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OF THE

MARINE BIOLOGICAL ASSOCIATION

OF

THE UNITED KINGDOM.

THE PLYMOUTH LABORATORY.

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E. W. L. HOLT, Esq. | W. GARSTANG, Esq., M.A.

Marine Biological Association of the United Kingdom.

Report of the Council, 1892-93.

The Council.

During the past year the Council has held eight meetings for the conduct of the business of the Association, of which the meeting on May 20th and 22nd was held at the Plymouth Laboratory.

Sir Albert Rollit, M.P., Mr. W. T. Thiselton Dyer, C.B., C.M.G., and Mr. Frank Crisp, V.P.L.S., have retired in the course of the year, owing to the numerous calls upon their time: the first vacancy was filled by the election of Prof. W. C. McIntosh, F.R.S.; the others are to be filled at the General Meeting.

As in previous years, the Council has pleasure in acknowledging the courtesy of the Royal Society in permitting the use of its rooms for the several meetings of the Association.

The Plymouth Laboratory.

The buildings, fittings, and machinery of the Laboratory are in a satisfactory condition, and have not necessitated any special outlay. A small sum has been spent in painting and wainscoting the Tank Room.

The Boats.

The question of the boats has occupied the Council very seriously during the past year. The old steam-launch "Firefly" is still at work, although it was decided to replace her a year ago. A new steam-launch, of about the same size as the "Firefly," was recently purchased, but has proved to be unsuitable for rough work. The little sailin boat "Anton Dohrn" is in excellent repair, and continues to be very useful.

As the work of the Association increases, the need of a deep-sea-

going boat is constantly more pressing, but there are no funds in hand sufficient for its purchase and maintenance. This need has been particularly felt of late in the fishery inquiries in which the Association has been engaged in the North Sea as well as at Plymouth.

The Library.

The Library continues to make steady progress. Among the more important additions during the past year are the Fishery publications of England, Scotland, and Ireland; of the United States, Canada, and Newfoundland; of Germany, the Netherlands, Norway, Sweden, and France (Marseilles). Important contributions relating to the German Plankton Expedition, and to the cruises of H.H. the Prince of Monaco have also been added. Valuable gifts of their publications have also been made by the Royal Society, the Zoological Society, the Royal Microscopical Society, the Harvard Museum, the Australian Museum, the Bergen Museum, the College of Science at Tokīo, the Royal Society of Victoria, the Natural History Societies of Denmark, Norway, the Netherlands, Boston (U.S.), and others. To these Societies, and to the numerous donors of books and papers, the Council render the thanks of the Association.

The Museum.

The type-collection is increasing satisfactorily under Mr. Garstang's care.

In addition to the specimens at Plymouth, a series of selected specimens has been arranged and mounted for exhibition, and has been greatly admired on the six occasions when it has been shown, namely, the second Conversazione of the Royal Society, 1892; the Conversazione of the Sheffield Literary and Philosophical Society, 1892; the Soirée of the Royal Microscopical Society, 1892; the Sea Fisheries Conference, Fishmongers' Hall, 1893; the two Soirées of the Royal Society, 1893. This exhibition series is being enlarged.

The Staff.

The Council in January last accepted Mr. Calderwood's resignation of the office of Director, and appointed Mr. E. J. Bles, B.Sc., late Honorary Research Fellow of the Owens College, Manchester, in his place. Mr. Bles entered upon his duties on April 12th of this year.

Owing to the generosity of Mr. J. P. Thomasson, who has made a second donation of £250 for this purpose, it has been possible for the Council to retain the services of Mr. Holt for fishing inquiries in the North Sea for a second year.

Mr. Garstang has been appointed for a second year to superintend the collection, preservation, and supply of material. The character

of the specimens supplied by the Laboratory has improved very greatly under his care.

Scientific Investigations.

Mr. Cunningham has continued his observations on the rate of growth and probable ages of young fish, a paper on which was published in the November number of the Journal. He has also continued his experiments on the colouration of the underside of flat-fishes. Since Christmas he has been occupied in an inquiry into the question of the destruction of immature fish, the first results of which appear in the May number of the Journal.

Mr. Cunningham has also succeeded in artificially fertilising the eggs of the flounders which he has reared in the Laboratory tanks during the last three years from a length of half an inch; the eggs developed, and the larvæ were artificially fed for ten days after the absorption of the yolk-sac. This result is of great importance and interest.

Mr. Holt has been at work now for eighteen months upon an investigation of the fisheries of the North Sea, and his papers in the Journals for November and May supply a large amount of important information. The Council contribute to the expenses of the Cleethorpes Aquarium of the Marine Fisheries Society (Grimsby) in return for Mr. Holt's use of their Laboratory and tanks.

Mr. Garstang has captured a large number of rare forms during the past year, on which and on other points of interest he contributes a weekly note in 'Nature,' and he has added five new species to the list of the British fauna. As a result of his work during the past year, an intimate knowledge of the localities of the fauna has been acquired, so that specimens can be obtained without delay.

Occupation of Tables.

The following naturalists have occupied tables in the Laboratory during the past twelve months:

E. J. Allen, B.Sc., University College, London (Development of Palæmonetes).
E. J. Bles, B.Sc., The Owens College, Manchester (Pelagic Fauna).
F. J. Cole, Assistant to G. J. Romanes, Esq., F.R.S. (Pleuronectid larvæ).
F. W. Gamble, B.Sc., The Owens College, Manchester (Turbellaria).
R. T. Günther, B.A., Oxford (Development of Cephalopoda).
S. J. Hickson, M.A., D.Sc., Cambridge (Alcyonium).
Gregg Wilson, Edinburgh, (Senses of Fishes).

Mr. M. S. Evans, F.Z.S., of Natal, also attended the Laboratory in order to learn the best methods for the preservation of animals.

In addition to those which have appeared in the Journal, the following papers, the outcome of studies made in the Laboratory, have appeared in the publications of learned Societies and in scientific

periodicals since the publication of the last list (Journ. M. B. A., ii, 281) :

Allen, E. J.—*The Nephridia and Body-cavity of some Decapod Crustacea*, Quart. Journ. Micr. Sci., xxxiv, 403.

Gamble, F. W.—*Contributions to a Knowledge of British Marine Turbellaria*, Quart. Journ. Micr. Sci., xxxiv, 433.

Garstang, W.—*The Development of the Stigmata in Ascidians*, Proc. Roy. Soc., li, 505.

—— *On some New or Rare Marine Animals discovered on the Coast of Devonshire*, Trans. Devon. Ass., 1892, 377.

—— *On the Structure and Habits of* Jorunna Johnstoni, Conchologist, ii, 1.

Groom, T. T.—*On the Early Development of Cirrhipedia*, Proc. Roy. Soc., lii, 158.

Minchin, E. A.—*Observations on the Gregarines of Holothurians*, Quart. Journ. Micr. Sci., xxxiv, 279.

Weldon, W. F. R.—*Certain Correlated Variations in* Crangon vulgaris, Proc. Roy. Soc., li, 1.

Willey, A.—*Observations on the Post-embryonic Development of* Ciona intestinalis *and* Clavelina lepadiformis, Proc. Roy. Soc., li, 513.

—— *Studies on the Protochordata*, Quart. Journ. Micr. Sci., xxxiv, 317.

Select Committee of the House of Commons on Sea Fisheries.

This Committee was nominated to inquire into possible measures for the improvement and preservation of British Sea Fisheries. A Committee of the Council was appointed to consider the extent and form of the evidence which the Association could tender; and Prof. Lankester, Dr. Günther, Mr. Cunningham, and Mr. Holt appeared before the Select Committee on June 13th and 15th.

Finance.

The Receipts for the past year include the annual grants from H.M. Treasury (£1000) and the Worshipful Company of Fishmongers (£400) : annual subscriptions have produced £160, composition fees £16, the rent of tables at the Laboratory £34, the sale of specimens £205, and the admission to the tank-room £70 ; the total amounting, with lesser sums, to £2199.

The Vice-Presidents, Officers, and Council proposed by the Council for 1893—1894 are:

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DR. *Statement of Receipts and Expenditure for the Year ending 31st May, 1893.* CR.

RECEIPTS.	£ s. d.	£ s. d.
To Balance from last year, being Cash in Bank and in hand less outstandings (General Fund and Bait Investigation Fund).....		106 16 6
„ H. M. Treasury		1000 0 0
„ Fishmongers' Company		400 0 0
„ Donation, J. P. Thomasson, Esq.		250 0 8
„ Annual Subscriptions		160 12 0
„ Composition Fees and Donations		16 5 6
„ Rent of Tables £34 0 0		
„ Sale of Specimens 205 16 9		
„ Sale of Journal 20 6 1		
	260 2 10	
„ Sale of Monograph	6 15 7	
„ Admission to Tank Room	70 0 10	
„ Interest on Investment	35 2 0	
		372 1 3
„ Balance forward, being amount overdrawn at Bankers less Cash in hand (General Fund and Bait Investigation Fund) ...		196 13 8
		£2502 9 7

Examined and found correct.

F. JEFFREY BELL,
S. E. SPRING RICE,
EDWIN WATERHOUSE,
C. STEWART,
} *Auditors.*

EXPENDITURE.	£ s. d.	£ s. d.
By Salaries and Wages :		
Director	205 0 0	
„ Allowance for Assistant.....	67 3 4	
Naturalist	250 0 0	
Mr. E. W. L. Holt, North Sea Investigation	200 0 0	
Mr. W. Garstang (Assistant Naturalist)	150 0 0	
Wages, Salaries of Clerk, &c.	350 17 0	
		1223 0 4
By Stationery, Office Printing, Postage, &c. ...		138 10 0
„ Printing and illustrating Journal		106 1 4
„ Purchase of Steam Launch.....		290 13 2
„ Sundry Expenses :		
Gas, Water, Coal, Oil, &c. ... £110 14 5		
Coal and Water for Steam Launch 36 3 2		
	146 17 7	
Stocking Tanks, Feeding, &c.	72 6 5	
Glass, Chemicals, Apparatus, &c. 139 3 2		
Less Sales to table renters 12 3 2		
	127 0 0	
Maintenance and Renewals of Building, Boats, and Nets	123 2 10	
„ Rates and Taxes	26 10 6	
„ Boat Hire	33 15 6	
„ Travelling.....	57 8 1	
„ Library	45 14 3	
„ North Sea Investigation at Cleethorpes, Grimsby	90 13 1	
„ Immature Fish Investigation.....	20 0 0	
„ Labrador Investigation	0 16 6	
		744 4 9
		£2502 9 7

Investment held 31st May, 1893 :
£900 Forth Bridge Railway 4% guaranteed Stock at 125...£1125 0 0

Director's Report.—No. II.

Some explanation is due to the members of the Association for the delay in the publication of the Journal, which in the ordinary course would have appeared in November, 1893. It is proposed for the future to issue the half-yearly parts in July and January, and accordingly the publication of the present number was deferred from November of last year to January, 1894. Unforeseen circumstances affecting myself have caused a further postponement, but the customary punctuality in the appearance of the Journal will be observed in the future.

One of the main objects of the Laboratory has been fulfilled since my last report (May, 1893) by the constant presence of zoologists in addition to the two naturalists on the staff. Their names are given below.

The field for investigation in marine botany and in the physiology of marine animals is at least as wide as that in marine zoology, yet neither a botanist nor a physiologist has made use of the resources of this Laboratory, where their work could be carried on with the minimum of trouble and inconvenience. A most interesting and important botanical problem, to mention one only which could well be studied at Plymouth, would be the nutrition and excretion of marine algæ, and the manner in which they affect the sea water they live in, under varying physical and chemical conditions. The physiology of marine animals, as far as it is known, has largely been the study of zoologists, who have made occasional observations on the living animals observed, and it is much to be desired that specially trained physiologists should apply modern methods to research on marine Invertebrata. By acquiring a quantity of well-established data for comparison with Vertebrates, the science would be made broader in its scope, and some questions of fundamental importance could be brought nearer to solution by the application of the methods of comparison. A subject which, from work already done, promises important results is the action of the various coloured and colourless circulatory fluids in the respiration of marine animals. There are a number of highly interesting questions connected with

the chemistry of sea water on the one hand, and the influence of bacteria upon its composition on the other, which can only be properly studied in a well-fitted marine biological laboratory. Even the purely chemical side of this subject has so far hardly been touched upon, and next to nothing is known of the quantity and behaviour of the combined nitrogen in different sea waters.

What I wish to make clear is that the Laboratory is not devoted exclusively to the use of zoologists, and that the means for the pursuit of any branch of science as applied to the sea and its contents will readily be supplied, and those who will undertake the work heartily welcomed.

