North Sea Investigations.

(*Continued.*)

By

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Economic.

Scientific.

I. On the Destruction of Immature Fish in the North Sea.

In subjoining the continued results of my statistical inquiries it is necessary to occupy but little space with introductory remarks, since the question has assumed no new features. The suggestions as to size-limits embodied in the draft report of the Parliamentary Committee would, if carried into effect, leave the North Sea fishery practically *in statu quo*.

It is true that the proposed size-limits would prohibit the sale of some small quantity of fish, of several species, that now finds its way into our markets, but the quantity is so far insignificant that its exclusion would not materially affect the profits of the vessel. I have endeavoured to show that no size-limit that fails to exclude from the market so large a proportion of the immature plaice caught on the Eastern grounds as to render that area unprofitable, is likely

to have any effect in increasing the supply either of that or of any other North Sea trawl-fish. No arguments having been brought forward against these views, I am not called upon to defend them further.

Of course I am aware that the difference in the size at which maturity is attained by fish in different districts presents a great obstacle to the formulation of a limit which shall be beneficial to all districts alike. Indeed, I would go further, and say that it is impossible to legislate sensibly by size-limit unless each district is treated separately.

The Procrustean method of cutting down the sizes in all districts to suit the requirements of that wherein the fish are the smallest entirely fails to commend itself to me.

Plaice.—In the last number of this Journal (p. 124) the statistics were carried up to the end of August, 1893, but as a year has now elapsed since I commenced to take the whole number of fish landed, the figures from April, 1893, may now be conveniently recapitulated.

Month.	Total No. of boxes.	North Sea.			Iceland.	
		Total.	"Large."	"Small."	No. of boxes.	No. of "voyages."
1893.	I.	II.	III.	IV.	V.	VI.
April	10,833	10,633	7,964	2,669	200	2
May (N. Sea, less 1 day)	19,859	15,176	7,532	7,644	4,683	20
June	19,555	12,205	5,880	5,325	7,350	30
July (less 1 day)	24,680	13,304	10,585	2,719	11,376	36
August (less 4 days)	19,141	12,287	10,668	1,619	6,854	21
September (less 7 days)	9,887	9,637	9,001	636	250	1
October	16,191	16,191	15,582	609	...	...
November (less 1 day)	11,219	11,219	10,403	816	...	...
December (less 7 days)	4,570	4,570	4,483	87	...	...
1894.						
January	4,463	4,463	4,254	209	...	...
February	3,707	3,707	3,604	70	...	...
March (less 6 days)	6,673	6,673	5,484	1,184	...	...
April (less 4 days)	15,997	14,911	7,844	7,067	1,086	7

I mentioned in my last report that a certain amount of the "small" plaice which appears in the returns were landed by foreign steam-trawlers—chiefly from Hamburg, Bremerhaven, &c. These vessels, in addition to catching what they can with their own gear, occasionally buy up the catches of the small boats on the eastern grounds and bring it across to our markets. It is therefore probable enough that some of the fish so landed is derived from grounds inaccessible to large vessels, but I have not noticed any difference in the quality.

In order to arrive at the quantity landed by our own vessels it is necessary to deduct from each month, as landed by foreign steam-trawlers, the following amounts :

1893.	April	294	boxes.
	May	1642	,,
	July	120	,,
	November	620	,,
	December	87	,,
1894.	January	200	,,
	March	448	,,
	April	2255	,,

It therefore appears that the unusually large quantity of "small" landed in the winter months is almost wholly accounted for by the contributions of foreign vessels. Previous to the cholera epidemic at Hamburg in 1892 I am not aware that these large vessels devoted much attention to the small plaice; in any case they did not land them here. Since that period, however, they have frequently landed their fish at this port, and, as I am informed, at Hull also. Last summer they landed several "voyages" of large plaice from Iceland, and from time to time they bring in large quantities of haddocks; but, as a rule, "small" plaice form by far the principal item in their contributions to our market. I do not consider that the difference alluded to, viz. that some of the fish are brought from small inshore boats, is sufficient to justify the exclusion of these foreign-caught fish from the returns, which profess to deal only with fish derived from first-class vessels. A small number of boxes from the Humber and Boston deeps, caught either in small boats or in a net worked from the shore, are not included. Sixty-eight boxes of mature but very small fish from the Baltic, consigned viâ Hamburg to this market, are also excluded. They are dealt with elsewhere in the present report (p. 194).

Remembering that vessels will work the Eastern grounds only when considerable catches can be made thereon, it is possible by observing the fluctuations in columns 4 and 6 to compute roughly the number of boats diverted from the North Sea plaice fishery proper, as apart from the pursuit of exclusively small fish on the area alluded to. Considering this, and taking into account the number of days omitted in various months, it may be inferred that the supply of fair-sized fish increased considerably in May, 1893, since the totals in column 3 remain about the same in April and May, although columns 4 and 6 give evidence of a great diversion of fishing power during the latter month. The decrease of column 3 in June may be partly accounted for, I suppose, by the injurious effects of the prevailing calm on the fishing of sailing vessels, since the increase in column 6 is more or less neutralised by a corresponding reduction in column 4, and so implies but little diversion of the power supplying column 3. This column shows a marked improve-

ment in July; but though in August a still further increase is noticeable (allowing for days omitted), the augmentation of fishing power indicated by the decrease in columns 4 and 6 would seem to show that the supply available for individual boats had on the whole diminished. A further reduction of individual supply may be inferred from comparison of the different columns in September, though the total remains unaffected, or is perhaps rather higher. In October, however, the distribution of power remaining practically the same as in September, we find a very marked increase in column 3, indicating an individual supply not inferior to that of July. This confirms to some extent opinions which I have heard expressed—that the unusually warm spring and summer (of 1893) would be productive of a fine autumn supply. If any such connection exists, the only explanation that occurs to me is that the warm weather has hastened the growth of the fish, so that the annual autumnal recruiting from the small fish on the Eastern grounds has been unusually great.

In November the supply again falls, and this in spite of the landing of individual catches of from 73 to 219 boxes from the "Holman" between the 16th and 23rd of the month; but the tempestuous weather of that month will be within the recollection of every one. While several fishing vessels were lost, many were temporarily disabled, and the consequent paralysis of fishing power is a factor that must be reckoned with in addition to scarcity of fish, which itself is usually enhanced by coarse weather. The lowest ebb is reached in February, but a rapid improvement is noticeable in the succeeding months; April is the only month in which we are able to compare the statistics of two years collected in exactly the same way, and so far as the large fish are concerned, the present year (allowing for days omitted) yields rather better results than the last. The difference, however, is not very great, but there is a very marked increase in the amount of small fish destroyed, indicating that the season is earlier this year than last on the Eastern grounds. It might also be inferred, by the consequent diversion of boats to these grounds, that the individual supply of large fish showed an improvement; but the fact is that a great number of boxes reckoned as "large" contained, during the month in question, only "half-fish." These are mostly immature, but above the limit which, for reasons given in former reports, I have found convenient for separating "large" and "small." The Iceland season is also early this year, or, perhaps, I should rather say that boats have commenced to go there earlier than they did last year. The first voyage had an unfortunate termination, as the vessel ran against Filey Brigg in a fog, and became a total wreck, with a loss of several hands. Some 20 boxes of her plaice, included in the above returns, were brought

to market by a yawl, but were condemned as unfit for food. A similar fate befell a consignment of Iceland plaice which reached the market by steamer, viâ Norway, on the same date, the 11th April. They were in very bad condition, and it is doubtful whether such consignments would pay expenses in any case.

As I did not commence to collect statistics of both large and small plaice until April, 1893, it is only possible to compare the catches of 1892 and 1893 by making use of the Board of Trade returns. In the figures given for 1892 (Journal, 1893, p. 84) only the "small" are from my own observations, the boxes of other specification being derived by converting the weight given in the Board of Trade returns into boxes, and eliminating the number of boxes of "small" which appear in my own records. As it is therefore probable that some error exists in the 1892 returns, from inaccuracy of the official figures or of conversion of weight into boxes, I put forward the following results with all due reserve :

1892. Six months, May to October, total, 86,000 boxes.
1893. „ „ „ „ 125,000 „

The apparent increase of 39,000 boxes looks promising enough, but is considerably discounted when we find that no less than 30,000 is due to an increase of Iceland fish, leaving a North Sea increase of only 9000 boxes. Examining the columns of large and small, a rough calculation being made, as in the case of the totals, for the days omitted, we find a total of 71,000 "large" and 22,000 "small" for 1893, as against 73,000 "large" and 11,000 "small" for 1892.

The increase, therefore, is entirely confined to Iceland and "small" North Sea fish, while in "large" North Sea fish there is a deficit of 2000 boxes.

