorset* ..... *C.*
1909 Midgley, J. H., *Grange-over-Sands, Lancs.* ..... Ann.
1903 Mill, H. R., D.Sc., 62, *Camden Square, London, N.W.* ..... Ann.
1899 Minchin, Prof. E. A., 4, *Tennyson Mansions, Cheyne Row, Chelsea, S.W.* Ann.
*1905 Mitchell, P. Chalmers, D.Sc., F.R.S., Secretary Zoological Society, 3, *Hanover Square, London, W.* ..... Ann.
1906 Morford, Rev. Augustin, *The Friary, Saltash, Cornwall* ..... Ann.
†1896 Murray, Sir John, K.C.B., F.R.S., *Challenger Lodge, Wardie, Edinburgh* Ann.
†1884 Norman, Rev. A. M., M.A., D.C.L., F.R.S., *The Red House, Berkhamsted, Herts* ..... Ann.
1910 Orton, J. H., B.Sc., *Imperial College of Science and Technology, South Kensington, S.W.* ..... Ann.
1906 Plymouth Corporation (Museum Committee) ..... Ann.
1906 Port of Plymouth Incorporated Chamber of Commerce ..... Ann.
1910 Porter, Horatio, 16, *Russell Square, London, W.C.* ..... Ann.
1884 Pye-Smith, P. H., M.D., 48, *Brook Street, W.* ..... *C.*
1893 Quintin, St. W. H., *Scampstone Hall, Rillington, Yorks* ..... Ann.
1892 Rüffer, M. A., M.D., *Conseil Sanitaire, Maritime et Quarentenaire, Alexandria, Egypt* ..... Ann.
1888 Scharff, Robert F., Ph.D., *Science and Art Museum, Dublin* ..... Ann.
1901 Schiller, F. W., *Butterhill, Stafford* ..... Ann.
*1909 Schuster, Edgar, D.Sc., 110, *Banbury Road, Oxford* ..... Ann.
1884 Sclater, P. L., F.R.S., *Odiham Priory, Winchfield, Hants* ..... Ann.
1884 Sclater, W. L., *Odiham Priory, Winchfield, Hants* ..... Ann.
1885 Scott, D. H., M.A., Ph.D., F.R.S., *East Oakley House, Oakley, Hants.* ... *C.*
1903 Scott, S. D., *Thirlestaine Villa, Cheltenham* ..... Ann.
1884 Sedgwick, Prof. A., M.A., F.R.S., *Royal College of Science, South Kensington, S.W.* ..... *C.*
1888 Serpell, E. W., *Loughtonhurst, West Cliff Gardens, Bournemouth* £50
1900 Sexton, L. E., 17, *Collings Park, Higher Compton, Plymouth* ..... Ann.
1904 Shaw, Joseph, *Bryanston Square, London, W.* £13
1908 Shearer, Dr. Cresswell, 2, *Round Church Street, Cambridge* ..... Ann.
1885 Sheldon, Miss Lilian, *High Park, Bideford* ..... Ann.
*1884 Shipley, Arthur E., M.A., F.R.S., *Christ's College, Cambridge* ... *C. and* Ann., £5
1886 Shore, T. W., M.D., *Woodlawn, Kingswood Road, Upper Norwood, London, S.E.* ..... Ann.

1885 Sinclair, F. G., *Friday Hill, Chingford, Essex* ..... *C.*
1891 Sinclair, William F., 102, *Cheyne Walk, Chelsea, S.W.* ..... *C.*
1884 Skinners, the Worshipful Company of, *Skinners' Hall, E.C.* £42
1889 Slade, Rear-Admiral E. J. W., R.N., M.V.O., H.M.S. *Hyacinth, East Indies Station* ..... *C.*
1888 Spencer, Prof. W. Baldwin, M.A., F.R.S., *University of Victoria, Melbourne* Ann.
1907 Sprague, Thomas Bond, M.A., LL.D., 29, *Buckingham Terrace, Edinburgh* Ann.
1897 Straker, J., LL.M., F.Z.S., *Oxford and Cambridge Club, S.W.* ..... *C.*

*1899 Thompson, Prof. D'Arcy W., C.B., *University College, Dundee* ..... Ann.
1890 Thompson, Sir H. F., Bart., 9, *Kensington Park Gardens, London, W.* Ann.
1884 Thornycroft, Sir John I., F.R.S., *Eyot Villa, Chiswick Mall* ..... Ann.
1906 Tims, H. W. Marett, M.D., *Deepdene, Cavendish Avenue, Cambridge* ... Ann.
1903 Torquay Natural History Society, *Torquay* ..... Ann.
*1897 Travers, J. A., *Tortington House, Arundel* ..... Ann.
1910 Travers, R. C., *Tortington House, Arundel* ..... Ann.

1891 Vaughan, Henry, 325, *High Holborn, London* ..... *C.*

1884 Walker, Alfred, O., *Ulcombe Place, Maidstone* ..... Ann.
1884 Walker, P. F., 36, *Prince's Gardens, S.W.* ..... Ann.
†1884 Walsingham, The Rt. Hon. Lord, F.R.S., *Merton Hall, Thetford* £20
1906 Waterhouse, N.E., 3, *Fredericks Place, Old Jewry, London, E.C.* ..... Ann.
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OF THE

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OF THE UNITED KINGDOM.

THE ASSOCIATION was founded at a Meeting called for the purpose in March, 1884, and held in the Rooms of the Royal Society of London.

The late Professor HUXLEY, at that time President of the Royal Society, took the chair, and amongst the speakers in support of the project were the late Duke of ARGYLL, the late Sir LYON PLAYFAIR, Lord AVEBURY, Sir JOSEPH HOOKER, the late Dr. CARPENTER, Dr. GÜNTHER, the late Lord DALHOUSIE, the late Professor MOSELEY, the late Mr. ROMANES, and Sir RAY LANKESTER.

The Association owes its existence and its present satisfactory condition to a combination of scientific naturalists, and of gentlemen who, from philanthropic or practical reasons, are specially interested in the great sea fisheries of the United Kingdom. It is universally admitted that our knowledge of the habits and conditions of life of sea fishes is very small, and insufficient to enable either the practical fisherman or the Legislature to take measures calculated to ensure to the country the greatest return from the "harvest of the sea." Naturalists are, on the other hand, anxious to push further our knowledge of marine life and its conditions. Hence the Association has erected at Plymouth a thoroughly efficient Laboratory, where naturalists may study the history of marine animals and plants in general, and where, in particular, researches on food-fishes and molluscs may be carried out with the best appliances.

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