Repairs and alterations in the building concern chiefly the west block. The passages and staircase walls have been distempered and painted. The laboratory known as the physiological room, occupied at present by Mr. Garstang, is used for the purposes of the specimen department, but, if necessary, would serve, as it has done before, for physiological experiment. The new fittings include a slate-top table (seven feet by three feet) with a leaden sea-water supply pipe running along the wall behind it, and pierced for six vulcanite nozzles. A bench for microscope work, drawers, cupboards, and shelves have also been added. In the same room I have provided an earthenware sink, with several fresh-water jets, which is enclosed in a cupboard with a rising wooden front (like a sash window), and serving to darken the sink completely, while specimens are washing in a stream of water after treatment with reagents susceptible to the influence of light, as osmic acid, chromic acid, &c.

The old steam-launch, the "Firefly," has done good service in spite of her many and great disadvantages for our purposes. Since December last she has been finally laid up, and the eighteen-foot sailing-boat, the "Anton Dohrn," has been made good use of inside the Sound during the recent continuously stormy weather. The sea has been too high for work outside the Breakwater, but on calmer days a fast steam-tug, the "Lorna," is always at our disposal, on hire.

Notwithstanding the fact that the past winter has been one of the coldest known for fifty years in Devonshire, the condition of the fish in the aquarium has remained extremely good, and none have died as in former winters. The red mullet referred to in Mr. Cunningham's note have lived in the tanks since August last, and are all perfectly healthy. The whiting have been, and plaice and flounders still are spawning. The eggs of the spotted dog-fish, *Scyllium canicula*, which have been fertilized and laid in the tanks, have developed normally during the winter.

I have placed between the tanks a series of water-colour drawings

of the permanent inhabitants, carefully copied from life by Miss A. Willis of Plymouth. The variety of the animals in each tank, and other obvious reasons, made it difficult to directly label each with its name; the pictures, however, supply the want to a large extent, and can often be examined more closely than the animal itself in order to help to confirm observations on colour, structure, &c.

These drawings were shown as part of an exhibit from the Association at the Cornwall County Fisheries Exhibition held at Truro in August, 1893. A complete set of nets actually used at the Plymouth Laboratory for natural history purposes was also contributed. The most successful and a very popular part of the exhibit was the collection of fishes (showing larval and post-larval development), brachyuran crustacea, and opisthobranchiate mollusca. The specimens were all collected by the Naturalists to the Association, and arranged for exhibition by Dr. Fowler.

The Exhibition is of more than passing interest, for it will have an important permanent outcome in the Cornwall County Fisheries School. The Exhibition has been the means of arousing public interest for the scheme initiated by Mr. E. W. Rashleigh of Kilmarth, a member of the Association, and his plans are now on the point of being realised. His results will, no doubt, be followed with great interest, and should have the full sympathy of the members of the Association. So far the County Council has given its approval and support, and the choice of a locality is at present under consideration.

The inquiry into the distribution of the anchovy in the Channel has been continued. The reward offered brought in less than twelve fish to the Laboratory from the end of October to the middle of December. Thus there is reason to believe that anchovies, like herring, pilchard, and mackerel, have in the past season been scarce in this part of the Channel. An attempt was made to obtain them with our own anchovy nets on the night following the capture of a few specimens three miles south of the Breakwater, but without success.

After numerous trials it has been found quite feasible to send most of the animals caught in dredge and tow-net alive to any part of the United Kingdom and Wales. Accordingly a new price-list has been prepared, giving a selection of the commonest and most interesting animals of each group, with two prices for each; one for the living animal, and the other, slightly higher, for the preserved specimen. By giving ample notice teachers and others can always rely on obtaining certain living animals on certain days, as we can secure them in advance when necessary and keep them alive until wanted.

EDWARD J. BLES.

March, 1894.

T. R. Riches, B.A. . . .	May 1st—December 21st.
E. J. Allen, B.Sc. . . .	June 1st.
E. W. MacBride, M.A. . .	June 8th—July 12th.
Prof. W. F. R. Weldon, M.A., F.R.S. .	July 1st—August 8th.
F. W. Gamble, B.Sc. . . .	August 7th—September 7th.
Florence Buchanan, B.Sc. . .	August 24th—October 4th.
E. T. Browne, B.Sc. . . .	September 4th—October 7th.
W. T. Hughes	August 7th—August 15th.
S. J. Hickson, M.A., D.Sc. . .	December 9th—January 6th.
G. P. Bidder, M.A. . . .	December 8th—February 28th.

North Sea Investigations.

(*Continued.*)

By

Ernest W. L. Holt,

Naturalist on Staff in Charge of Investigations.

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

Introductory.—Owing to enforced idleness during the period which would otherwise have been devoted to preparing my reports for publication, I am under the necessity of reserving much of the information collected during the last four months for a future occasion, and of treating only in the briefest possible manner the few subjects selected for present discussion. I have again to express my obligations for much courtesy and assistance received from members of the Grimsby fishing community, and to the Marine Fisheries Society of the same town for cordial co-operation in the work carried on at their laboratory and aquarium at Cleethorpes.

The subjoined remarks are continued from those which appeared in the last number of this Journal, and the subject is treated in the same manner.

As I explained when endeavouring to compute the proportion to the total borne by the undersized fish recorded in the reports of last year, the method adopted by the Board of Trade statisticians in collecting their figures is not such as to inspire the most implicit confidence in the accuracy of their results. Accordingly, since during the present season more time was available for statistical investigations, I have relied for my totals on the method previously adopted only in the case of small fish, viz. on observations based on the number of boxes landed on the Grimsby pontoon. In this work

I have received the most valuable assistance from Mr. W. Clark, the laboratory attendant.

It is to be regretted that it was not possible to extend the statistics thus collected so as to comprise all members of the various species under discussion, but so little time elapses before the fish landed from the boats are sold and scattered that a considerable staff would be necessary for this purpose. I have therefore confined my efforts to obtaining an accurate account of all the plaice landed, since there is no doubt that, in view of the objects of these investigations, the plaice is the most important species. The haddock, no doubt, is equally or even more important in a general sense; but since it is a species which in no way lends itself to protection by means of a size limit, and which, on the whole, appears to have suffered less from over-fishing than any other, I have postponed for the present any attempt to collect full statistics. That my statistics are absolutely accurate is more than I can claim, but I believe that the method adopted presents less opportunities of error than any other feasible under existing circumstances. It will be noticed that in some months one or more days are omitted. I have purposely abstained from completing them by the deduction of an average, since the variation of the supply from day to day is so great that such an average is quite unreliable. In the case of large plaice, home consumption (by fishermen) is a not inconsiderable item. For this I have allowed, with, as I believe, approximate accuracy, by counting the level boxes landed from the only fleet fishing the grounds frequented by large fish as full boxes. So far as I know, no allowance is necessary in the case of the small plaice.

Plaice.—In my last report I enumerated the number of boxes containing only small fish landed up to the 20th March.

The figures for the whole month are as follows :

From the Eastern grounds . .	439 boxes.
From the Lincolnshire coast . .	40 „

During the following months the statistics deal with the whole quantity of fish landed. Boxes containing only small fish are recorded as "small," other boxes figuring as "large." Boxes from Iceland contain only large fish, and are enumerated separately.

Month.	Total boxes from N. Sea.	"Large" N. Sea.	"Small" N. Sea.	Iceland.
April	8,533	7,864	2,669	300
May, less one day . .	15,176	7,532	7,644	4,683 *
June	12,205	6,880	5,325	7,351
July, less one day . .	13,304	10,585	2,719	11,376
August, less four days . .	12,287	10,668	1,619	6,854

* This number includes all days on which fish were landed from Iceland.

In April 145, and in May 85 cases of small fish were sent to Grimsby market from the Continent by cargo boat.

Comparison with the figures for last year (N. S., vol. ii, p. 381) shows a very considerable increase in the quantity of "small" landed in the early part of the season, which commenced this year as early as March. This is due very largely to the early summer of the present year, which brought the fish, and, in their train, the boats, on to the eastern grounds sooner than usual. Moreover, instead of only sending one fleet to the Terschelling ground, during the present season Grimsby has furnished no less than four small fleets to assist in the work of destruction, whilst, in addition to steam trawlers hailing from our own and other British ports, we have been favoured with frequent visits from foreign vessels bringing small plaice from the same grounds. Thus in May 22 "voyages" of "small" were landed by British steam trawlers, whilst foreign vessels from Hamburg, Bremen, Gelstemünde, and Rostock contributed seven "voyages." The destruction was apportioned as follows :—by British steam trawlers, 3917 boxes; by foreign steam trawlers, 1642 boxes; by smacks, 2085 boxes. The latter were much hampered throughout the season by want of wind. Besides Grimsby boats, fleets from other east coast ports also visited the Terschelling and neighbouring grounds, including boats from Lowestoft. In view of the fact that our own boats brought practically none but small plaice from these grounds, it is somewhat surprising to learn from evidence given before the Parliamentary Committee that Lowestoft fishermen are so fortunate as never to catch any small fish at all.

Since the method of collecting statistics has during the present year been the same in the case of "large" and "small," we may venture to compute the comparative numbers of each with more accuracy than could be hoped for before. Taking the month of May as before, I found that 100 fish was the average contents of a box of "large," and that of these about 40 per cent. failed to reach what I consider to be the biological standard of maturity. There would therefore be in the boxes of "large" landed during May some 753,200 fish, of which 451,920 would be mature and 301,280 immature; whilst in the boxes of "small," containing each about 250 fish, practically the whole 1,911,000 fish would be immature. Thus of the total of 2,664,200 no less than 2,212,280 would be below the biological limit. This may be of some interest, but is of perhaps little practical importance, since, as I have endeavoured to show in former reports, we may hope to afford the necessary protection to the species without having recourse to the biological standard for legislative purposes. Indeed, from the experience of two seasons, I

now believe that a limit of only 13 inches, but not an inch less, would serve the required purpose. Now in the boxes of "large" only about 7 per cent. are less than 13 inches in length, whilst in the boxes of "small" 10 per cent. is a very generous estimate of the proportion of fish above 13 inches. Hence we find that of the total given above 1,772,624 fish fail to reach the limit of 13 inches. Figures for every month might be computed on the same basis, allowing for some variation in the number of fish in a box of large. This depends largely on the grounds worked. In May, as it happened, no boats were at work on the Great Fisher Bank, where the proportion of large fish is the highest for the North Sea. During June and the following months a certain amount of trawling was done on that ground; later in the season the "Holman" catches would materially lessen the average number in a box, which would reach its minimum in the winter months, when comparatively few small plaice are brought ashore from any ground. It appeared to be a general idea amongst experienced men that the average number of fish in a box of large was about fifty, but I have been able to convince any who were willing to put the matter to the test that nowadays this estimate is far under the mark.

As to the Iceland fish, judged by North Sea standards, those from the open grounds are all large, and a box of 10 stone contains only some thirty fish. As those landed in May were all from such grounds the total number would be about 140,490. As the number of Iceland boxes during that month nearly equals a third of the North Sea total, the great difference of the total numbers of fish from each district is not uninstructive. From all accounts it appears to be much as though we were comparing the condition of the Dogger when first trawled with that to which we have now reduced it.

With regard to the "large" plaice landed, it may be mentioned with some satisfaction that the only Grimsby fleets which have during this year refrained from persecuting the small fish appear to have met with tolerable success. Of these the largest always lands its fish in London; and beyond that it was fishing the north-west corner of the Dogger during the summer I have no information as to its movements. The smaller fleet at first fished the same ground, and after refitting visited the "off grounds" of Scarborough, *i. e.* the ground lying about thirty-five miles off that port.

With regard to the Humber "flat-fish," they have this year formed an even more insignificant item in the market than was the case last year, and the District Fisheries Committee having now taken steps to enforce their bye-laws, it may be supposed that the appearance of small fish from our own territorial waters will in future years be extremely rare.

Probably the Humber plaice, which I found to be unusually abundant this summer, owed their comparative immunity in great part to the abundance of the prawns, which was such as to restrict the energies of the river trawlers to the legitimate objects of their industry. On the other hand, the general abundance of shrimps at the margin, by attracting unusual attention from the shore fishers, no doubt caused some increase in the destruction of very small plaice by the shove-nets and shrimp "seines." By substituting a cheese-cloth bag for that usually employed in the construction of a shove-net I succeeded in obtaining examples smaller than any which came under my notice last year. The first of these, measuring 15 mm., occurred on the 20th April, and probably represents the minimum size at which the species enters the river.

Turbot, brill, and soles.—On the whole the amount and proportion of small turbot landed during this season did not appear to differ greatly from the conditions recorded for last year. Amongst brill, however, I noticed that the proportion of immature fish landed from the eastern grounds was considerably higher than before, but still not such as to afford, from market observations alone, any evidence of very great destruction of the young of this species. A very marked improvement in the Terschelling sole fishery, attributed by fishermen to the warm summer, was the principal reason why so many of our smacks worked that ground during the present season; and it is to be regretted that the pursuit of this species entails so much destruction of small plaice, since the soles landed from Terschelling comprised only a small proportion of immature fish. Humber soles first made their appearance in the market on the 31st March; the fish, consisting, as last year, chiefly of immature specimens, remained abundant in the river throughout the season, but no very great catches were landed by the shrimp-trawlers. Very small examples, so far as I could ascertain, were taken by the shore shrimpers less frequently than last year; and on no occasion, when using the shove-net, did I catch any myself. The 8th August was the earliest date on which I obtained fish which appeared to be undoubtedly of this season's hatching. They were taken in a fine-mesh trawl, and measured $1\frac{3}{8}$ inches (35 mm. ca.) in total length, and others only slightly larger were taken during the few succeeding days. All other soles taken at the same time measured from 5 inches upwards.