Comparing the numbers of "large" month for month in the two years, the fluctuations are much in the same proportion, the chief exception being in July and August. In 1892 nearly two thirds of the total catch of these two months was obtained in the first of them, whereas in 1893 rather more were caught in August than in July.

That plaice are actually decreasing in the North Sea is a fact so generally recognised that it hardly needs illustration, but the present scarcity may not be so apparent from figures dealing with aggregate catches as it becomes when we examine the catches of individual boats. In examining the total figures it must be borne in mind that the fishing power is enormous, our own large fleet being supplemented not only by foreigners, but by vessels hailing from other British ports, such as Scarborough, Shields, Aberdeen, Glasgow, and even Milford Haven.

The scarcity is most felt in the winter months, when, for whatever

reason, the fish are very hard to catch. Thus in the last winter a smack failed to average two boxes of plaice in ten consecutive voyages along the neighbouring coast and off Flamborough Head, an area which has the reputation of being fairly productive for the season. The matter may be further illustrated by extracts from some observations of which my friend Mr. R. Douglas permits me to make use. On the 1st February, 1893, a steam-trawler landed one plaice after ten days' fishing, on the 3rd another landed one box after eight days. On the 13th December, 1892, a steam-trawler had three boxes for fourteen days, and on the next day two similar vessels had two each for eight days. These figures are unfortunately by no means so rare as to be exceptional.

A new departure in the trawling industry has been made by the launch, during last year, of several steam-vessels designed for fleeting vessels. Their function is simply to fish, the catch being taken to market and the coal supplied by cutters. As the company to which they belong does not land its fish at this port I have no means of knowing what the results have been, but it is obvious that a steam-vessel, staying perpetually on the fishing ground, is a most powerful engine of destruction,—dangerously so, in fact, in the present state of the grounds.

Haddock.—The appended figures show the total number of boxes of "small" fish landed during the months specified :

1893.	September (less 7 days) . .	4670 boxes.
	October	8457 ,,
	November (less 1 day) . .	6712 ,,
	December (less 8 days) . .	5792 ,,
1894.	January	5248 ,,
	February	3848 ,,
	March (less 6 days) . .	5363 ,,
	April (less 4 days) . . .	8502 ,,

On the whole the supply of "small" haddock has shown a steady increase since my inquiries were commenced, allowing for fluctuations in individual months. It has so far been impossible to extend the statistics so as to include fish of all sizes, so that I am unable to say what proportion the "small" bears to the total. During the present year, however, I have noticed large catches consisting entirely of "small," a condition not previously observed. So far as I know, the general supply shows no marked decrease.

Cod.—The figures relate to trawled codling, with the restrictions explained in previous reports :

1893.	September (less 7 days) . .	2123 boxes.
	October	2939 ,,
	November (less 1 day) . .	2491 ,,

1893.	December (less 8 days) . .	2730 boxes.
1894.	January	3096 „
	February	2607 „
	March (less 6 days) . .	2363 „
	April (less 4 days) . . .	1093 „

Examination of the returns given in the two previous numbers of this Journal (1893, p. 87, and 1894, p. 128) shows that whatever decrease took place in the summer as compared with the winter months of 1893 is much more striking in regard to the late than to the early months of that year. I drew attention (Journal, 1893, loc. cit.) to the large catches that were made on certain grounds in the winter of 1892–3, and expected that a similar condition would obtain during the next winter. There has been, however, no congregation of small codling on those or any other grounds at all comparable to that of the previous winter. It is true that the aggregate number landed is considerably in excess of last year's supply, but the fish have been brought in in small quantities. Considerable catches first became apparent in November, 1892, and continued to appear until March, 1893. The principal grounds, it will be remembered, were the Yorkshire Hole, and, later on, Flamborough Head. Now a considerable number of boats were working the Hole after the gale of November, 1893, as a fair supply of soles had appeared there; but there was no quantity of codling. In fact, the first record I have of any considerable catches of codling is in February. Seventy boxes is the largest "voyage" (as against 122 last year), and 16 boxes is quite exceptional. "Voyages" of from 60 to 23 boxes are recorded between the 2nd and 5th of March, and thereafter no catches of any magnitude were observed. In all cases the best catches were made during the past winter off Flamborough Head, none occurring at the Yorkshire Hole or any of the other grounds mentioned. The absence of these shoals of codling is evidently not due to scarcity, it is simply a failure to congregate as they did in the winter of 1892–3, and it seems quite possible that the gale of November may have had something to do with it. The fish did congregate, as in the former winter, later in the season off the Head, though in less numbers, and, as our experience is limited to two years, it is not possible to say whether the earlier congregation is a normal feature or the reverse. Answers to inquiries I have made have been too vague to be altogether reliable.

Complaints by deep-sea liners were very general in February of the present year as to the scarcity of cod on the off-shore grounds. The cause, they supposed, was the prevalence of westerly winds, which had apparently the effect of setting the fish into the shore, the best catches being made near the coast. The fish, however, seem to

have made their appearance off Whitby in the same month, though the success of different boats in their pursuit showed considerable variety.

II. On the Territorial Fishing Grounds of Scarborough and its Neighbourhood.

In July, 1893, at the invitation of Professor M'Intosh, I took part in some trawling operations which were being carried on by the steamship "Garland" in the neighbourhood of Scarborough, with the object of obtaining soles to stock the Scotch Fishery Board's hatchery at Dunbar, &c. I was thereby afforded an excellent opportunity of making myself acquainted with the condition of the inshore fishing grounds, which, two years previously, had been closed to trawling by an enactment of the North-Eastern Sea Fisheries Committee.

It was claimed by those who had chiefly interested themselves in procuring the bye-law that a considerable improvement had already manifested itself in the local line-fishery, but on that point, from want of any personal acquaintance with the pre-existing conditions, I can offer no independent opinion. I was invited, however, by Mr. J. Woodall, vice-chairman of the committee, to put forward any conclusions which my observation of the present condition of the grounds might suggest as to the desirability of the retention or abolition of the bye-law.

I propose in this note to give a very brief acount of the investigation, and of the conclusions derived therefrom, and I take this opportunity of thanking Mr. Woodall, not only for hospitality extended to myself during my stay at Scarborough, but for a great deal of valuable information as to the fisheries of Scarborough and the surrounding district.

The grounds examined extend along the coast for a distance of a little over ten miles, as the crow flies, from Hayburn Wyke to Filey Brigg. Scarborough lies about midway between these two points, forming the apex of a very gentle general incurvation of the Yorkshire coast-line in this district. The land descends everywhere in rather abrupt cliffs to the beach, which is rocky in general character, though here and there are patches of smooth sand at the water's edge. Beyond low water mark a considerable stretch of land rock separates the area suitable for trawling from the margin, except at Cloughton, where a very narrow strip of sand extends almost to the head of the Wyke, or small bay which bears that name. Beyond the land rock, the existence of various isolated rough patches makes the trawling ground rather intricate, but we were fortunate in obtaining the services of an efficient pilot, and suffered little or no

damage to the nets. It may here be remarked that the proper charting of the inshore waters for piscatorial purposes is a duty that might be very profitably undertaken by the fishery authority under whose jurisdiction they fall, since the Admiralty authorities take no account of such physical characters of the bottom as do not interfere with navigation, and the information available from existing charts is, in consequence, lamentably meagre from the point of view of the fisherman or of those concerned in the study of fishery problems.

Speaking generally, our hauls were made along the edge of the land rock, or following the trend of the coast a little further out ; but it is also possible, by avoiding certain outlying rocks, to trawl right out to a ground beyond the three miles limit. This ground extends practically from Whitby to Flamborough Head, but we are not at present concerned in discussing its condition. All the grounds I have mentioned are collectively termed the Scarborough " in " grounds. The " off " grounds bearing the same name lie about thirty miles seawards.

The grounds close inshore may for the present purpose be classed together, since we found no great variation in their condition or products, but one of them calls for a little separate notice. This is the Cloughton Wyke Ground, consisting of the narrow strip of sand already alluded to. It has long been famous as a sole ground at the right season, and used to be worked as follows :—At the commencement of the ebb the boat would be taken as far in as the water allowed, the trawl shot and hauled out of the Wyke, thence about two miles offshore and north to another little inlet called Hayburn Wyke. On the flood the *modus operandi* would be reversed, but by far the most soles would always be taken on the ebb. According to my information the soles were chiefly taken near the head of Cloughton Wyke itself, and Mr. Woodall tells me that they were found to feed on a species of Nereis which occurs there in great numbers. I am also informed by Mr. G. L. Alward, on what he considers to be reliable authority, that soles have been dug out of the sand at low water in the same wyke, a statement which the burrowing habits of soles in captivity go far to support.