Lemon soles.—No very large numbers of immature fish were observed in the market during the present year. From continuous observations of the catches of several shrimp-trawlers, who were kind enough to reserve for my examination all unmarketable fish obtained by them from time to time, I find that very small examples,

such as those taken last year in the "Vallota," were present in the river from the beginning of April, and I have little doubt that some remain there throughout the whole year.

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

March, less six days	1,107 boxes.
April	2,424 ,,
May, less one day	2,890 ,,
June	3,596 ,,
July, less one day	3,841 ,,
August, less five days	5,761 ,,

Cod.—The appended figures relate to the boxes of small codling, as explained in the previous number of this Journal, landed by trawlers only, during the months specified.

March, less six days	2,037 boxes.
April	1,596 ,,
May, less one day	1,204 ,,
June, less one day	1,490 ,,
July, less one day	1,838 ,,
August, less five days	2,717 ,,

In the last number of this Journal I expressed the opinion that statistical inquiries would confirm the general belief that the amount of small haddock and codling landed by trawlers was less during the summer than during the winter months. The above figures, compared with those given for last winter, point, however, to the opposite conclusion, especially in the case of haddock, which show a steady increase throughout the summer. Codling, it is true, show a diminution between March and August, but it is only a slight one. However, since in the case of this species the summer supply of fish of all sizes was undoubtedly greater than that of the winter, it follows that the proportion of undersized fish was considerably larger during the latter period. This is very probably true also with regard to the haddock, but I have not the figures to show it. It is lamentable to reflect that whilst these wretched immature haddocks found a ready sale, at least double the quantity of large fish, of magnificent quality, had to be thrown overboard by Iceland trawlers as utterly unmarketable.

Whiting.—From examination of the catches of shrimp-trawlers, and from my own trawling operations in the Humber, I found that small whiting were very scarce in the river during the spring and summer, so that there was no possibility of any great destruction of the young of this species by river fishermen. I found some difficulty in obtaining sufficient numbers of small fish, even from deep-

sea boats, to arrive at a conclusion as to the average size at which the fish reaches maturity. This appears to be about 9 inches, and fish of a less size are seldom brought to market. Considerable numbers are sometimes caught, but I have no doubt that a great proportion of immature whiting escape through the meshes of the ordinary deep-sea trawl.

II. On the Iceland Trawl Fishery, with some Remarks on the History of North Sea Trawling Grounds.

A result of the ever increasing scarcity of trawl fish in the North Sea has been that the more enterprising members of the fishing community are constantly seeking new grounds.

Thus in past years boats have been pushed out from Hull and Grimsby to the west of England, the west of Ireland, and during last year as far south as the Bay of Biscay; but though I am convinced that there is a great future for trawling on some of the off-shore grounds of the west of Ireland, I am not aware that up to the present time the results have been sufficiently remunerative to warrant any great influx of boats in any of the directions mentioned.

On the other hand, the boats which have pushed to the northward have been infinitely more successful. In this direction the line-fishers have always been the pioneers of the trade.

Thus the Great Fisher Bank, long known as a fine lining ground, was accidentally discovered to be suitable for trawling some twenty years ago, and it is only within about the last fourteen years that it seems to have been regularly trawled.

It has chiefly been fished in the winter, since it seems to be most productive at that season, whilst the east coast grounds have afforded occupation to the fleets in the summer.

Nowadays, however, the eastern grounds have so deteriorated, and public opinion has been so strongly directed against the destruction of undersized fish on these grounds, that the discovery of new grounds for the summer has been a matter of the highest importance.

The discovery of the splendid lining grounds (for halibut, &c.), commonly known as the Faroe "banks," was followed some years later by the opening up of the southern coasts of Iceland for similar operations, and for some years past Iceland has been the chief source of our supply of halibut during the summer months.

Trawling vessels which have been sent from time to time as far north as the Orkneys do not seem to have encountered much luck, though it appears that Scotch vessels have been more successful in this direction. Trawling has also been carried on, but as yet with

only moderate success, to the east of the Shetlands, but the enterprise of one of our firms has at last opened up a trawling ground, the resources of which, if properly husbanded, can hardly be estimated.

In the summer of 1891 the s.s. "Aquarius" (Grimsby Steam Trawling Co., Mr. T. Cutton, master) shot a trawl off Ingol's Hofde Huk ("Ingol's Hoof" according to Grimsby pronunciation), on the south coast of Iceland, and returned with a fine catch of plaice and haddock. In the winter the Iceland grounds are closed, partly by ice, but more by the prevalence of foggy weather; but in the summer of 1892 about nine steam trawlers renewed the experiment.

Nature of Catch.

Large catches of plaice and haddock were made, the quantity varying from about 100 to 400 boxes of each per trip. Other items of the catch included witches (*P. cynoglossus*), common dabs, whiting, and Norway "haddock" (*Sebastes norvegicus*), all abundant; cod, ling, cat-fish (*A. lupus*), and skate, fairly plentiful; megrims (*Rh. megastoma*) common in certain parts of the ground; halibut moderately plentiful, but local. Lemon soles were very scarce, and no turbot, brill, or true soles were taken.

Of unmarketable species one specimen of *Molva abyssorum* and of *Gadus saida* respectively have reached my hands from Iceland trawlers. Long rough dabs and prickly rays (*R. radiata*) I have ascertained to be common, but my inquiries have failed to elicit evidence of the presence of any other species of food-fish.

Fishing Grounds.

The ground principally worked is known to our fishermen by the name of "Ingol's Hoof," and is described to me as lying off a fairly even stretch of coast which extends about S.W. from Ingol's Hofde Huk. The shore consists of low cliffs or banks, awash with the tide and pierced by the mouths of numerous streams draining the gradual incline of cindery volcanic soil which stretches seaward from a line of hills parallel to the shore. The bottom consists of very dark mud, the colour being due to its volcanic origin. Trawling is carried on at between 6 and 7 fathoms, close inshore, and about 40 fathoms in the offing, but a large part of the fishing took place in 1892, within three miles of the land. Another ground, more to the westward, is known as "Madam Piper's Bay," and trawling has also been carried on, with good results, off the West Horn at some distance off shore. In addition to these grounds, some of the fjords

were also explored in 1892; and during the present year, in spite of a prohibition on the part of the Danish Government against fishing in territorial water, the practice has been continued by British boats. Several of these have had reason to regret it, having encountered rocks; whilst I am informed that one Danish steam trawler has become a total wreck. There can be no doubt, however, that there will be found ample room for the development of a large trawling industry without encroaching on the territorial waters; and we may here recall that when the Faroe banks were first found suitable for line-fishing, boats used to go there in twos and threes, it being supposed that the productive area was so limited that a single boat might miss it, whereas it has since proved to extend for hundreds of miles.

The plaice are very large as compared with North Sea fish, especially those from the Ingol's Hoof and West Horn grounds. The smallest fish I have ever seen brought in measured 12 inches; only an insignificunt quantity were of less than 17 inches, whilst specimens of about 27 inches were a large item in the catch. The largest I measured was 30 inches long, but I am quite sure that I have seen specimens which were several inches longer. The maximum size recorded for North Sea fish is 28 inches. I have never seen any longer than 27 inches, and comparatively few above 24 inches.

The pigmentation is characteristic, and should serve to avoid the confusion that might otherwise arise in the minds of such naturalists as are apt to record anything they see on their fishmonger's stall as British. The ground colour, due to the darkness of the soil all along the coast, is a dark greyish brown, often very dark; the spots are usually much fewer than in North Sea fish, and often of very irregular outline; the central region is rust-colour, or a dark brown flecked with the former tint, and is surrounded by a broad and very distinct margin of a lighter shade, either white, cream-colour, or a brown much paler than the ground colour. In large examples this margin may measure from $\frac{1}{4}$ to $\frac{1}{2}$ an inch in width. In a few fish, however, in all cases small specimens, I have seen the spots as numerous, and of as bright an orange as one finds in Dogger fish, and I have reason to believe that the colour of the spots is not, as might be expected, dependent on that of the ground. This description applies, of course, only to dead fish, which would not show any mottlings that may exist in the ground colour during life.

In 1892 the fish were found in abundance at Ingol's Hoof from the beginning of June until the end of July, when a trawler who went there could find none. They seem, however, to have shortly returned. The other grounds were not worked in the beginning of

the season, but yielded plenty of fish in July and August. After that the boats ceased to go there, and whether the fish remained on the grounds or not is unknown.

Haddock form an item no less important than the plaice. They appear to have been very abundant the whole time the trawlers were at work. They are of great size, the extreme length of those which I have measured in 1892 being 19 and 33 inches,* though no doubt both larger and smaller fish occurred. I should say that a North Sea haddock seldom attains a length exceeding 27 inches, whilst fish of only 10 inches are often thought worth bringing ashore. Without having submitted them to very minute comparison I can only say that the points in which Iceland differ from North Sea haddock appear to be only such as are dependent on the growth of the fish. They exhibit a very strong ridge in front of the first dorsal fin, and the lump in front of each eye is very prominent, but an approach to this condition is always apparent in the largest North Sea fish.

The witch (*P. cynoglossus*) is, I suppose, the next important species. On the whole I concluded that Iceland fish were rather smaller than their North Sea allies; they are also much darker in colour, and would appear to extend into more shallow water.

Common dabs are, on the whole, considerably larger than North Sea fish, though I have occasionally noticed a specimen from the latter region as large as any from Iceland. In colour the northern representatives are a very dark sepia, devoid of spots or markings in the condition in which they reach this country. When long rough dabs have been brought in they have been of very large size, and similar in colour to the common dabs.

Not very many halibut were trawled at Ingol's Hoof, and such as were taken there were mostly of good size. On some other grounds, however, small fish, 14 inches and upwards, seemed rather abundant.

Megrim (*R. megastoma*) attain a very large size, but not, I should say, larger than in the Irish seas. I was told by the skipper of a trawler that they were chiefly caught in shallow water near fresh-water outlets. This is in marked contrast to the habitat of the species on our own coasts, but every student of ichthyology knows that the vertical distribution of a fish is often found to vary with the horizontal.

Whiting are very large, and, I believe, in good condition when caught, but as this fish requires to be very fresh to be valuable, it is not likely to form an important feature in the Iceland fishery.

Norway "haddock" (*Sebastes norvegicus*) appear to be very abundant, but in 1892 only those taken in the last few hauls were

* The fish from Madam Piper's Bay are rather smaller than those from the other grounds.

brought ashore, while in 1893 very few were landed at all. They ranged in size from 11 to 22 inches, the last being much the nearest to the average size. I was at pains to find out whether smaller specimens than those brought ashore were met with, but have only heard of one, which was brought to me, and measured about 7 inches. Day says the species attains a length of 4 feet, but no examples were met with by our trawlers larger than the size I have indicated. The colour is a reddish orange rather than scarlet, and the opercular spot is very faint. No transverse markings are apparent in the dead condition. They thus differ somewhat from the smaller specimens which are occasionally brought in from the neighbourhood of the Great Fisher Bank, and from the single small Iceland specimen. These agree in colour with the descriptions of *S. viviparus*, doubtless a synonym of the same species. As long as the Iceland fish continued to be brought in I found no marked change in the condition of the reproductive organs. The sperm-sacs in the male were charged with milt, and in the females the ovaries were small and flaccid, containing ova in various stages of development, but unripe, and a few larvæ, the bulk of the brood having apparently escaped.

Cod appeared to be in rather poor condition when landed, but this may have been as much due to want of space to pack them properly as from any other reason.

The skate which I examined corresponded for the most part with the descriptions of *Raia macrorhynchus*, but I was unable to satisfy myself that there were anything but varieties of *R. batis*. The same applies to all specimens of the larger species of *Raia* which I have seen brought in, whether by trawlers or liners, from the Iceland and Faroe grounds. Though there is infinite variety, so many intermediate forms occur that I have so far found no characters that denote the existence of more than one species. *R. alba* and *R. oxyrhynchus* are not represented, and I have not been able to detect *R. nidrosiensis* (Collett), if it has occurred.

Present Condition of the Industry.

It must be admitted that at present the Iceland trawl fishery has not been a great success from a pecuniary point of view, and it may be feared that if continued on the existing lines it may even deteriorate. The fishing grounds lie 900 miles from the mouth of the Humber, and the voyage thither consequently takes about 90 hours, ten knots being considered a very fair speed for a steam trawler to maintain during a long run. The utmost coal-carrying capacity of a boat, even when the fish hold is utilised as a bunker, and as much coal as the Board of Trade officials will permit is piled

upon the deck, is for about three weeks' consumption. Consequently, the run to and fro occupying about a week and half a day, there remains at most only about a week for fishing operations. This, nevertheless, has been found quite enough to fill the ship, and indeed some vessels have landed large catches after only twelve days' absence. The Danish, and other continental steam trawling vessels, are rather larger than our own, and can therefore, I suppose, remain at sea for a longer period, but our fishermen consider that any advantages that may be gained by increasing the size of vessels are more than counterbalanced by the injury which a large vessel is apt to inflict on the trawl in a heavy swell. This distrust may ultimately be overcome, since we know that similar fears which manifested themselves at every increase in the tonnage of smacks have never been realised.

There have been two causes which account chiefly for the poorness of the pecuniary results of the Iceland venture—the great size of the plaice and haddock, and the poorness of quality of the former. This last character was especially noticeable in 1892. The spawning season off Iceland is much later than with us, many fish spawning as late as June. Consequently the plaice first landed last year were for the most part recently shotten, and they had hardly recovered condition to any appreciable extent before the season closed. Moreover they were only landed during the time when fish of all sorts were tolerably abundant, and had to contend in the market against great quantities of much smaller examples of their own species from the eastern grounds. It might be thought, after all the clamour that we have heard about the diminution in size and numbers of North Sea trawl-fish, that a good supply of large specimens would be welcome, but it is one of the most regrettable features in the trade (in view of the facility for obtaining legislation based on the size of fish landed), that very moderate sized or even small fish are in far greater demand than large ones.* Thus in 1892 the Iceland plaice could only fetch from 8*s*. 6*d*. to 11*s*. per box, though the boxes were piled so high that none could have contained less than 10 stone; as much or more could often be obtained for a box of small fish from the eastern grounds, and if the condition of the Iceland plaice left something to be desired, most assuredly that of the others was not much better.

Against the haddock nothing could be urged except that they were too big, the quality being undeniably splendid; yet in 1892 they were even less remunerative than the plaice. Boxes of 10 stone sold for eighteenpence or two shillings, and seldom brought as much as three shillings. Since I have been at Grimsby I have seldom

* *Vide infra*, p. 139.

known the smallest North Sea haddock fetch so little, though they are often none of the sweetest.

The "Norway haddock" also found a very poor market, but that is no more than could be expected in the case of a fish quite new to the consumer, and possessing, at least according to my own taste, but little intrinsic merit. They seem to me to resemble sea-bream more than anything else, but have less flavour and are drier. Still, being worth about 4*s*. a box, they paid the fisherman in 1892 better than the haddock, though it is probable that if brought ashore in larger numbers the market would soon have been glutted. In 1893, though as abundant as ever, very few indeed were brought ashore, in consequence, as I suppose, of the failure of an attempt to cure them during the previous year.

Taking advantage of the early summer of the present year, a start was made in April, the first boat landing its catch on the 14th. A very marked improvement was noticeable in the condition of the plaice, which were mostly fine firm fish, not yet ready to spawn, but as large as any that were brought in last year. The haddock were also in good condition, and as there was a good demand for fish, there was a ready sale. The plaice fetched 50*s*., and the haddock 9*s*. per box. This seemed to promise better business for the Iceland boats, and it was not long before other "voyages" were landed, but the price was not maintained. Thus on the 2nd May plaice fetched only 17*s*. 9*d*., and haddock 4*s*. per box, but witches found a ready sale at 27*s*. 6*d*. Prices remained about the same throughout the month, but in June we find plaice as low as 9*s*. 9*d*., and never higher than 15*s*. The change is, of course, due in part to the greater abundance of fish in the market, and in part to the deterioration of the quality of the Iceland plaice, many of which were by that time shotten. Good prices were still obtainable for witches, but the haddock were driven out of the market, and it became the practice of fishermen to heave overboard all haddock except those caught in the last haul. Witches acquired an importance which they had not previously been suspected of, and the success of an Iceland voyage depended greatly on the quantity of that species landed. Cod continued to be brought ashore in considerable numbers, but, whatever their quality, the appearance of this fish after it has been some time in the fish-hold becomes unattractive, and I have known Iceland fish sell for only 8*s*. per score.

It is only natural that fishermen should have made endeavours to procure Iceland plaice more in accordance with market requirements than those with which I have been dealing, and in this they have been to some extent successful. I have seen several "voyages" of fish similar in size, and to a great extent in appearance, with ordinary

North Sea plaice; some of these were avowedly taken in fjords, where fishing by vessels other than Danish is illegal, and, though the fishermen observe a certain reticence on the subject, I have no doubt that all the small fish landed were caught close inshore. They commanded a ready sale at a remunerative price, but I am inclined to think that the prospects of the fishing are by no means improved by this circumstance. Though large enough by standard of North Sea fish to escape criticism, it is probable, taking into view the large size attained by the species in northern waters, that they are chiefly young and immature fish, the destruction of which is rather to be deplored, whilst any extensive poaching on Danish preserves in Iceland seems likely to hinder an understanding with that power which may become necessary with regard to other areas.

Comparison with North Sea Grounds.

The opening up a virgin trawling ground at a time when public (including scientific) attention is so much directed to fishery questions is of peculiar interest, since by watching its development we may be able to form a judgment as to the correctness of theories deduced from such accounts as we possess of the earlier history of the grounds off our own coasts.

These accounts are extremely meagre, consisting as they do of the reminiscences of a generation of fishermen which is now fast disappearing. Moreover to some minds they are prejudiced by the rather general idea that the conditions of the seafaring profession are not altogether unfavourable to the development of the imagination, and that the grain of salt proper to the assimilation of piscatorial narratives is not a small one.

Nevertheless there are certain facts which appear with remarkable regularity in all narratives, whether of those who actually witnessed the occurrences, or received them from their immediate predecessors. To take the Dogger Bank, which, as essentially a plaice and haddock ground, is well suited for comparison with the Iceland trawling grounds, I am given to understand on all hands that when the trawl was first used there an extraordinary number of large plaice were taken: they were not so large as the Iceland fish, nor in fact, so far as I can learn, any larger than some few which are still to be got in the same place; but the quality was very poor, and (Mr. G. Alward is my authority for this statement) the spots were brown and not red. Fishermen called them "elephants' lugs" in derision.

As trawling was continued a great improvement in quality was noticed, "shoal" fish becoming, as they have since remained,

notable for their prime condition, and (again on Mr. Alward's authority) the improvement was accompanied by a change in the colour of the spots. It was some years before any scarcity of fish became noticeable, and when such scarcity induced fishermen to explore new grounds—*e. g.* the Brown Bank and some of the east coast grounds—the same phenomena were experienced so far as plaice were concerned.

There is thus a consensus of experience that trawling at first improves the quality of plaice, but that this process may be carried out with such hearty good-will that the fish incur the danger of being improved off the face of the earth, is an axiom which does not find such universal acceptance. Trawlers appear to consider that the action of their gear in stirring up the bottom and uncovering molluscs, worms, &c., is the principal cause of the improvement in plaice, but there is perhaps a more probable explanation.

The plaice is a fish which, after attaining a certain size, is little subject to the attacks of other species ; in fact, I do not recollect ever to have found the remains of this fish in the stomach of any other, though I know that it occasionally falls a prey to the angler (*L. piscatorius*) ; nor can I find, by watching their habits in captivity, that plaice are much given to molesting each other. Consequently, on a ground which is never fished, it might well be that plaice would increase to such an extent that they would overtax the food supply, and, under such conditions, they would be of very poor quality. Seeing that the action of the trawl is infinitely more destructive to the plaice than to the organisms which form their food, trawling would at first, by thinning the numbers of the fish, increase the supply of food available for the survivors, and allow them to get into better condition than they were before. But as it is quite evident, if this theory is correct, that the quality is only raised at the expense of the quantity, it follows that unless this process is exercised in moderation the result must finally be disastrous. Nevertheless, in the face of universal experience to the contrary, there may yet be found those who assert that the more you trawl the more fish there will be.

As to the condition of the haddock in the early days of Dogger trawling I have no very definite information. They were very abundant, but I have not heard that they were of inferior quality, except on a ground lying to the east of the Dogger ; there it appears that the objectionable smell of the viscera, due, no doubt, to the organisms on which they fed, was the worst fault that could be urged against them. The truth is that haddock were so utterly worthless to trawlers until a curing establishment was started at

Hull some time in the forties, that little or no attention was paid to them; they were amongst the perquisites of the apprentices, and this circumstance may have prevented them from being thrown overboard in very great numbers, but certainly many of them must have been treated in this way. I have endeavoured to show in the last number of this Journal that it is of little use returning trawled haddock to the sea, and there can be no doubt but that the shovelling overboard of large quantities of dead fish is injurious to a fishing ground. We may suspect, indeed, that this practice, which was extensively carried out in the case of small plaice, on some, at any rate, of the North Sea grounds, may have had its share in the diminution of the general fish supply, and it is matter for the greatest regret that it has been commenced, in the case of large haddock, on the Iceland grounds. It is hardly to be supposed that much effect would be felt as yet, but it is a fact that the liners can no longer get their fish on the grounds where the trawlers have been at work this season, and I am inclined to think that they, the liners, are right in attributing this circumstance as much to the fouling of the bottom with great quantities of dead haddock as to the disturbance caused by the trawl. As I have said, no improvement is possible in the condition of the haddock, and we must look to market considerations only to check the present waste of large specimens; but in the case of plaice I think we may reasonably hope that a slight diminution by trawling may effect an improvement in condition, and should this be attained, and the grounds be not unduly fouled, the climatic conditions of the locality not less than its distance from the markets may probably, by providing a most efficient close season, suffice to avert for many years the final and disastrous stage arising from over-fishing.

Alleged Cause of Low Prices.

A few words as to the apparent causes of the low price of Iceland fish may not be out of place. I have made inquiries amongst members of the buying fraternity most interested in the matter, but I fear the relations of supply and demand in fish are beyond the comprehension of the lay mind, and can only give the facts as they are told to me, with such comments as may occur.

The Iceland plaice are too large to be sold fresh, and have therefore been mostly drysalted and sent to Holland and Germany, but they are difficult to cure, being very watery, and do not sell well.

Granting the present poorness of quality, which we may hope to see disappear as the fishery develops, I do not understand why it should be ncessary to cure and export them. If the demand for

cheap fresh fish in our own country is a genuine one, it is surely possible to place these fish, which only cost the buyer something less than a shilling a stone, before the consumer at a price at which the latter would not complain, and which would yet leave to the former, and also to the fishmonger, a decent margin of profit. There seems no difficulty in disposing of undersized fish, of which the quality is certainly not better.

As to the haddock, I am informed that they are too large for smoking, for this reason,—that it is impossible to place a smoked haddock of that size on the market for less than sixpence (though it may be remarked that it only cost the curer about a penny when fresh); and that the consumer, who for the most part belongs to the poorer classes, has usually only a penny or twopence to spend, for which sum he can obtain a small cured haddock. The retailers will not cut up the fish, because it spoils the appearance *and lowers the price*. I am told that most of the Iceland haddock brought here in 1892 were split, drysalted, and exported, but that the profits were infinitesimal.

In the fresh condition, available, as they were in 1892 and will probably be in most future years, only in the summer, Iceland haddock have to contend in the market with the immense supply of herrings prevalent during that season. There is no doubt that they would sell splendidly in the winter, and even later in the autumn I am told there would be a good market for them in Rotterdam. Line-caught fish suffer from the same competition, and I have seen 285 from 21 to 30 inches in length sold on the 13th September for twenty-five shillings, the seller informing me that he could confidently reckon on getting a shilling each for such fish a month later. For myself I cannot but think that they could be placed on the market in the fresh condition at a price at which they might compete favorably with the herring; and the only conclusion I can form on the whole matter is that the producer and consumer would find it to their mutual advantage to be brought into closer relationships.

Though not to any great extent a product of the trawl fishery, there is another northern species to which I would like to advert here briefly, viz. the tusk (*Brosmius brosme*). Great numbers of tusk are caught by our liners on the Faroe grounds all the year round, and on the Iceland grounds during the time they are worked,* but the fish are seldom brought ashore except in the winter, as that is the only time when they command a sufficiently high price to make it worth the fisherman's while. Nevertheless the tusk experiences no immunity in the summer, being the unfortunate possessor of a

* I am told that in these latitudes tusk come into quite shallow water.

very large liver, which goes to fill the liver cask.* There is thus a most regrettable waste of good food.

Dr. Günther originally directed my attention to the impossibility of procuring this fish, which he, with reason, considers one of the best that swims, in London, and I find, on inquiry, that they can only be sold either to workhouses and such institutions, or to fish-hawkers who take them into the country and dispose of them under the name of "Deep-sea Ling." This vernacular name is at least as apt as that by which they are known to naturalists and fishermen in this country, torsk or tusk being etymologically identical with Celtic, German, and Scandinavian names applied to the cod and some of its congeners.