My own experience of Cloughton Wyke is confined to a single haul, made during the daytime in very clear water. We did not catch any soles, and I am assured that it is only possible to catch soles there in daylight when the water has been rendered turbid by heavy weather from the eastward. Moreover the season for soles had hardly begun. The ground was clean except for a little *Flustra foliacea* and a few hydroids. The fish caught differed in no respect from those taken on the other parts of the inshore grounds. The

ground lying to the south of Scarborough was also fairly clean, but elsewhere a considerable amount of rubbish was met with. The commonest hydroid in this, as in any other part of the North Sea known to me, is *Hydrallmania falcata*. Seaweeds are represented chiefly by *Fucus serratus* (near the rocks), and various red weeds (Delesseria, &c). Usually we caught a few edible crabs, and sometimes a lobster, but of smaller Invertebrates other than hydroids and polyzoans my notes mention the occurrence of only *Portunus holsatus*, *Corystes cassivelaunus*, and *Asterias rubens*.

My records deal, in all, with thirteen hauls, and the fish taken on the different grounds may be treated collectively, as, on the whole, one ground yielded much the same as another. Soles, which formed the object of the "Garland's" operations, were decidedly scarce, sixteen and a half pairs being the most obtained in any one night's fishing. They were, however, all fine fish, no immature specimens being taken. We were told that it was too early in the season to get many soles in the trawl, though good catches were being made by the liners. I cannot pretend to say why these fish should be more readily caught on a hook at this time of the year, since we were working practically the same ground as the liners; but such seems to be undoubtedly the case, and it is only one amongst the many features of marine biology which our ignorance at present relegates to the category of mysteries. One can understand that directly after spawning the fish are more hungry, and so take a bait more readily than at other times; but that is far from explaining why they are more successful in evading a trawl at that season. It seems probable that the reason is to be sought in some sessional change in the organisms on which they prey, or in the habits of such organisms. Be this as it may, I record the simple fact on authority that appears to me to be entirely reliable.

Neither turbot nor brill find a place in the list of fish caught, though at one time I am told that the former species was not infrequent in the bay. There is only mention of one lemon sole, a specimen of 5 inches.

In each of two hauls about twenty plaice are recorded; on all other occasions the number was considerably less, so that this fish cannot be regarded as at all numerous during the time we worked. On one occasion we took three of 17 inches; specimens of 14 and 15 inches are mentioned in two hauls; in all the rest the size was smaller, the minimum being 5 inches. Common dabs were only moderately abundant, and most were small. The only other flat-fish taken were three specimens of *Solea lutea*—about two or three miles off the Castle. In Eagle Clarke and Roebuck's "Yorkshire Vertebrata" this species is included as "reported as having been taken

at Whitby." Beyond this I find no record of its occurrence on the north-east coast of this country. I know that it occurs regularly on the Well Bank to the south, and it is mentioned by McIntosh as common at St. Andrews, while Edwards says that it occurs also on the coast of Banffshire. The present record points to the probable correctness of that from Whitby, and no doubt the species is generally distributed along the eastern coast. There is, however, no evidence of its occurrence in estuarine waters on this coast.

Turning to round-fish, cod of any size were extremely scarce. One fine fish was taken, and on several occasions we got a few small ones, 5 to 7 inches long. Haddock varied in number, but were comparatively scarce except in two hauls, when we took a great number from 5 to 9 inches long. Very few on any occasion exceeded a length of 12 inches. Whiting were much more abundant as a rule, and varied in size from 3 to 14 inches. In one haul, when the cod end was enclosed in an outer bag of fine mesh, a considerable number less than 6 inches in length were caught, but when the outer bag was removed very few of these very small fish came aboard. I noticed also a decided improvement in the quality of the fish towards the end of our operations, since, while in the earlier hauls immature specimens (*i. e.* less than 9 inches long) were in the majority, the numbers were equalised later on, and sometimes the mature fish were actually the most numerous. It was evident that a movement was taking place amongst the larger fish, having the effect of driving the small ones elsewhere, since I have found that cannibalism is highly developed in this species. In reporting on the Humber fisheries in previous numbers of this Journal I have already adverted to the great sessional irregularity of the movements of whiting in inshore waters, and can only now repeat that the conditions at a given time in one year cannot be relied on to hold good for others.

Gurnards were always fairly abundant, but the number of small always exceeded that of the large, except in the last haul but one, when the large fish were in a decided majority. These fish, therefore, appeared to be undergoing a movement similar to that noticed among the whiting. Several very small herring and a few thornback rays were taken, completing the list of food-fishes, unless we include the monk or angler in this category. Several of the latter were taken, none of very large size. Unsaleable fishes were represented by a few "hard-heads" (*C. scorpius*), "bull-routs" (*A. cataphractus*), lesser weevers, and dragonets.

To review the above results briefly, we may say that the investigation showed that the fish forming the object of a legitimate trawl-fishery were confined to a few whiting, gurnards, and dabs, a very moderate quantity of soles, and an infinitely minute number of plaice

and cod. On the other hand, a rather large quantity of undersized haddock, whiting, and gurnard were thereby destroyed; while the destruction of small plaice, though not great in actual numbers, was very considerable in regard to the local supply of this species.

It is evident, therefore, that there is a *primâ facie* case against trawling on these grounds at this time of the year, merely because the waste is in excess of the products. We may consider the matter from another point of view, viz. whether the consumer can be adequately provided by means other than trawling. This question may be so limited as to deal only with the soles, since these are the only important product which cannot obviously be obtained without encroaching on the three-mile limit; and here we find an answer in the affirmative. While our best night's fishing yielded only 16½ pairs, and our catch was usually much less, 25 and 18 pairs were respectively taken by two cobles line-fishing on these grounds during one night of our stay at Scarborough. Such success was not exceptional, and I do not think a coble ever caught so little as we did on any one night. That the catches of the "Garland" are no fair test of what may be achieved by trawling is an objection which may be urged with some show of reason so far as concerns any one night's fishing, since it is well known that a sailing vessel will trawl more soles than a steamer if both are fishing side by side over the same ground. But when we consider the dependency of a smack on the wind, and the intricacy of these particular grounds, I think it may fairly be assumed that a sailing vessel would not have materially improved upon our aggregate catch during the week. I therefore consider that the interests of the consumer can be sufficiently served by line-fishing.

Policy in fishing matters is too often degraded to the merely social aspect of the case, viz. the relative claims of local and other fishermen, or of the local liners and trawlers when the two industries co-exist in the same fishing community. With this I have nothing whatever to do, but may remark that, according to my own experience, one class is burdened with about as much providence and public spirit as the other.

I did not neglect, while at Scarborough, to make inquiries as to the effect which the territorial restriction of trawling was thought to have had on the inshore line-fishery, but as evidence on this subject was given before the Parliamentary Inquiry, in some cases by the men who were my own informants, I need only refer to the matter very briefly. It was asserted that the sole fishery had very greatly revived since trawling was forbidden in these waters, and I have no doubt that this is the case. It requires no argument to show that

trawling and lining cannot be carried on together in one limited area without injury to the latter industry.

As to the haddock fishery, I was told that the trawlers still encroach so much on the territorial haddock grounds that not much benefit has been felt by the liners. These grounds lie further out than those on which the soles are chiefly caught, so that the sole-fishery is not affected by this poaching. The matter is therefore of less general importance, but owing to the amount of undersized fish on the ground it could not but be beneficial to enforce the bye-law in its entirety.

III. The Blonde (*Raia blanda*, Holt and Calderwood, MS.), a Species hitherto confounded with *R. maculata*, Montagu.

In collaboration with Mr. Calderwood, I have been engaged, since I first entered the Association's service, in attempting to revise the British Rajidæ, and one result of our efforts has been the discovery of a species which has hitherto escaped separate description. It seems, therefore, advisable to put forward a brief diagnosis at once, reserving a full description to another occasion.

The species was first met with by one of us on the west coast of Ireland, but the large size of the only specimens obtained rendered it impossible to define it in a satisfactory manner. Recently, however, we have had the good fortune to obtain a nearly complete series from the North Sea, and there can be no doubt of its distinctness.

In the appended diagnosis especial stress is laid on those points which serve to distinguish the species from the closely allied *R. maculata*.

Size.—Reaches a width of over 30 inches; males become sexually mature at a width of 24 inches or more; the egg-purse about $5\frac{1}{2}$ inches long, exclusive of attachment processes.

Shape.—Anterior profile obtusely rounded, the extremity of the snout projecting in a short *semicircular* process, except in adult males, where it is more or less conical, *never sharply pointed.* Anterior margin with two salient curves, varying in degree according to age and sex. Tail rather broad anteriorly, and distinctly flattened in old examples.