If the merits of this fish as an article of food were more widely recognised it could not but be beneficial to the industry, and would do away with the almost wanton waste that now takes place in the summer, whilst the advantage to the consumer would be commensurate.

In this connection it may be interesting to glance at the fate of certain other fishes after they reach the market. Every one knows that the parts of the skate which appear at table are the wings or pectoral fins, but it may not be so generally known that the removal and preparations of these wings is a separate though small industry, and that the only consideration received by those engaged in it is the refuse of the skate, viz. the head, abdomen, pelvic fins, and tail. Nevertheless the business is said to be a paying one. After the wings have been removed there remain certain lumps of flesh on the carcass, those of most account being the masseter muscles. These are carefully removed and disposed of to fried-fish shops as "skates' nobs," a delicacy much in favour with the patrons of such establishments, and reputed to possess the peculiar virtue ascribed to skate's flesh in its greatest degree. I believe, however, I am betraying no secret in remarking that there may be ingredients in the preparation which are not mentioned in its title. Cat-fish (*Anarrhichas lupus* and *A. minor*) are prepared for transmission to the fishmonger by removing the skin and head, and in this instance again the refuse is the recompense of the operator, who cuts out the very large cheek muscles. The tail of the monk or angler (*Lophius piscatorius*) when skinned and cut up into lumps is not unlike the flesh of the skate; at all events, like the fragments of Anarrhichas, it is used to adulterate "skates' nobs," and I do not know that the latter are considered any the worse for it.

* The livers and roes of fish are about the only remnants of the old "stocker-bait," the perquisite of the inferior members of the crew. It may not be generally known that haddocks were once included in this term. Livers fetch about 10*s.* and roes about 6*s.* per cask. The former are not infrequently adulterated with *Actinoloba dianthus!*

Coal-fish (*Gadus virens*), whether from liners or trawlers, are common enough in Grimsby market, and the trawlers often bring in a few large pollack (*G. pollachius*), the largest I have measured being forty-three inches in total length. Both of these species are extensively bought by country hawkers, who scrape off the scales, and find a ready sale for them under the title of "white salmon."

Conclusions.

To return to matters more essentially germane to the subject under discussion in these remarks, I would submit that the present condition of the Iceland trawl-fishery forms no insignificant argument for preventing the destruction of undersized fish. I think it will be admitted that if the market could once be cleared of the immense quantities of small plaice which flood it during the summer months an improvement of price for full-grown fish, by no means confined to that species, would be one of the first results; at the same time the large quantities of haddock, torsk, &c., which are at present wasted, would, by becoming moderately profitable to the fisherman, serve to supply the market sufficiently to prevent any undue strain on the purse of the consumer; at the same time the present practice of fouling the Iceland grounds with dead fish would be checked, to their incalculable benefit. It matters little by what means the sale of small plaice is prevented so long as it is done effectually; and though I see no reason to alter my opinion that the enforcement of a reasonable size-limit for flat-fish is the most feasible plan, I am quite prepared to bow to the superior wisdom of those in favour of geographical restrictions, whenever, by such means, their object shall have been attained.

I have before this endeavoured to show that the size-limit for plaice which I have recommended would have the same result as the geographical restrictions generally desired in closing the eastern grounds of the North Sea to trawlers; and if this object is attained, by whatever means, it becomes apparent that we must look for an outlet for our boats during the summer months. Such, in my opinion, is offered by the Iceland grounds, and, as we have seen, the steam trawlers have largely availed themselves of it. It cannot be denied, however, that smacks working there would be liable to risks which at present are more or less prohibitive. It is a dangerous coast, apparently not too well charted, subject to fogs, and hardly lighted at all. It is a great distance from our ports, and it is absolutely impossible for a vessel which may be disabled there to refit without sending for supplies from home. It appears, therefore, that whilst single boating would be out of the question, smack-owners

could hardly think of sending their fleets there without establishing depôts on the island and arranging for some improvement in the lighting during the fishing season. The establishment of depôts would of course bring profit to the inhabitants, and for this consideration the Government of the latter might perhaps be induced to undertake the duties of lighting and of improving the present harbour accommodation, which is, I understand, of the scantiest. I make these suggestions with all due deference, since those engaged in the North Sea fishing trade are about the last persons to be accused of a want of enterprise or of incapability of safe-guarding their own interests; but I have no doubt that the check on the fish supply of the North Sea, which, until the beneficial action of such has time to make itself felt, must ensue from legislative action, or, in the absence of that, the continued depletion of the grounds, will before long result in the establishment of Iceland fleeting during the summer.

Letter from Wilfrid T. Grenfell, Esq., M.R.C.S.,

Superintendent of the Mission to Deep Sea Fishermen.

At the request of the Secretary I venture to send you a brief account of the voyage we made last year in the smack "Albert" 97 tons register, belonging to the Council of the Mission to Deep Sea Fishermen.

We sailed from Yarmouth on June 15th and returned on December 1st, having sailed to St. John's in Newfoundland, along the coast to Labrador and as far north as Hopedale, thence south again and up the Straits of Belle Isle, visiting almost all the fishing stations, and returning by St. John's direct to Yarmouth. The return journey from St. John's to the Start Lighthouse was accomplished in only twelve days.

Your Society, through the Director of the Plymouth Laboratory, furnished me with three deep-sea reversing thermometers, and one instrument for bringing up specimens of bottom water. We used the thermometers on wire with Basnett's patent deep-sea sounder, but this was only gauged up to 100 fathoms, and, not having any line suitable for the thermometers on board, I was unable to take any very deep soundings. Moreover, the work was new to me, and until I was joined by Mr. Adolph Nielsen, the Superintendent of Fisheries for Newfoundland, I had, I am sorry to confess, not realised the value which soundings might have. In the Report of the Fishery Commission of the colony the scientific work carried out is fully detailed, and for those who have not access to that little book it may be worth while my summarising the general conclusions arrived at, especially as to the results to be anticipated from a more extended series of observations, and as to the lines on which these should be made.

We added to that work surface temperatures across the Atlantic both ways, and on our return journey were only prevented by extremely boisterous weather from recording deep-sea soundings also. The observations I have forwarded to the Plymouth Laboratory. Captain Sir Baldwin Walker, R.N., has since shown me some interesting records he made during four years on the Newfoundland coast in H.M.S. "Emerald," but he regrets greatly that the Naval

officers along these shores have no reversing thermometers for deep-sea work. Without any doubt repeated observations made all round the coast would become of the highest value.

The very life of the colony is at times imperilled by the critical condition of the fisheries,—lobsters failing, seals not being found, herring not reaching the coast, and cod vacating their normal haunts. Poverty, misery, and want, with great loss to merchants as well as fisher-folk, result, a great deal of which might apparently be avoided if more were known about the movements of the fish, of the bait, and of the Arctic and Gulf currents, which seem constantly to be varying, and may account often for most unexpected failures.

The resident English fisher-folk along the coast number some 5000, while every summer about 25,000 to 30,000 men, women, and children flock from Newfoundland to catch cod on the Labrador coast. They remain from three to four months, returning only when compelled by the sea freezing over.

I must be categorical in my description of these people in order to convey succinctly an idea of this peculiar fishery.

The coast is rugged and broken, the country barren and inhospitable. Eight months in the year both sea and land are completely ice-bound. No domestic animals but dogs exist, and no vegetables can be grown, except a chance potato or cabbage in the very extreme south.

The people have *no legal representative whatever*, though a Custom-house official visits the coast in the summer in a small schooner, and is also empowered to act as a magistrate. If a criminal wishes to be tried he could with some difficulty manage it.

The schooners which bring the people form a very assorted fleet, and carry a mixed crew of men and women, besides more or fewer passengers who have no boats of their own to come in. These latter huddle into the main hold on the top of the salt, fishing gear, and stores. These boats are not surveyed before starting, and do not all clear from any custom house. More surveyors and better arrangements are urgently necessary.

Once on the coast, mud huts and small stages are erected, the merchants' agent or a large fish planter generally having a larger stage, and a store of goods near the people he has "supplied."

A universal truck system exists, and at the end of the summer the dry fish are "weighed in" in quintals (hundredweights), and go to pay off the outfit advanced in spring. The fish are caught on "jiggers," two hooks back-to-back, or in cod traps, which are simply submerged rooms of nets; but squid, caplin, or launce are used for bait when obtainable.

The cod is successively "throated," "headed," "split," "salted,"

and dried in the sun, and then sent to Mediterranean, English, or Brazilian markets.

The people are a fine, tall, well-built race, brave to fool-hardiness, and generous and hospitable to a fault. Accidents and sickness are by no means uncommon; I have always found the people dividing up orphaned children among themselves, and even Esquimaux rearing the orphans of English settlers.

They experienced this year epidemics of diphtheria and influenza, the people dying in many parts without any possibility of getting medical assistance. No doctor resides anywhere on the coast.

Their hospitality to one another in the winter, when all the country is cut off from the civilised world, brings them occasionally to the verge of starvation.

The causes leading to the summer migration are :—(1) The decline of the Bank Fishery and the French and Canadian bounties; (2) the depletion of the inshore cod and lobster fisheries; (3) the monopoly of the winter seal fishery by the large steamers of the merchants' firms; (4) the crippling of any development of agriculture or mining by the French treaty rights on the shore. It is interesting to note that not more than 500 Frenchmen find it worth their while to fish in summer on the Newfoundland coast, and yet to preserve that exclusive right the only possible resource, in the case of the failure of the fisheries, is entirely destroyed in this, our oldest British colony.

The following is a summary from Mr. Nielsen's report. First of all, he shows from his Norwegian experiences that codfish do seek waters of a certain temperature; (2) that these temperatures can be ascertained; (3) that by the use of deep-sea thermometers more successful fishing can be ensured than by haphazard work; (4) that the fishermen in the Lofoden Islands have used these instruments with great success; (5) that codfish in different countries learn to endure different temperatures within certain limits; (6) that cod thrive between 34° and 52° F., that outside these limits they get drowsy and stop feeding, but do not necessarily lose in condition or flesh; (7) that cod quickly perish from cold when the temperature sinks below 31° F. Moreover fishermen on the coast said that they could have filled their nets and vessels with codfish in this stunned condition at some places off the Labrador coast if they had had a cod seine, and at the same time they lost their summer's "fare" of fish, because the cod would not feed. At times in the stomach of these fish lumps of ice are found, probably frozen after death. Mr. Nielsen sums up as follows :—"The meteorological condition of the waters has a most effective influence upon the habits and movements of the fish and bait, and is a very

important factor to take into consideration in the prosecution of the fisheries on the coast of Labrador. I feel certain, therefore, that the use of deep-sea thermometers in the Labrador fisheries would be of the greatest advantage to all interested in this industry in finding and locating the fish after the fishermen once learned how and where to use them, and by experience had obtained the required judgment and knowledge of the habits and movements of the cod in waters of various temperatures in the different localities on the coast."

Indeed Mr. Nielsen eventually proved most successful as a piscatorial prophet, and could tell the fishermen who took us around on the banks where to fish with most success. He based his prophecies on the fact that uneven bottoms with lively vegetation and a rotatory current, where the temperature ranged between 36° and 39° F., and the specific gravity between 1·026 and 1·027, were the best.

The water off the coast never exceeds 46½° F., even on the hottest summer day, and in some places we found layers of hot in cold water, varying at different depths, or again at short distances apart.

Thus in one place at the bottom (110 fathoms) the temperature was 31·7°, at 100 fathoms 36°, at 80 fathoms 31°, till at 15 fathoms it again became warmer. Thus the fish would be stunned from 15 fathoms, and would feed and live at 100 fathoms down.

What is the source of the hot water? Is it from (1) hot springs, from (2) uncharted branches of the Gulf stream, from (3) unknown far-north warm sources, or from (4) land-water as rivers? Whatever is the source the great rush of thousands of fisherfolk to be first in following up the retreating ice of winter is sufficient to prove that cod are found far north, where we are apt to think no fish could exist, and that as they get further north the fishermen have of late years found the cod more abundant. It is thought on the coast that not only the cod but also the herring, which have been disappearing from southern Labrador of late years, are working further and further into Arctic regions. There seems little reason to doubt at any rate that the movements of the herring and caplin, which are the food of the cod, are largely influenced by meteorological conditions, as well as the other food on which in turn these fishes feed. It was remarkable that at Okak this year the vessels fishing were almost "clean," getting no fish at all, while both north and south of that station good catches were made. Perhaps had they had thermometers they could have foretold this result and saved their voyage. Possibly a temporary inset of some cold current from a change in the formation of the bottom would account for this.

In the Arctic current we found numbers of specimens of animal life, and under stones and in small pools on the shore there were

abundant evidences of organic life. Our preparation, however, both for collecting and storing had been very insufficient, and not much was done in collecting with surface nets or dredges. We sail again about May the 30th from the west coast of England, but we shall again be greatly hampered on so broken and so badly charted a coast, as the necessary funds have not come to hand to allow of the purchase of a small steam launch to tend the vessel.

W. T. GRENFELL.

Council of the Marine Biological Association.

NOTE.—Mr. Grenfell, who made surface collections for the Association some time since (Journ. Mar. Biol. Ass., Vol. I, p. 376), and was supplied by us with deep-sea thermometers for his last voyage, left England again in May for Newfoundland and Labrador, taking with him apparatus for a more elaborate scheme of work; it is hoped that his observations will throw further light on the movements and habits of the cod as affected by their food, &c. For such observations no better locality could be selected than the Newfoundland banks.—G. H. F.

The Life-history of the Pilchard.

By

J. T. Cunningham, M.A.,

Naturalist to the Association.

We have recently begun to receive from the French Ministère de la Marine a monthly journal entitled Pêches Maritimes, and published as a supplement to the Revue Maritime et Coloniale. The number for August of this journal commences with an article on *La biologie de la sardine,* by M. Paul Guéry. This article consists chiefly of summaries of the researches of four zoologists on the reproduction and life-history of the sardine. We have the summaries given under the following headings:

1. Le laboratoire de Concarneau. Opinion de M. le Professeur Pouchet.
2. Le laboratoire d'Endoume. Opinion de M. le Professeur Marion.
3. Laboratoire de Plymouth. Opinion de M. Cunningham.
4. Opinion de M. le Dr. Henneguy.

In the first section it is stated that in Professor Pouchet's opinion the sardine is a fish of the high seas, attracted to the coast neither by hunger nor the reproductive instinct, but whose migrations are determined by the wandering instinct characteristic of pelagic species, and are subject at most only to influences of temperature. It is pointed out that, according to M. Pouchet, we know nothing concerning the life-history of the sardine.

Then Prof. Marion's conclusions concerning the Mediterranean sardine are described with this difference, that, whereas no observations made by Prof. Pouchet are mentioned, some account is given of the observations of Prof. Marion on which his conclusions are founded. It cannot be said that full justice is done to these observations, no mention being made of the eggs found in the sea, and identified by Prof. Marion as those of the sardine, but we must make allowance for the restrictions of space.

No objection can be taken to the summary given of my own

observations, as published previously in our Journal, except that after they have been correctly quoted they are called *theories* which differ from those of Concarneau. M. Henneguy has studied the question whether any relation could be discovered between the varying abundance of sardines and variations in the abundance of any pelagic organisms which form their principal food. His results were negative.

The commentary by the writer of the article upon the publications which he has summarised is remarkable and surprising. He says the contradiction between the results reached on the one hand at Concarneau and on the other at Plymouth and Endoume is a matter for anxiety as to the reality of the progress made. One is obliged, he says, to accord the same degree of confidence to the statement of men who devote to the service of truth the same zeal, the same loyalty, and the same knowledge. And yet they contradict each other, and the conclusion drawn is that laboratory work is not adapted to solve the problem of the biology of the sardine. This, it seems to me, exemplifies the erroneous way in which scientific evidence is usually regarded by practical men, whether on boards of authority, commissions of inquiry, or in courts of justice. The opinion of one expert is weighed against that of another, and the only comparison by which they are judged is the reputation and authority of their respective authors. Therefore if two experts of equal reputation give contradictory opinions the result is zero. Now it is perfectly obvious that the reputation of a man should depend on the truth of his conclusions and not *vice versâ*, and that in a question of evidence the reputation of the witness is of no importance if he has no evidence to give. But the difficulty is that in the experience of men of affairs scientific methods and scientific knowledge are so completely excluded that they cannot give due weight to the facts on which opinions are based, and cannot therefore judge whether one opinion has more foundation than another. In the question of the reproduction of the sardine, which to anyone familiar with researches on the life-history of fishes is not so wonderfully complicated, the fact that Prof. Pouchet has not seen the ripe eggs of the fish, or the ripe fish themselves, does not in the least invalidate the observations of those who have seen them, namely, Prof. Marion and myself.

However, I have recently been able to add to the observations I have previously made on the reproduction and development of the pilchard. This year I have for the first time obtained artificially-fertilised eggs, and hatched the larvæ in the laboratory, and succeeded in rearing the larvæ for several days after hatching.

The eggs were taken from ripe fish obtained on the night of

September 5th, ten miles south of the Eddystone, by the crew of a Plymouth boat, to whom I had given bottles for carrying the eggs and instructions for dealing with them. Usually ripe pilchards are caught in mackerel nets, pilchard nets not being often used at a sufficient distance from land during the season when pilchards spawn, but in this case the boat was using pilchard nets and fishing for pilchards. The total catch amounted to 2,200 fish, but only a few of those were ripe. In the bottles when brought to me there were a considerable number of dead eggs at the bottom, but several thousands of living ones floating at the surface of the water. These were fertilised and developing, the blastoderm having extended already half round the yolk.

The characteristics of the eggs I have described in previous papers. In these, the divided yolk, single oil-globule, and large perivitelline space were present exactly as in the eggs obtained from the sea, or the unfertilised eggs taken on previous occasions from the fish. A drawing of one of these eggs actually taken from the pilchard and artificially fertilised, agrees in all respects with the figure which I published as the egg of the pilchard in Plate 5 of Vol. I of this Journal. But among these eggs I noticed one which presented an interesting variation or abnormality. This egg is represented in Fig. 1. It resembled the other eggs in all respects except one, namely, that instead of the normal large space between the envelope or

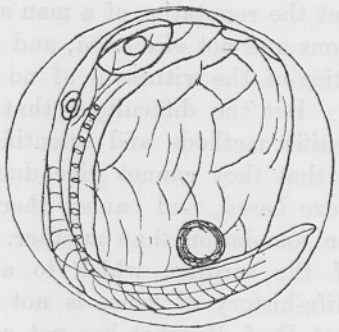

FIG. 1.—Abnormal, but healthy, egg of the pilchard, having small perivitelline space.

vitelline membrane and the egg proper, there was a narrow space as in the majority of other pelagic eggs, for instance the mackerel or plaice. I once found an egg showing this character among those taken from the sea by the tow-net, and thought it was the egg of some other species, its parentage being unknown. It is now clear that it represents an occasional variation in the egg of the pilchard. I kept this egg separate until it was hatched, and found the larva

hatched from it differed in no respect from those hatched from normal eggs.

These pilchard eggs were placed in a glass hatching jar in one of the laboratory tanks, and treated in the way described in my Treatise on the Sole. The temperature of the water was 17° C., and its density, 1026·5. The eggs all hatched on September 7th, only three days after fertilization. The newly-hatched larvæ agreed exactly with Fig. 30, plate 5 of Vol. I of this Journal. The larva is 3·8 mm. in length. Fig. 2 shows the appearance of the living larva seen from above in its natural position, floating with the yolk-sac uppermost. In this position little protuberances are seen on each side of the body; these are larval sense organs, such as are seen in the larvæ of fishes generally, and from them are derived the sense organs of the lateral line, but in the adult pilchard these sense organs are wanting, so that the larval sense organs evidently disappear during development.

When the larva is first hatched the yolk is large, the mouth not open, and there is no pigment, except a few black chromatophores along the dorsal region of the body. The yolk diminished on the second day, September 8th, and on the third day, September 9th, the mouth was found to be open as a wide rhomboidal aperture on the under surface of the head. A little yellow pigment and reflecting substance was now present in the eye.

On the 10th, by the growth of the lower jaw and under parts of the head, the mouth had become terminal; the eyes were black and opaque, and there were black chromatophores along the sides of the body ventrally. The yolk was reduced to a very small remnant, and with the absorption of the yolk the head region had become much shorter in comparison with the rest of the body. On this day I tried to feed the larvæ with minute particles obtained from minced worms, but they took none of it.

On the 11th I gave them some of the minute organisms obtained by the tow-net, and also a little more of the worm food, and, on examining some of the larvæ, saw some of the food in the intestine. The food was particles of worm.

On the 12th, when the larvæ were five days old, they were 5·5 mm. in length, the yolk was all gone, and they continued to feed on the particles of worm. Although I had the finest tow-net used, and put the produce into the jar containing the larvæ, none of it was ever found in their intestines. The tow-net produce included minute Peridiniidæ, diatoms, worm larvæ, &c., which I thought probably formed the natural food of the larvæ, but they did not feed on it. On the 14th there was evidently a diminution in the number of the larvæ, and I found that some had died and fallen to the bottom of the jar. During

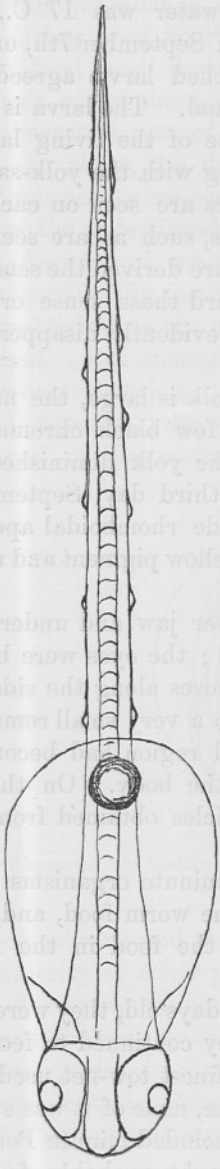

FIG. 2.—Newly-hatched larva of the pilchard, with ventral surface uppermost, showing sensory papillæ.

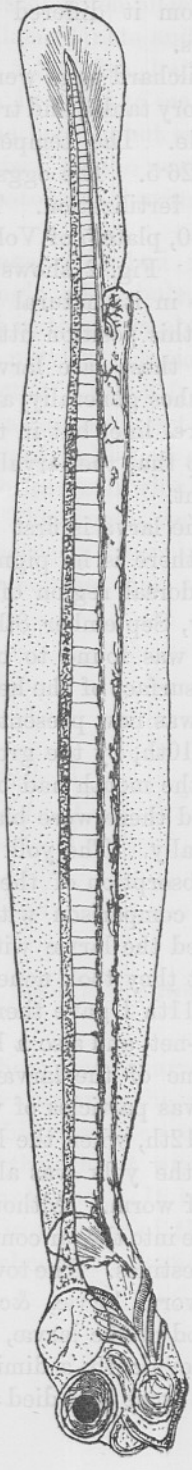

FIG. 3.—Larva of pilchard, nine days old.

the days that they were feeding they were seen to "peck" at the particles of food suspended in the water, and the food was seen in the intestine as a white opaque mass contrasting with the transparency of the body. On the 15th there were few left alive, and on the 17th only one was left, which I took out and mounted. Thus, the longest time any were kept alive was ten days. In the oldest larvæ no great advance in development had taken place; no indication of the permanent fin-rays had appeared, but radiating lines in the larval fin in the caudal region indicated the commencement of the primitive fin-rays. The oldest larvæ did not exceed 5·5 mm. in length in the preserved condition, and very little shrinkage took place in the process of preservation. Fig. 3 shows the condition of one of the larva killed and preserved on September 16th, when nine days old.

In September I found that the Saltash men were fishing with large seines for sprats, in the Hamoaze on the west shore, between St. John's Lake and Millbrook Lake. Besides abundance of adult sprats there were taken numbers of small fish of the character of whitebait, and miscellaneous fish of other kinds, including a few small mackerel, small bream, and *Belone acus*. On examining a sample of the small clupeoids I found they consisted chiefly of young sprats from $2\frac{1}{8}$ to $3\frac{1}{2}$ inches in length, evidently the produce of the preceding spawning season in the early part of the year. But there was also a small proportion of young pilchards, $2\frac{3}{4}$ to $4\frac{5}{8}$ inches in length. These must be derived from the spawn shed in the same year in the early part of the spawning period, that is to say in the months of May and June. It has long been known that sprats and herrings are found in estuaries at this age and size, but pilchards have not hitherto been recorded in such localities in England, nor I believe elsewhere on the Atlantic coast. Young pilchards of this age are taken regularly, as described by Professor Marion in the Annales du Musée de Marseille, 1890 and 1891, in the Gulf of Marseilles by seines and other engines worked from or close to the shore.

The Ovaries of Fishes.

By

J. T. Cunningham, M.A.,

Naturalist to the Association.