Proportions.—Width of the disc about twenty-five per cent. greater than its length, and about thirty per cent. less than the total length; the tail slightly the longer in males. The length of the snout from $4\frac{3}{4}$ (in young) to nearly $5\frac{1}{2}$ times (in adults), and the distance from the tip of the snout to the coracoid from $2\frac{1}{2}$ to $2\frac{6}{11}$ times in the width of the disc. The distance between the nostrils

equal to or rather less than their distance from the tip of the snout. The length of the eye from 1½ (young) to 2 times (adults) in the distance between the supra-orbital ridges, which is equal to, or in large examples greater than, the combined length of the eye and spiracle.

Dentition.—Teeth small; obtuse in females and immature males, sharply pointed in adult males; arranged in from less than sixty to over ninety rows in the upper jaw.

In specimens about	9 inches	across the disc about	66	rows.
„	„	16	„	„	74 „
„	„	23	„	„	78 „
„	„	29	„	„	93 „

Spinulation.—*Upper surface.*—A few spines at the end of each orbital ridge and along the rostrum in young examples; the former frequently, the latter always wanting in adults. A spine on each shoulder in young examples may persist until a large size is attained. Exclusive of sexual alar spines, the other large spines typically in a median row from the head to the dorsal fins, the last spine between the dorsals, and in a lateral row on each side of the tail. These rows are formed by a young and adult series, the young series of the lateral caudal rows being frequently lost before the old series appears. The latter usually very imperfect in males, but double in its anterior region in females. The young series of the median row often imperfectly replaced, except on the tail, in either sex. Very large examples may have lost nearly all the adult median series. Of the median series in young examples, three or four, *always more than two*, spines are in front of the pectoral region.

Small asperities confined to the pre-pectoral region of the disc in young examples, *extending all over the disc* in half-grown fish of either sex and in adult females. Gill region and central area of the pectorals smooth in adult males.

Under surface.—Young examples (9 inches across disc) with a *narrow border of very closely set asperities along the anterior margin*, not extending to the angles of the pectorals. A similar border, in rather larger examples, along the edge of the tail. Under surface otherwise smooth. Some asperities about the region of the coracoid and anterior part of the abdomen in half-grown examples of either sex, and about the general surface of tail in females. The anterior border increases in width with age, and in old males, rarely in old females, extends backwards over a great part of the snout. Adult females in addition have scattered asperities over the whole under surface, except the outer parts of the paired fins.

Colour.—The upper surface a pale fawn, may incline to chestnut, rarely to cold sepia; usually darker over the abdomen and lighter on the head than elsewhere. Thickly sprinkled with small dark

brown spots, rarely exceeding $\frac{1}{4}$ inch in diameter, *which extend to the margins of the disc.* A number of small pale rounded areas, with a certain bilateral symmetry of arrangement, on the wings, each area surrounded by a ring of spots not larger than the rest, and never coalescing with each other; occasionally a central "pupil" spot. Under surface white, sometimes a little brown on the tip of the snout.

* * * * * * *

It will be seen from the above that the new species differs from *R. maculata*, Montagu, in many points. Comparing specimens of equal size, the eye is smaller, the teeth smaller and more numerous, and the distance between the snout and the coracoid greater in *R. blanda* than in *R. maculata.*

The difference in spinulation is very strongly marked, since *R. maculata* never attains anything like the same development of the asperities of the upper surface, as is present in half-grown *R. blanda.* The anterior border of asperities on the under surface is also entirely wanting in *R. maculata;* the greatest degree of ventral spinulation attained by that species throughout life taking the form of a few scattered asperities on the snout, about the pectoral region, and on the tail. Moreover the maximum width attained by *R. maculata* hardly exceeds 20 inches, and its egg-purse only measures about $2\frac{1}{2}$ inches exclusive of attachment processes. Though the size of the spots on the upper surface is subject to variation, they are always larger and more numerous than in *R. blanda* of the same size, and never extend to the margins of the disc. In some examples they are altogether absent. There may or may not be a single conspicuous ocellus on each wing, but if present it is always surrounded by a ring of largish spots, which are frequently more or less coalesced; such an ocellus is always larger than any of those exhibited by *R. blanda,* and though other pale areas may exist on the wings of *R. maculata* they are never at all distinct.

There are a number of spotted rays found in the South Atlantic and Mediterranean, which all appear to possess the anterior border of ventral asperities, but are yet specifically distinct from *R. blanda.* The species which most closely approach it are *R. asterias* (Müll. and Henl.) and *R. punctata* (Risso); but of these the former, besides differing conspicuously in colour, has a very much larger mouth, while the latter, a very small species, has much larger teeth than *R. blanda.*

A species described under the name of *R. brachyura* by Lafont (Soc. Linn. Bordeaux, xxviii, 1873, p. 503, pl. xxv) may possibly be identical with *R. blanda,* but the description is very meagre and the figure primitive. It is impossible from the context to be certain whether a statement that there are no "aiguillons" on the ventral

surface precludes the presence of such asperities as are present in *R. blanda ;* while the figure, so far as it resembles anything that is likely to have an actual existence, is more like *R. asterias* than *R. blanda.* It having proved impossible to procure specimens of a spotted ray from the same locality, we are compelled to pass the species over as insufficiently defined.

Turning to British authors, Montagu's descriptive remarks apply only to the smaller British species of spotted ray, the varieties he mentions being merely colour phases. He states, however, that *R. maculata* grows to a larger size than *R. clavata,* which is not the case in any district with which I am acquainted. It is therefore possible that he knew the larger species, but did not recognise it as distinct. However, as his description is obviously based on the smaller, his claim as sponsor thereto holds good.

Day's figure of *R. maculata* is undoubtedly taken from an immature male of *R. blanda,* which appears from the scale given to have been about 25 inches across the disc. The author remarks that in this specimen the spots were rather closer together than usual, but the drawing does not strike one as a very successful illustration of either species. The description given in the text refers chiefly to the smaller species.

Couch evidently selected a specimen of *R. blanda* for special description, but his general remarks apply to both species, and his figure specially to neither, though probably taken, at least as far as the spots are concerned, from *R. maculata.* Subsequent to the publication of his work on the British fishes, the late Dr. Day described as new to Britain a spotted ray which he considered to be identical with *R. punctata,* Risso. It was stated, possibly by a clerical error, that the teeth were larger than those of *R. maculata.* The identity of the specimen is now lost, but the Day collection, now in the British Museum, contains a small spotted ray, which bore no label when received at South Kensington. It is undoubtedly a young example of *R. blanda,* but it remains uncertain whether it is the specimen recorded as *R. punctata.*

But if our ichthyologists have hitherto failed to distinguish between *R. maculata* and *R. blanda,* the same reproach cannot be urged against our fishermen and fish merchants. Under the names of Homelyn and Blonde, or Blund, respectively, these two species have long been recognised as distinct at Grimsby, and presumably at the other great fishing centres of the North Sea. It is true that, owing to the scarcity of young blondes, many are unable to distinguish the latter from homelyns, but certain specific characters are well enough known to those specially engaged in the skate trade. The name " blonde " is said to have been derived from the Belgian

fishermen, with what truth I know not; and in naming the species *R. blanda* we have made use of the Latin epithet which assimilates most closely in sound to the vernacular name in general use.

In conclusion we may be permitted to express our indebtedness to Dr. Günther for advice and references, and especially for invaluable aid in the comparison of specimens at the British Museum. Indeed, I may add that it was chiefly at his instigation that those inquiries were instituted which have now resulted, as I trust, in finally establishing the distinctness of the two species.

IV. The "Recessus Orbitalis," an Accessory Visual Organ in Pleuronectid Fishes.

I have applied the above name to a structure described in a paper read before the Zoological Society, of which the present remarks are a brief abstract. It first came under my notice when examining the cephalic anatomy of a common sole, but as I could find no mention of it in Cunningham's Treatise on that species, I supposed that the specimen before me might be exceptional. It proved, however, to occur regularly, not only in the sole, but in all other Pleuronectids which I examined, viz. the halibut, long rough dab, brill, plaice, flounder, and lemon "sole." The material at my command proving unsuitable for a study of its development, I am unable to form any very valid opinion as to its homologies, and can only put forward what I know of its condition in the adult.