In connection with the inquiries which I undertook at the beginning of the present year into the question of the destruction of immature fish I have been investigating since the issue of the last number of the Journal the development of eggs in the ovary of some flat fishes and the history of the ovary before and after maturity is attained. I have made it my special object to trace the history of the ovary from one spawning period to the next, in order that it might be possible to understand more clearly than at present, from the appearance of an ovary examined at any given time, in what stage of development it was. Mr. Holt has made some observations on this subject, and discussed them in his paper in the number of this Journal for November, 1892. He states there that the first approach to maturity in the ovary is denoted by an enlargement of some of the ova, and the assumption by them of an opaque condition. He terms those ova which have begun to get opaque, "active," and those which have not, "inactive." In a footnote it is stated that the changes which give rise to the opaque condition are not the same in all species, but that they appear to possess the same significance. Mr. Holt leaves undecided the question whether all the active ova are expelled during the spawning period, so that there is a period following the process of spawning when only "inactive" ova being present, the condition of the ovary is not distinguished by internal structure from that of a fish which has not begun to breed, which is immature. He says that he has met with no such condition in the plaice, but that dabs presented such a condition in September after spawning about April. He says that when spent plaice are examined the ovary always contains a number of small active ova, in addition to a host of inactive, but he is uncertain whether the "active" ova represent the early condition of next season's crop, or only ova which, though they pass the inactive stage, are absorbed without becoming ripe. Mr. Calderwood in his paper on Fish Ovaries in the same number of the Journal dis-

tinguishes the ova into three stages, the great, the small, and the minute. The great are those to be extruded at the next spawning season, and correspond to the "active" ova of Mr. Holt's paper, while the small and the minute are the "inactive." Scharff in his paper in the Quart. Journ. Mic. Sci., 1888, on which Mr. Calderwood's views are largely based, describes the smaller ova and the larger ova. The latter correspond to the "active" ova of Holt's paper, and Scharff describes the formation of yolk in them, but does not deal with the process in relation to the periodic changes which take place in the ovary.

A comparison of these papers shows that the history of the formation of the yolk in the ova of fishes in connection with the periodic development of the crop of ova which are shed at each spawning season has not yet been thoroughly investigated. My own observations show that the opacity which distinguishes the active ova in Mr. Holt's description is due entirely to the development of the yolk. I will describe what I have observed in the ovaries of various species, commencing with the plaice.

Of the plaice I examined in January some were ripe or nearly ripe and some immature. In the immature ovary the ova are all transparent, and when they are examined with the microscope in the fresh state their structure can be clearly seen. Leaving aside the tissue of the ovary, the stroma, which forms membranes round the eggs, the egg itself is seen to consist of structureless transparent protoplasm containing the nucleus, almost equally transparent, in the centre. The nucleus or germinal vesicle is enclosed by a membrane and contains the nucleoli, rounded bodies distributed at the periphery in contact with the inner surface of the membrane. The appearance of these young yolkless ova in the fresh state is shown in Fig. 1, *a*. In the other fish which are mature, and which are about to spawn, some of these yolkless eggs are present, but they are in small proportion to the opaque yolked eggs which make up the bulk of the enlarged ovary. The yolked eggs are so opaque that it is impossible to see into their interior, but by examination of their surface the yolk can be seen to consist of separate globules or spherules of various sizes. In some specimens eggs which are very nearly ripe and ready for extrusion are seen. These are more transparent, and the transparency is seen to be due to a fusion of the yolk globules into a homogeneous mass. When this takes place, and the egg becomes ripe, the transparent mass of yolk occupies the whole central region of the egg, and the protoplasm forms a thin layer surrounding it. The germinal vesicle cannot be seen in the fresh ripe egg, but it is well known that it is represented by structures which can be demonstrated by appropriate methods in the external layer of

protoplasm. It is worthy of note that in the ovary of the plaice, when spawning commences, the ripe eggs are scattered here and there uniformly throughout the germinal tissue, not confined to one place. In other words one part of the ovary does not get ripe before another, but in all parts the eggs ripen in succession, until all are shed.

When all the eggs of the season have been shed the ovary is found in a flaccid, empty condition, the germinal tissue on the walls of the ovary being thin and containing much blood. The fish is now spent. The first specimen I found in this condition last season was obtained on January 28th. The specimen was 24 inches long; the ovary had not shrunk greatly in length, it was $7\frac{3}{4}$ inches long, measuring from the anterior end of the ventral fin, and the end of it was $4\frac{1}{4}$ inches from the posterior end of the same fin. In the internal cavity of the ovary a number of detached, ripe eggs were found; these were dead, but fresh, and seemed to have shed after the death of the fish. No ripe or nearly ripe eggs remained in the stroma or germinal tissue of the ovary. When a portion of this tissue was examined it was found to consist chiefly of transparent, yolkless ova exactly similar to those seen in the immature fish, but besides these there were scattered here and there singly, ova which showed a thin layer of yolk granules round the periphery. The appearance of the eggs from a small portion of the germinal tissue is shown in Fig. 1. The yolked eggs were somewhat opaque and

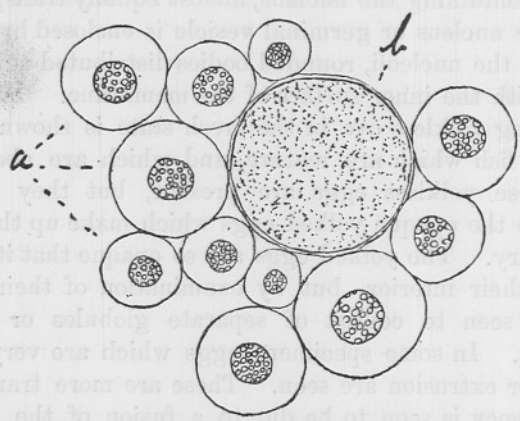

FIG. 1.—Eggs in the ovary of a spent plaice. *a*, yolkless ova; *b*, yolked ovum destined to degenerate.

presented a dull, unhealthy appearance. The smallest of the yolked eggs was ·27 mm. in diameter, and the largest of the yolkless eggs very little smaller; the largest yolked eggs were ·36 mm. in diameter. I was at first inclined to interpret this condition as

showing that the formation of yolk in the eggs for the next spawning season had begun by the time the present spawning was finished. This is the condition referred to by Mr. Holt on p. 369, Vol. II of this Journal, and he states that he was uncertain whether the yolked ova represented the early condition of next season's crop, or only ova which remain undeveloped in the spent fish and are absorbed without developing further. The question is, therefore, whether the ripening of the eggs from the immature condition for the next spawning commences before the spawning of one season is concluded, that is to say, whether the development of the yolk takes a little more than, or less than the interval between two spawning seasons.

Examination of other shotten fish, which of course became more numerous as time went on, showed clearly that no advance, but, on the contrary, a retrogression took place in them in the development of yolk. On February 2nd I examined a shotten plaice, 15¼ inches long, in which there were ripe but dead eggs in the cavity of the ovary. In the germinal tissue examined under the microscope there was a good deal of loose yolk from ripe eggs which had been broken during the spawning, but there were no small yolked eggs as in the specimen described above.

On February 24th I examined a female plaice which appeared to be spent from the external appearance of the ovary alone. The right ovary was 3¾ inches long and the distance from the end of it to the end of the ventral fin 3⅜ inches. In immature specimens the length of the ovary is always much less than this latter distance. The fact that it was a spent fish was placed beyond doubt by the presence of dead ripe eggs in the cavity of the ovary. Yet in the germinal tissue itself, when examined under the microscope, not a trace of yolk was to be seen in any of the eggs, the largest of which was ·29 mm. in diameter.

In March I examined no plaice, but in April several, some of which were evidently spent. On April 7th a specimen 14⅜ inches long had a right ovary 2⅞ inches long, and the end of it was 4½ inches from the end of the ventral fin. This fish might, from the size and appearance of the ovary, have been set down as immature, but in the stroma, under the microscope, could be seen here and there shrivelled remains of yolked eggs, much fewer in number than the yolked eggs in spent ovaries previously seen, but evidently of the same kind, and suggesting clearly that the ovary was spent, and reverting to the yolkless condition. Another specimen of the same size, examined on the same date, had the ovary in a similar condition, but the degenerating ova were still fewer in number. The size and external appearance of the ovary in these

specimens are not different from those seen in a specimen which is certainly immature.

In May I examined three plaice; one was a spent female, the right ovary measuring $4\frac{1}{2}$ inches in length, and $4\frac{1}{8}$ inches from the posterior end of the ventral fin. There were remains of ripe ova still in the oviduct, and some partially opaque yolked ova in the germinal tissue. The other two were over 15 inches long, and had no yolked ova in the ovary, nor any other indication that they had previously spawned.

In June I examined few plaice. On the 9th I opened a female $14\frac{3}{8}$ inches long; the end of the right ovary was $3\frac{7}{8}$ inches from the anterior end of the ventral fin, $3\frac{5}{8}$ inches from the posterior end. There were the remains of dead ripe eggs in the cavity of the ovary, but at first no trace of yolked ova was found in the germinal tissue; afterwards a few shrunken yolked ova were found, evidently in process of absorption.

In July, on the 15th, I first found that the formation of the yolk in the ova of next season's crop had commenced. In one specimen, 16 inches long, the length of the right ovary was $4\frac{5}{8}$ inches, its distance from the posterior end of the ventral fin $3\frac{5}{8}$ inches. The germinal tissue appeared to the naked eye opaque, white, and evidently yolked. Under the microscope the majority of the ova were seen to contain so much yolk as to be quite opaque, and the largest of them were ·5 mm. in diameter, that is considerably larger than the largest yolkless ova. Fig. 2 shows the appearance of the

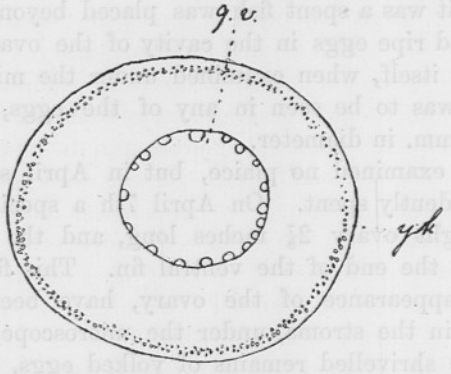

FIG. 2.—Ovum of plaice in which formation of yolk has commenced, magnified about 200 times. *yk.*, yolk; *g. v.*, germinal vesicle or nucleus with nucleoli at periphery.

smallest ova in which yolk had begun to be formed. Nothing was seen to denote that this fish had spawned previously, but considering its large size it probably had.

Another specimen, 15¼ inches long, exhibited a less advanced stage in the development of the yolk. The right ovary was 3½ inches long, 4⅛ inches from the posterior end of the ventral fin. In the majority of the ova the yolk was present in an external zone of the egg. There was nothing in the germinal tissue to show that this ovary had spawned before, but a small free clump in the cavity seemed to consist of the membranes of old ova of last season.

Another specimen, 14½ inches long, was still less advanced, the yolk being present only as a thin layer of small granules in the most external region of the egg, and the quantity of it was so small that the transparency of the ova was scarcely diminished. Other specimens larger than this last showed no trace of yolk or indications that they had previously spawned, and were either immature, or in the resting condition.

On August 8th I took a plaice from a tank in the aquarium, one of a number which were observed to spawn in the beginning of the year. The specimen was 18⅛ inches long. The right ovary was 3½ inches long and 5¾ inches from the posterior end of the ventral fin. There were no indications that the fish had spawned before. The formation of yolk for next spawning was already somewhat advanced. The largest of the yolked eggs, which were quite opaque, was ·5 mm., the smaller ·2 to ·3 mm. ; the largest of the yolkless eggs was ·19 mm. Another large specimen from the same source, killed on August 17th, was found to be in a similar condition.

It is quite certain from these observations that, so far as the microscopic appearance of the germinal tissue is concerned, the spent ovary of the plaice, when examined in the fresh state under the microscope, may be quite similar to an immature ovary. This is clearly exemplified by the specimen described above as examined on February 24th. It is certain, I think, that all the yolked ova left in an ovary after spawning has taken place degenerate and disappear, and the formation of yolk in the succeeding crops of ova does not commence till some time after spawning is over. The earliest date at which I have observed the formation of yolk to have commenced is July 15th. It is also certain that the number of yolkless eggs left in the ovary after spawning is far less than the number of ripe eggs shed in the following season. Consequently the greater number of the eggs of one season's crop are produced *ab initio* during the year. It is to be noted that after a comparison has been made between an ovary in which yolk is commencing to develop and a spent ovary containing superfluous yolked ova the latter cannot be mistaken for ova which are developing for the next season. They are few in number and scattered singly, while the developing ova are abundant everywhere, and they have a dull, unwholesome appearance.

The cases in which I found only yolkless ova in spent ovaries were recognised as spent, like the dabs in the same condition described by Mr. Holt, by the presence of the remains of ripe eggs in the ovarian cavity. Are there cases in which, these remains having been expelled, nothing is left to distinguish a fish that has recovered from spawning from one that has never spawned? I have no evidence by which to answer this question conclusively, but it is certain that ovaries which are known to have previously spawned, from the presence of degenerating yolked ova, are sometimes no larger than others which are, from the absence of any indication to the contrary, set down as immature. For instance, in a plaice, $14\frac{3}{8}$ inches long, the spent ovary was $2\frac{7}{8}$ inches, and the end of it $4\frac{1}{2}$ inches from the end of the ventral fin, while in a specimen $13\frac{1}{4}$ inches long, apparently immature, the ovary was 3 inches long and only 4 inches from the end of the ventral fin. To avoid this possible uncertainty in distinguishing immature fish it would be advisable, in order to ascertain the limit of size at which maturity commences, to examine a large number of specimens within a short space of time—one month for example—in the middle of the spawning period. At this time there would be no mature specimens in which yolk had not commenced to develop, and no spent specimens which had reverted to the resting condition.