The *recessus* in those species in which it is most conspicuously developed consists of a diverticulum of the membranous wall of the orbital cavity. It is sac-like in form, with very delicate membranous walls, except where the latter are traversed by anastomosing muscular bands. Such bands may also cross the lumen of the sac, and may even form more or less complete septa. The *recessus* of the lower eye lies below the skin immediately behind the eye, occupying a space bounded by the anterior face of the superficial jaw muscles, the backward continuation of the interorbital septum and the membranous wall of the orbital cavity. With this cavity it communicates by one or more rather large openings with thickened rims, and frequently by other smaller openings, the whole number being rather close together, and variable within the limits of a single species. In the brill the *recessus* of this eye is in the form of a conical process of the membranous wall, of which only the apex is strengthened by internal muscular apparatus. In the halibut there is no definite sac in connection with the lower orbit, but a portion of the membranous wall is differentiated by the development of numerous interlacing muscular bands, backed by very delicate mem-

branous sacculi. The condition first described, actually met with in the plaice, is sufficiently applicable to the other species mentioned.

The *recessus* of the upper eye is in all cases a definite sac, always larger than its fellow of the lower eye, and always situate on the blind side of the skull, and to some extent overlaid by the superficial jaw muscles of that side. It communicates with the upper orbital cavity by a narrow neck, which passes through the large foramen between the pseudo-mesial process of Traquair and the parasphenoid. It is essentially similar in internal structure to the fully developed organ of the lower eye. Its shape depends merely upon its topographical relationships.

In the fresh condition the *recessus* of either eye, when sac-like in form, is colourless and quite translucent, except for a slight milky opacity where the muscular bands are most numerous. It is, as may be supposed from the description of its internal structure, highly elastic, and is filled in life by a colourless fluid also present in the orbital cavity. It is rather richly supplied with blood-vessels, distributed on the inner face of the sac when such is present, and we may assume, as in the case of peritoneal and synovial cavities, that the fluid is deposited by mechanical filtration through the blood-vessels. In any case I have been unable to detect any special secretory apparatus in the epithelium of its walls. The only source of innervation which I have discovered is from the V. cranial, whether from sensory or motor roots I am as yet unaware.

The fluid coagulates after a time into a milky white plasma, finely granular in microscopic preparations, and taking on a faint pink stain from borax carmine, but the *recessus* retains its elasticity for some considerable time after death. Thus, if the eye is pushed inwards, the fluid is forced into the *recessus*, which thus becomes enormously distended; but as soon as the pressure is relaxed the *recessus* contracts, and the eye rises to its former level.

It will be familiar to those who have observed the habits of flat-fish in aquaria that the eyes are normally protracted to a considerable degree. If the fish is frightened by placing some object near the eyes, the latter are immediately withdrawn into their sockets, while a corresponding inflation may be observed in the region of the *recessus* of the lower eye—the only one which can be seen. As soon as the object of terror is withdrawn the eyes rise again. Now there is no protracting apparatus in the muscles of the eye, and it is evident that the mere relaxation of the oblique and recti muscles would be quite insufficient to protract so heavy an organ as the eye to the degree actually attained. It is therefore evident that this result is attained by the pressure of the fluid contents of the orbital cavity, and that the *recessus* is functional in

regulating these vertical movements,—in affording an outlet to the fluid of the orbital cavity when the eye is withdrawn by the contraction of the recti and oblique muscles, and in protracting it when these muscles are relaxed by driving back the fluid into the cavity. Its action appears to be almost if not wholly involuntary; but though one might expect to find a connection with the sympathetic system, I have not succeeded in doing so.

According to my observations, limited to Pleuronectes, Solea, and Rhombus, the power of protraction is possessed in degrees corresponding to the order in which I have named these three genera, and the *recessus* is developed in the same degree. That the organ of the upper eye is always the larger is explained by the condition of the orbital cavity. That of the lower eye is in part bounded only by loose skin, which allows some play to the elasticity of the undifferentiated part of the membranous wall when the eye muscles are contracted, and is also sensible to the pressure of the external element when the muscles are relaxed. The upper orbital cavity, however, bounded as it is by the skull and firm dorsal muscles, is wholly dependent on its accessory organ as an outlet for the fluid. The eye, in fact, could not possibly be retracted if no *recessus* were present. The great inequality in the accessory organs of the halibut, which exhibits the minimum development of the lower and the maximum of the upper *recessus*, is probably due to the convexity of the head, whereby the lower eye is set in a higher plane than the upper, which is also much nearer the dorsal ridge than in the other species studied. Hence it is evident that the pressure required to raise both eyes to the same level must be very unequal, but I have no means of saying from actual observation that the eyes are protracted to the same plane in life.

A pouch-like diverticulum of the membranous wall of the orbital cavity was discovered many years ago by Dr. Günther in *Chorinochdismus dentex*, one of the Gobiesocidæ. So far as I can tell from examination of the organ in a specimen that has been a very long time in alcohol, it corresponds well enough to the *recessus* of flat-fishes. Dr. Günther conjectured that it might represent a *saccus lacrymalis;* but though I am loath to speculate on this subject without a knowledge of its development, I am bound to say that the relationships of the organ to the orbital cavity do not appear to point to this homology. The organ lies between the eye and the maxilla, but the different position of the *recessus* of the lower eye in a flat-fish is only such as would be brought about by the rotation which we know to take place in the eye of a metamorphosing Pleuronectid larva. A difference in the levels of the eye in the British Museum series of *C. dentex* suggests that the function of the organ is similar

to that which I have demonstrated in the case of the *recessus ;* and very probably this structure, which I suspect to be no more than a specialised portion of the membranous wall, not homologous with any known visual organ in higher animals, may prove to have a wider distribution than is at present known to us.

V. On an Adult Specimen of the Common Sole with Symmetrical Eyes, with a Discussion of its Bearing on Ambicoloration.

Under the above title a detailed description of the specimen in question was communicated to the Zoological Society at a recent meeting. The fish is a female 15 inches long, differing from a normal specimen in no external feature of note except that the left (normally the upper) eye is nearly opposite to the right. The eye is partially withdrawn below the skin, and its vision doubtless must have been to some extent further impeded by the sensory filaments, which extend right up to the periphery of the cornea. Still, without doubt, the fish could see reasonably well with this eye. The left side is colourless, and the effect of the eye, which had the iris of the normal colour, peering out from the dead white surrounding region, was very striking in the fresh condition. On examining the skull it was found that the union of the left ectethmoid and sphenotic into the " pseudo-mesial process " of Traquair had taken place as usual, and had taken on its usual fibrous connection with the large ligament bone which underlies the interneural spines of the anterior part of the dorsal fin. The abnormality of the skull was, in fact, limited to a slightly less development of the left ectethmoid, especially of its anterior spur, and the greater size of the very variable foramen which exists between the pseudo-mesial process and the parasphenoid. This foramen normally gives exit to a cranial nerve, and puts the left *recessus orbitalis* into communication with the left (or upper) orbital cavity ; but in the specimen before us it is traversed by the muscles and the optic nerve of the left eye. The muscles have precisely their normal attachment, and the left ectethmoid has undergone the normal rotation. The eye rests internally against the pseudo-mesial process, and the general arrangement of the parts suggests that it has been drawn by the rotation of the attachment of the oblique muscles as far inwards as the interposition as the pseudo-mesial process has permitted it to go.

The question of ambicoloration is dealt with at some length in the paper, but the exigencies of space only permit me to notice a few points. In the first place it is evident that the occurrence of a normally coloured flat-fish with practically symmetrical eyes renders it evident that there is no necessary connection between the ambi-

colorate condition and the partial arrest of the migration of the upper eye met with in so-called "Cyclopean" examples. In making full reference to the recent important memoir of Messrs. Cunningham and MacMunn on the *Coloration of the Skin of Fishes* (Phil. Trans., 1894, p. 765), such additional material as I have examined points to a general acceptance of the opinions on ambicoloration therein formulated, but several minor details require a few words. Thus the restriction, apparent from the examples studied by these authors, of pigmentation of the lower side to the region posterior to an imaginary line drawn through the pre-operculum, in partially ambicolorate but structurally normal turbot, does not hold good in the case of one which has recently come into my hands. No malformation is apparent, but the anterior border of the continuous pigmentation is formed by a line which passes from the origin of the dorsal to the angle of the pre-operculum, and thence forward again across the lower part of the gill cover to the anterior end of the isthmus. In addition, the maxilla and a great part of the mandible are also coloured. Accordingly, while admitting that Cunningham and MacMunn's limitation covers the great majority of cases, we must hold that any degree of ambicoloration, short of completeness, may occur in the turbot without apparent structural abnormality.

The authors note that reliable records of the "Cyclopean malformation" are limited to certain genera and species, which do not include the sole, but are unable to discover any "correlation between the occurrence of this malformation and any peculiarity of the species in which it occurs." So far as the sole is concerned, this species has a skeletal peculiarity in the form of a great blade-like ligament bone interposed between the base of the front part of the dorsal fin and the top of the skull, which is not present in any of the genera in which the malformation has been observed. Taking into consideration the relationship of the parts concerned in the malformation, I suggest the possibility that this feature may supply the missing correlation. It is also possible, and perhaps more likely, that the burrowing habits of the sole would be fatal to the survival of a "Cyclopean" example of this species, since the length of the "hook" necessitated by the great forward extension of the dorsal would be a serious impediment to it, while all available evidence supports the opinion of the authors that their abnormal flat-fish do not differ at all in habit from their normal brethren.

The authors note the frequent occurrence in the brill of a form of ambicoloration in which spots of pigment occur in a series along the interneural and interhæmal regions of the lower side, and Bateson (in a communication to the Zoological Society which I have not yet in print) has pointed out that these spots are symmetrically arranged

with regard to the numbers of the dorsal and anal fin-rays. I do not find it stated, however, that these spots are obviously the survivors of those which are so conspicuous in the metamorphosing larvæ of nearly all flat-fish, and which occur, moreover, in the larval condition of many round-fishes. Further, the same series of spots are retained throughout life on the ocular side of some of the smallest Pleuronectids (*e. g. Rhombus norvegicus*), and I am strongly of opinion that the frequency of this form of ambicoloration in the brill points to atavism as an important factor in ambicoloration generally. Messrs. Cunningham and MacMunn cite a difficulty in the way of this interpretation of atavism, which I am unable to appreciate. It is that the "symmetrically vertically swimming ancestor of the flat-fish" must have had "an unpigmented white or silvery ventral surface, as other symmetrical fishes have," whereas in an ambicolorate flat-fish the dorsal and ventral regions are equally pigmented. But vertically swimming fishes are not all pale on the under surface, such forms as Platax and Dascyllus, in remotely related families, being as dark below as above; and it is surely reasonable to suppose that the flat-fish of to-day were derived from high laterally compressed fishes such as these, rather than from round-fish of the ordinary type. Even flat-bellied round-fish living at great depths may be as dark, or darker on the belly than on the back, as in the case of *Macrurus æqualis;* and I do not see why the fact, so ably demonstrated by Cunningham, that the colourless side of a flat-fish may retain the power of pigment production under favourable conditions of light, should not suggest to us that the pale ventral surface of a round-fish may be potentially darker, or even as dark as the dorsal region.

Another point which appears to me to distinctly hint at atavism as a factor in ambicoloration is the constant or very usual co-existence of what one may term "ambiciliation," *i. e.* the dermal armature is much more equally developed in ambicolorate than in normally coloured flat-fish. It is difficult to see how this can depend on the light, while it is quite intelligible that any reversion of the derma should react equally on the colour and the armament.

VI. The Reproduction of *Caranx trachurus*, Linn., the Scad or Horse-mackerel.

In my paper on the eggs and larval and post-larval stages of Teleosteans taken during the survey of the west coast of Ireland ("Sci. Trans. R. Dub. Soc.," vol. v, ser. 3, p. 9), I included some notes on the intra-ovarian egg of this species, as to the development of which no previous information was forthcoming.

The material then at my disposal seemed to justify the conjecture

that the ripe egg would be found to be pelagic, and similar to that of the mackerel, only smaller.

I am now able to describe the ripe unfertilized egg, having obtained a number of spawning females from the North Sea on the 19th May, 1894. Ripe males were obtained on the same day, but the milt appeared in bad condition; at all events, an attempt at artificial fertilization proved unsuccessful.

The fish, which were stated to have been caught on the previous day, appeared perfectly fresh, and on pressing those which appeared to be gravid the spawn was readily discharged. Somewhat to my surprise, the ripe ova were in most cases accompanied by a great number which were still opaque, though only gentle pressure was applied. When only ripe ova were ejected the whole mass had a distinctly yellowish colour, which I subsequently found to be caused by the fact that the oil-globule is usually of a bright orange colour to the naked eye. Under the microscope, whether by reflected or transmitted light, the globule appears cupreous. In the spawn of one individual the globules were practically colourless.

The eggs, for the most part, were not spherical, but were quite translucent, and floated buoyantly in the *estuarine* water of the Cleethorpes tanks. I estimated the diameter, in the spherical condition, to vary from 1·03 to 1·09 mm. The diameter of the oil-globule, when only one was present, varied from ·26 to ·27 mm., but some ova, when first extruded, exhibited two or three smaller globules which soon fused into one. *Motella mustela* and *Trigla cuculus* show a similar, if less rapid, fusion of the globules after deposition, and the last-named species also illustrates a similar variation in the coloration of the globules.

The zona, in the species under discussion, is very thin, and is sparingly and rather irregularly dotted with minute vesicle-like markings—a character noticeable in the newly deposited ova of many Teleosteans.

The chief peculiarity occurs in the yolk, which in the ova that seem to be ripe is perfectly colourless and translucent, and divided throughout its substance into a number of segments of varying size. The segments are mostly more or less rounded in outline, and the general appearance can be more aptly compared to that of a mass of small bubbles than to anything else. Fig. 1 shows the surface of such an ovum. It will be noticed that the segments do not overlie any part of the oil-globule, which appears invariably to occupy a small area of unsegmented yolk-substance. In most ova this area is confined to the immediate neighbourhood of the globule, but in one it occupied at least one third of the whole yolk mass. The segmented area was evidently encroaching by the formation of fresh segments,

as during the time I had the ovum under observation, a vesicle which appeared at first to be united by a narrow neck to the undifferentiated

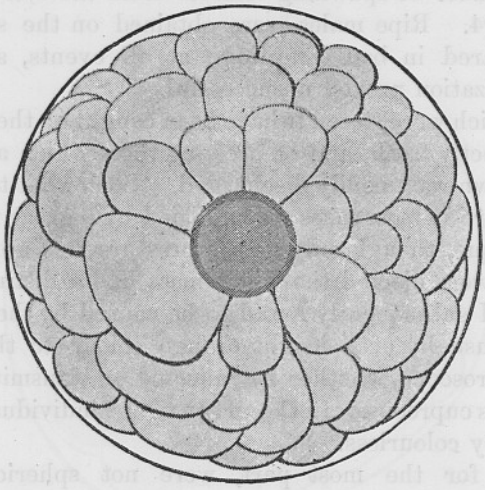

FIG. 1.—Unfertilized egg shortly after extrusion.

region became entirely separated from it. The process was probably taking place over the whole area, but it was only possible to observe the final constriction in the case of this particular segment, as none of the others were in profile. I conclude that the formation of the yolk segments takes place after the hyaline enlargement of the ovarian egg has manifested itself, and, so far as my observations go, it appears to extend gradually from pole to pole. I am inclined to suspect that it may extend more rapidly along the periphery, since in examining some ova immediately after extrusion I failed to satisfy myself that the central region was segmented. Others, however, at the same stage, and all older living ova examined, were segmented throughout.

I attempted artificial fertilization, but do not think it was successful. Forty-eight hours later all the ova were dead, except a few kept in a vessel to which no milt had been applied. These last presented the appearance shown in Fig. 2. A very slight perivitelline space had appeared, and there was a small and slightly opaque blastodermic cap : the character of the yolk was unchanged, and the eggs still floated.

The dead ova in all the vessels, whether supplied with milt or not, exhibited a similar blastoderm, which, as is well known, frequently appears without fertilization. The yolk presented a peculiar appearance, the segments being restricted to an irregular mass

underlying the blastoderm (Fig. 3). None were visible in the vegetative third of the yolk mass, nor did they extend, as a rule, to the periphery in any region. The blastoderm was opaque and granular. as was also, but to a less degree, the unsegmented part of the yolk,

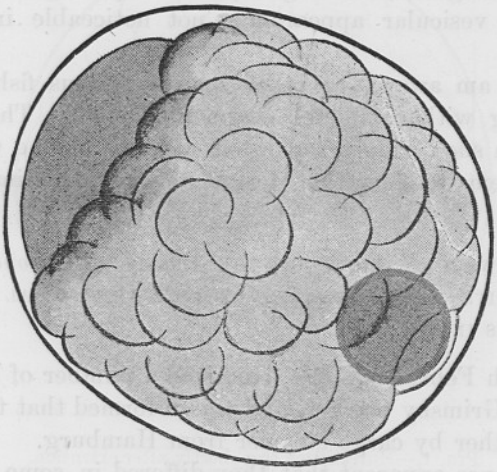

FIG. 2.—Living unfertilized egg forty-eight hours after extrusion.

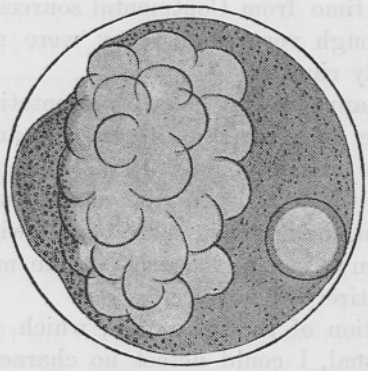

FIG. 3.—Dead unfertilized egg forty-eight hours after extrusion.

The segmented part, however, retained in great measure its former translucency, but the segments, especially those near the surface, were very irregular. I consider that this condition was arrived at by decomposition setting in from the periphery, involving the breaking down of the peripheral segments, and not by a shrinkage of the segments towards the central area.

To recapitulate: the egg of the scad is pelagic, and measures

about 1·03 to 1·09 mm. in diameter before fertilization ; it possesses a single oil-globule, ·26 to ·27 mm., either colourless or of a bright orange colour (and probably of any intermediate tint), which presumably disappears more or less with the development of the egg. The perivitelline space is probably small. The yolk is colourless, and segmented throughout, the segments in early stages having a very characteristic vesicular appearance, not noticeable in the ova of Clupeoids.

So far as I am aware, no other acanthopterous fish is known to possess an egg with completely segmented yolk. The existence of this feature in such widely separated families as the Clupeidæ and Carangidæ seems to show that it is of no taxonomic importance.

VII. On a Dwarf Variety of the Plaice (*Pleuronectes platessa*, Linn.), with some Remarks on the Occasional Ciliation of the Scales in that Species.

On the 28th February, 1894, I noticed a number of boxes of small plaice in the Grimsby market, and was informed that they had been consigned thither by cargo steamer from Hamburg.

It was at once apparent that they differed in some respects from the small plaice landed by our own fishing-boats, as also from any that I had hitherto examined among consignments which reach this port from time to time from Continental sources. It was evident, in fact, that, although very small, they were nearly all sexually mature, and actually ripe.

I selected what appeared to be a representative series for closer examination at the Cleethorpes Laboratory, and found that the smallest ripe female measured only 9½ inches in total length, whilst the largest fish of the lot, also a ripe female, was only 13½ inches long. My selection, having been made mainly with a view to inquiry as to size in relation to sexual maturity in the more important sex, consisted almost entirely of females.

With the exception of the coloration, which was in some individuals rather unusual, I could detect no character in which these fish differed to an appreciable extent from the North Sea examples with which I am familiar, but from the presence in the same consignment of a number of unusually spinous flounders (*P. flesus*, Gottsche) I formed the idea that they must have been caught in some locality to which our own vessels never penetrate.

I need hardly say that, in view of the opinion I have expressed in this Journal and elsewhere as to the large size at which North Sea plaice first begin to spawn, the occurrence of such small mature examples (possibly from a North Sea ground) came as rather a shock to me.

Therefore when, through the courtesy of Mr. G. H. Mudd, I had been put into communication with the consigners, I was greatly relieved to find that the fish were actually caught in the Baltic, and not in the North Sea at all.

Since it appeared to be within the bounds of possibility that the very unusual weather of last summer might have had some effect in accelerating the maturation of the sexual organs in young fish, I had in the meantime examined a number of small plaice which were being brought into the market from the usual sources (including a large number landed by a German steam-trawler from the Horn Reef), but found the conditions to be precisely similar to those which I had noted and recorded in previous years.

The Hamburg merchant from whom I derived my information as to the origin of the small spawning fish also tells me that they never grow to a large size and are sometimes called "Golden butts." Now "Goldbutt" is the vernacular name which Gottsche found to be applied to what he considered the most typical examples of *Pl. platessa*, Linn. He describes two varieties, *Pl. borealis* and *Pl. pseudoflesus*.*

The points in which the latter variety differs from the type (of Gottsche) are indicated as the presence of ciliated scales on the ocular side (on the sides of the head and of the abdomen, along the lateral line, and along the bases of the dorsal and anal fins), and the small number of the dorsal and anal rays. This variety, in which, as is implied by the description given by Smitt,† the blind side may also be to some extent ciliated, is stated by that writer to be identical with Nilsson's var. *baltica*, and to be commonest in the Sound and the Baltic. I do not find that Gottsche expressly mentions that it has been taken in the North Sea, since its occurrence in Hamburg market is no proof of this. Kroyer, however, has recorded it from Hästholm.‡ Gottsche noted that "gold butt" first appeared in the Hamburg market in winter, and only rarely. At Copenhagen they were in the market the whole of summer. Most were taken in Oresund. *Pl. pseudoflesus* are simply stated to have been taken in company with "gold butt."

I had considered it very probable that *Pl. pseudoflesus* occurred amongst the small plaice which are constantly landed at Grimsby during the spring and summer from the opposite coast of the North Sea, but had never succeeded in finding any, nor, among the first lot which I obtained from the Baltic, could I find any trace of ciliation. As I have already remarked, those which I examined were

* Wiegm. Arch., 1835, p. 143.

† Hist. Skand. Fish., ed. 2, 1893, i, p. 393.

‡ *Teste* Smitt, loc. cit.

nearly all females, a point worthy of note in this connection. The number of fin-rays, however, presented some approach to the formula given by Gottsche, but the variation was in excess of that therein indicated, since some of the specimens had as many rays as a typical North Sea plaice.

Two other consignments of small Baltic plaice were received at Grimsby a little later, and I again examined a number of specimens. In one consignment I found a single fish with very well-marked ciliation, but the rest of those which I handled appeared in the somewhat dim light of the fish market to be quite smooth. In the third consignment a box proved to contain nearly equal numbers of ciliate and smooth examples. The ciliation was present in different degrees, so that there was an absolute continuity in the series from the perfectly smooth to the fully ciliate condition.

In those examples in which the ciliation is most strongly marked, the scales on the head and interspinous regions of the ocular side have the free margin produced into from two to four distinct spines, which are outwardly directed, so as to project vertically to the surface of the body. The scales of the median region of the body are only feebly or not at all ciliate, the spines when present being more numerous than those in the regions previously referred to, but much smaller and not outwardly directed. The scales on the ocular sides of the fin-rays are also feebly ciliate.

On the blind side the ciliation is much less marked, and is altogether absent from the scales on the prominent parts. The scales on both sides exhibit a certain degree of imbrication, but not more than may be observed in young examples of ordinary North Sea plaice, the non-imbrication of the scales in this species being a character only entirely applicable, at best, to large examples.

The proportions of the small Baltic fish, whether ciliate or smooth, are of no service in distinguishing them from ordinary plaice, but some of the ciliate examples are rather strikingly coloured.

The following notes were taken from the fresh condition :—Ocular side reddish brown, with a number of orange spots. Of these the larger are irregular in shape, and surrounded by a narrow pale "halo," while each scale in the orange part is outlined with dark brown. The largest spot, in an individual 10 inches long, measured $\frac{7}{16}$ by $\frac{3}{8}$ inch. These spots occur chiefly on the dorsal half of the body, viz. along the interneural ridge, and dorsal to the lateral line. The smaller orange spots are also most numerous on the dorsal half. A number of dark brown or blackish spots, some interspersed with a little orange, occur chiefly on the ventral half. Rows of large blackish patches, some with an orange centre, occur along the dorsal and anal fins, and some small dark markings are present on the

caudal fin. The blind side has the semi-translucent whiteness characteristic of normally coloured plaice.

Most of the smooth examples which I examined had only small pale orange spots, rather few in number and remote from each other. Such was also the case in only slightly ciliate examples, but both series showed intermediate degrees of coloration, rendering it impossible to draw any absolute distinction based on colour alone.

While dealing with the coloration it is worthy of remark that amongst a number of flounders (*Pl. flesus*) present in the consignments of small plaice, some were pigmented in very much the same way as the most ciliate of the plaice, but had no dark pigment, while the blind side was dead white. Other flounders in the same consignment were uniform brown or blackish brown (on the ocular side).

The flounders were very much more spinous than any which I have seen from our own coasts, practically the whole of the ocular surface being in some cases covered with rough tubercles, which were also present to a considerable degree on the blind side. According to Smitt (op. cit., p. 397) Scandinavian flounders appear to be also more spinous than our own, in which the tubercles, according to my experience, are confined to the lateral line and the bases of the dorsal and anal fins. On examining examples from the Atlantic coast of Denmark I find some in which the spinulation is rather in excess of that exhibited by British specimens, a condition which might be expected from the intermediate position of the locality.

To return to the Baltic plaice, I handed over a series of ciliate and non-ciliate examples to Dr. Günther, who suggested that the ciliate ones were the males. I know of no observations which support such an opinion, but, on examining those which I had reserved for my own use, I find that it appears to be correct.

I append a list of the fish examined for this purpose.

Inches long.			
A. $12\frac{1}{4}$	Smooth; female; mature	D. 75	A. 55
B. $11\frac{3}{8}$	„ „ „	„ 72	„ 51
C. $10\frac{5}{8}$	„ „ „	„ 67	„ 54
D. 10	„ male; immature	„ 75	„ 55
E. 12	Head feebly ciliate; female; mature	„ 68	„ 53
F. 9	Head and interspinous regions ciliate; male; mature	„ 67	„ 51
G. $9\frac{3}{4}$	„ „ „ „ „	„ 69	„ 52
H. $8\frac{3}{8}$	Ciliation extending a little on to trunk „ „	„ 72	„ 52
J. $9\frac{3}{8}$	Intermediate between H and L „ „	„ 64	„ 48
K. $9\frac{3}{8}$	„ „ „ „	„ 70	„ 54
L. $11\frac{1}{2}$	Everywhere ciliate except in immediate neighbourhood of pectoral; male; mature	„ 72	„ 54

The details of ciliation given above refer to the ocular side.

In ten other non-ciliate examples, all or nearly all females, the fin-

ray formula was D. 63—74, A. 47—55. The formula of all which I have examined is therefore D. 63—75, A. 47—55, and it is evident from the condition in those separately enumerated that the formula shows no grounds for suggesting a distinction, other than sexual, between the ciliate and smooth examples. I have omitted to transcribe the proportions, as they differ in no degree inexplicable as individual variation.

The inferences which appear to be permissible from the details enumerated above are as follows :—(1) The female, in these dwarf Baltic plaice, is either smooth, or ciliated only on the head. (2) The male is almost always more or less ciliate ; perhaps always ciliate when mature, the ciliation increasing with the growth of the fish.

I may add that none of my examples show the ciliation especially conspicuous along the lateral line, though this has been given as a character of *Pl. pseudoflesus*.

It would appear, then, that the variety last named is merely the male of what Gottsche considered to be the typical form of *Pl. platessa, i.e.* the "gold butt." The "scholle," the variety *Pl. borealis* of the same author, appears to be the ordinary North Sea plaice.

Apart from these Baltic fish, I have met with instances of ciliation in two other examples of the plaice. The first was a mature male, $19\frac{3}{8}$ inches in length, taken in April of the present year on the Great Fisher Bank. In colour and general appearance it resembles a number of normal examples taken at the same time, but the scales on the ocular side have about 8 to 10 very short pectinations in the central region of the posterior edge. On the blind side the scales are either smooth or only very feebly ciliate.

The other example is a male from Iceland, $24\frac{1}{2}$ inches long. The ciliation of the ocular side is much the same as in the Fisher Bank specimen, but the scales of the blind side are smooth. In both examples the scales of the caudal region imbricate to some extent, but not more than in smooth fish from the same locality, and the ciliation is by no means confined to this region of the body.

There is good reason to believe that there is a regular migration of plaice between the Fisher Bank and the north-west coast of Denmark (and probably also the Sound), and that, in fact, the Fisher Bank plaice are reared on the Danish coast. It is not, therefore, surprising that ciliate examples should be met with both on the Fisher Bank and at Hästholm.

It seems probable enough that the characters of ciliation and size would be found to vary in a degree corresponding to the locality if a series could be obtained from the different parts of Denmark, from the Baltic to the southern region of the North Sea coast. No such material, however, is available, and all that can be said, in view of

observations recorded above, is that the diagnosis of *Pl. platessa* must be so amended as to allow for the occurrence of ciliated scales, especially in males.

Judging by the analogy of fresh-water fish (*e. g. Salmo*, &c.), it seems quite possible that fish which reach a large size in the North Sea might remain permanently stunted if confined to the Baltic. On such an hypothesis one might regard the small mature Baltic plaice as distinct in nothing, save environment, from their larger brethren in the North Sea. The very general ciliation of the males in the former, and the rarity of this character in the latter seems, however, to show that a more important distinction exists, and that the small fish are a true variety, indistinct enough, no doubt, if specimens from intermediate localities could be procured. Living ova, which I took from some of the specimens described above, measured from 1·706 to 1·796 mm. in the unfertilized condition, dimensions which overlap the extremes recorded for the ova of Atlantic plaice, but which nevertheless yield a considerably less mean diameter. That the Baltic herring are considerably smaller than the North Sea and Atlantic representatives of the same species is well known, and it would appear that the difference in size is apparent from the earliest stages, since the former, when newly hatched, are only 5·2 to 5·3 mm. long (Kupffer), and therefore about 2 mm. shorter than such newly hatched North Sea larvæ as have come under my own notice (Ann. Mag. Nat. Hist., 1889, p. 369).

On the other hand, the flounders which I found amongst the consignment of Baltic plaice were fully as large as those met with on our own coasts, and it is a significant fact that the flounder is a fish which flourishes best in brackish or even in nearly fresh water. The low specific gravity of the Baltic water is familiar to everybody, as is also the fact that its existing fauna differs, in the absence of certain marine organisms, from that of the open sea. Hence it is very interesting to note that these small plaice appear to reach a limit of size (about 13½ inches) which practically corresponds to the size which is attained by a young North Sea plaice before it leaves such an estuary as the Humber for the offshore grounds. It is, no doubt, the quest of food suitable to its increasing needs that causes the emigration of the young North Sea fish, and even without special knowledge of the food-supply in the Baltic, it is perhaps permissible to assume that it is the inadequacy of the food that limits the growth of the goldbutt. It is restricted, in fact, to a permanently estuarine condition.

The question of dermal armature in relation to environment is much more difficult, and I am not at present prepared to attack it; I may say, however, that materials which I have been accumulating

point to some conclusion in which the theory of protection has no very obvious place.

VIII. On some Specimens of *Molva abyssorum*, Nilss., from Iceland and Faroe.

The present note is a brief abstract of a paper read before the Zoological Society in May of the present year. The species was previously known only from the coast of Scandinavia, where it occurs chiefly at depths exceeding 100 fathoms, and appears to be known as the Birkelonge, or "Trade Ling." I was able to show that it occurs regularly, if in rather small numbers, on the lining grounds off Faroe, and has also been taken, both by line and trawl, on the south coast of Iceland.

The species may be described as differing from the common ling (*M. vulgaris*, Flem.) chiefly in characters which, in Gadoid fishes, have been found to be indifferently associated with either an abysmal or a boreal habitat. Thus the maximum size reached is smaller, the eye larger, the fin-rays more numerous, the body more slender and elongate, and the caudal peduncle very much more slender than in the common ling. The visceral anatomy shows very well marked characters; the liver is very large, and the walls of the alimentary canal extremely delicate—so much so, in fact, that it is difficult to lift the intestine, even in fresh specimens, without rupturing it. Besides being more delicate, the intestine is also much shorter than that of the common ling, while the stomach is much larger. The comparative shortness of the intestine has been noted by Günther in the case of a deep-sea member of the Percidæ, and a reduction in the thickness of the walls of this structure appears to be strictly comparable to the reduction noticeable in the bones and muscles of deep-sea fish generally.

The air-bladders of the two species of ling do not differ materially, but the kidney of the deep-sea fish is less swollen in its posterior region than that of *M. vulgaris*. Moreover the so-called head-kidney in *M. abyssorum* is more definite in outline than the corresponding structure in the common ling, and was found to be typically reniform in structure and obviously functional. The head-kidney of the common ling, however, contains a certain amount of reniform matter, and cannot be regarded as wholly functionless.

At the time my remarks were written, the only figure of *M. abyssorum* which I was able to discover was a small outline drawing given by Ström (Sond. Beskriv.), and I had therefore appended a larger and more detailed figure, adding another of the common species for purposes of comparison. However, before my

paper was communicated to the Society, the appearance of Smith's edition of the History of Scandinavian Fishes (Lond., 1893) supplied coloured illustrations of both species. The figure of *M. abyssorum* differs from my own specimens, and from the descriptions given by other authors, in that the upper jaw is shown as longer than the lower. In all my own specimens, seven in number, the lower jaw projects distinctly, but Smith states that the contrary was the case in those which had come under his notice. They appear to have been of rather smaller size, and there is an indication in my own series that the relative length of the lower jaw increases with the growth of the fish. This is well known to occur in *Gadus virens*, in which the relative lengths of the jaws in the young are completely reversed in the adults, but I do not think it can occur to anything like the same extent in the species under discussion.

My paper, besides dealing at length with the points referred to above, gives detailed measurements of all the specimens, and discusses the relative antiquity of the two species. My conclusion that *M. abyssorum* is a specialised offshoot from a form not greatly differing from the common ling of the present day is exactly opposite to that arrived at by Prof. Smith, who holds *M. abyssorum* to be "essentially the predecessor" of the other. To me it appears impossible to accept this view without also regarding the typically abysmal Gadoids as more primitive than the littoral forms, and such an inference seems wholly unsupported by the interpretation which the present state of our ignorance permits of the evidence of the subject.