Dab.

I have not studied the dab in the spent condition, but I have found that the formation of yolk certainly commences in some specimens in September. I killed one specimen $11\frac{1}{2}$ inches long on September 18th; the ovary was $2\frac{1}{8}$ inches long, $3\frac{7}{8}$ inches from the end of the ventral fin. The yolk formed a thin layer of very small granules in the extreme outer region of the egg, and was not sufficient to diminish its transparency to any great extent. The diameter of the largest of the yolked eggs was ·17 mm. In some of the ova under microscopic examination the membrane of the germinal vesicle was seen to be slightly wrinkled. The appearance of one of the eggs is shown in Fig. 3.

Flounder.

Mature flounders examined in January had ovaries in an advanced condition. In February many were ripe. In July I killed two from the aquarium which were known to have spawned in the spring. One was 11 inches long, the ovary was flaccid and rather large, and did not resemble an immature ovary in external appearance. Microscopically examined, only yolkless ova were found in the germinal tissue, with here and there a shapeless opaque mass, obviously a

degenerate yolked ovum left at the previous spawning. In another of the same size the right ovary was $2\frac{3}{4}$ inches long, $2\frac{5}{8}$ inches from

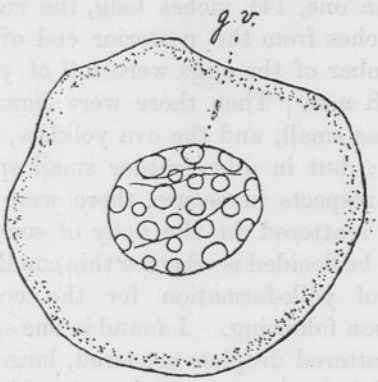

FIG. 3.—Ovum of dab in which yolk has just commenced to develop; magnified about 250 times. *yk.*, yolk; *g. v.*, germinal vesicle with nucleoli. In Fig. 2 the germinal vesicle is shown in optical section, here in surface view.

the posterior end of the ventral fin, and was in the same condition. These flounders spawned at the end of April and beginning of May, and it is seen that the condition of the germinal tissue had almost reverted to that of the immature ovary, but the size and appearance of the ovary showed that the fish had spawned. Another specimen, $12\frac{3}{8}$ inches long, from the same tank, was killed on August 25th; the germinal tissue exhibited only yolkless ova, all traces of previous spawning had disappeared. On August 31st I examined a specimen $15\frac{5}{8}$ inches long caught in the Hamoaze. The ovary was large and flaccid, and had evidently spawned before. The formation of yolk in next season's eggs had just commenced, and no trace of the previous spawning was left in the appearance of the germinal tissue under the microscope.

I have not yet been able to examine the spent condition or to determine the period at which yolk commences to develop in the merry sole (*Pleuronectes microcephalus*). In December and January mature specimens were in an advanced condition but not ripe. Ripe specimens were obtained from February to July, but none in the spent condition.

Common Sole.

My observations on the ovary of this species are far from complete, and I shall hope to resume the discussion of it on a future occasion. From what I have hitherto observed I am inclined to infer that the development of the yolk in the sole extends beyond the period of a year, so that the maturation of one

crop of ova begins before the preceding crop has been shed. In January large mature specimens had the ovary in an advanced condition, for instance, in one, $14\frac{1}{4}$ inches long, the right ovary was 6 inches long and $3\frac{3}{8}$ inches from the posterior end of the ventral fin, while the greater number of the eggs were full of yolk and reached a maximum size of ·8 mm. Then there were immature specimens in which the ovary was small, and the ova yolkless, the largest only ·17 mm. in diameter; but in other rather small specimens, whose ovaries were in most respects immature, there were a small number of minute oily drops scattered in the body of some of the largest ova. The question to be decided is whether this condition represented the commencement of yolk-formation for the coming spawning season, or for the season following. I found in one specimen, besides ova in which these scattered droplets occurred, larger ova in which a larger number of globules were present, and evidently constituted the commencement of yolk formation. This specimen was $12\frac{3}{8}$ inches long and the ovary was only 3 inches long, $5\frac{1}{8}$ inches from the end of the ventral fin. As soles have for the most part finished spawning in May it seemed improbable that this specimen was ripening for the approaching season. The condition of the ova is seen in fig. 4.

FIG. 4. FIG. 5.

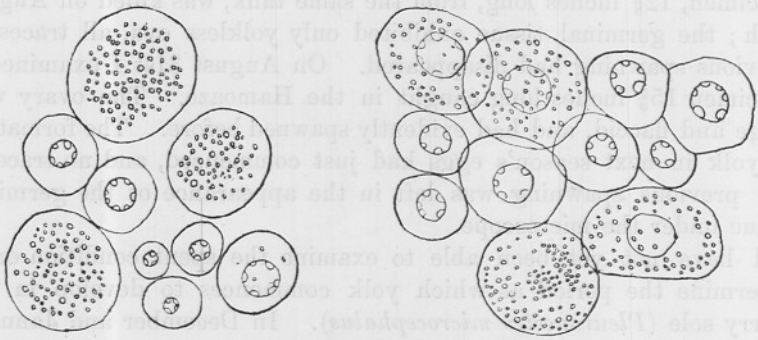

FIG. 4.—Ova from the ovary of a sole $12\frac{3}{8}$ in. long, examined January 27th. Low power.

FIG. 5.—From a sole $12\frac{1}{8}$ in. long, examined February 3rd.

In February specimens between 12 and 13 inches long were found in the condition described, as well as larger fish, which were almost ripe. The condition of the ova in a specimen $12\frac{1}{8}$ inches opened on February 3rd is shown in Fig. 5. The same condition was found also in March, in which month many mature specimens were ripe. In April no soles were examined, but in May some specimens still presented the condition described, while in large specimens diagnosed

as spent the minute globules, or the commencement of yolk, were observed in a number of the ova, and seemed to denote, not as in the plaice ova destined to degenerate, but the development of yolk for next season's crop. A number of small soles were examined in June, $6\frac{5}{8}$ inches to $10\frac{1}{2}$ inches in length, and in many of these the globules were present in the ova. A more complete study of the sole's ovary, especially in the spent condition, will be necessary in order to fully elucidate the matter, but it is clear that the development of the yolk in this species is somewhat different from that observed in the plaice and flounder. In distinguishing between mature and immature soles I have always set down those in which only the minute globules were present in the ova, or in which the yolk was only just commenced, as immature, since it was evident that such ovaries could not reach the mature condition in the season in which they were examined.

Turbot.

In a turbot, 30 inches long, examined on January 27th, the roe was flaccid and collapsed, evidently one that had previously spawned. Under the microscope the yolk was found to be commencing to develop in some of the largest eggs, while here and there yellowish opaque masses and one or two shrunken dead eggs represented the

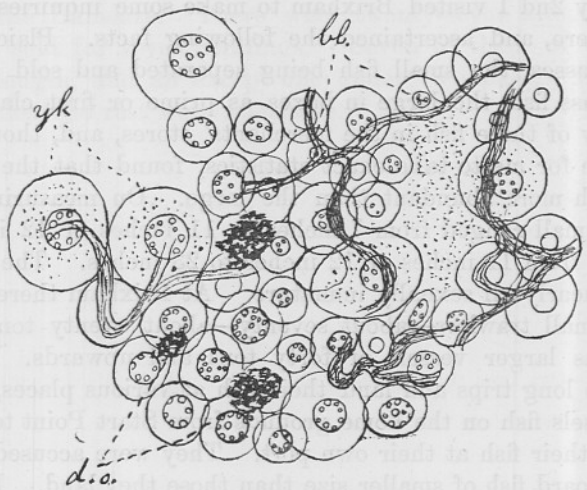

FIG. 6.—Portion of the germinal tissue from ovary of a turbot 30 in. long, examined January 27th. *yk.*, ova in which formation of yolk has commenced; *bl.*, blood-vessels; *d. o.*, degenerate ova left from previous spawning.

remnants of the previous spawning. The condition of the germinal tissue in this specimen is shown in Fig. 6. In immature specimens examined on the same date, $15\frac{5}{8}$ inches and 17 inches in length, the

ova were all transparent, not a trace of yolk was visible, nor were any degenerating eggs present. A specimen, 19¾ inches, examined on March 4th showed the yolk commencing in an immature specimen, but whether it would have spawned the same summer I cannot be certain. I have not been able to trace the history of spent specimens.

Brill.

A specimen, 16⅛ inches long, on January 25th, had the yolk advanced in development. A few opened in March were ripe, or nearly so.

With regard to the relation of maturity to size, and of the destruction of immature fish, I have not much to add to my paper on *The Immature Fish Question* in the last number of the Journal, but a brief record of a few subsequent observations is necessary.

A few merry soles landed from trawlers were examined in April, May, June, and July, and all were mature, for the most part actually ripe. On June 3rd a specimen, 7⅛ inches long, was taken in our own otter trawl five or six miles south of the Mewstone; it was a female and immature, all the ova being transparent without a trace of yolk. This is the only immature merry sole I have yet obtained at Plymouth.

On May 2nd I visited Brixham to make some inquiries about the fishing there, and ascertained the following facts. Plaice are sold in two classes, the small fish being separated and sold as offal or second class fish, the large in boxes as prime or first class. I saw a quantity of these fish in the merchants' stores, and, though it was impossible for me to take exact statistics, found that the small fish were much more abundant than the large. On measuring I found that the small ranged from 7 inches to 11 inches or 12 inches, and the large from 11 inches or 12 inches to 23 inches. The small fish must be nearly all sexually immature. At Brixham there is a large fleet of small trawlers—about seventy—about twenty tons burthen, as well as larger vessels of forty tons and upwards. The large vessels go long trips and land their fish at various places, while the small vessels fish on the home grounds from Start Point to Portland, and land their fish at their own port. They were accused of throwing overboard fish of smaller size than those they land. Besides the plaice I saw large numbers of small whiting 8½ inches long. Small soles were scarce, and none were under 8 inches. Of lemon soles very few were small, and all I saw were ripe or spent. The smallest I could find measured 10½ inches.

The Devon Sea Fisheries Committee has now prohibited trawling within certain limits in the region where these Brixham trawlers fish.

On May 4th I saw a tuck-net hauled for flat fish at Beesands near Torcross. The mesh of the net was $1\frac{1}{4}$ inches square. The whole net was 100 feet long, and it was hauled by fourteen men, seven at each end. The catch was very small, a few small fish were thrown back before I saw them, besides these there were thirty flounders $6\frac{3}{8}$ to $13\frac{3}{4}$ inches long, four plaice under 8 inches, and six above, and a few dabs. The men told me that the fishing was unusually poor, but as they have scarcely any market for flat-fish, and use the produce of their seines principally to bait their crab-pots with, it is certain that the seine fishery at Beesands is too small to be of great importance in relation to the destruction of immature fish.

On June 8th I obtained on the Barbican, Plymouth, a number of small soles brought in from Saltash, and probably caught by tuck seines in the Hamoaze. There were twenty-seven altogether, and they were sold for seven shillings. Seven of them were under 8 inches in length, and all except one under 10 inches. Eight were mature males, the rest were immature.

NOTES AND MEMORANDA.

Aphia pellucida, Day (Latrunculus pellucidus, Collett).—An adult male of this species, $2\frac{1}{4}$ inches long, was taken in the tow-net at the surface south of the Mewstone on June 12th last. When alive it was very transparent, with a few scattered black chromatophores along the back and the ventral edge.

Specialised Organs seen in Action.—As we often can only conjecture the exact function of special organs in marine animals, and opportunity seldom occurs to see them in actual operation, the following observations are perhaps worth recording.

It is well known that the decapod Cephalopoda have, in addition to eight short arms, two others which are long, provided with suckers only on the enlarged terminal portions, and usually retracted into sockets. A specimen of Sepia has for some months past been living in a healthy and vigorous condition in one of the aquarium tanks. At first it injured the posterior end of its body by knocking against the sides of the tank, but having got accustomed to confinement it ceased to do this and the abrasion began to heal up. It was found to catch and devour small crabs with eagerness. In catching this kind of prey it threw itself upon the crab with its short arms spread out, and although the tentacular arms were seen to be protruded this was done so rapidly that the movement could scarcely be followed. When a prawn was offered to the creature much more use was made of the tentacular arms. The prawn moves very slowly and deliberately until alarmed, and then darts away with great rapidity by flapping its tail. It also has the habit of retreating into crevices between the rocks when an attempt is made to catch it. The cuttle-fish accordingly stalks a prawn carefully, to avoid alarming it, becoming at the same time evidently keenly excited, its colour deepening in places and constantly changing, blushing as it were all colours at once. When it gets within a few inches of the prawn it raises its two upper arms and looks like an elephant with uplifted trunk, and then suddenly darts out its two tentacular arms together, seizes the prawn between the clubbed ends, and immediately draws it back within reach of the short arms which close over it and hold it firmly while it is devoured. The stroke of

the tentacular arms is extremely rapid and certain in aim. The prawn is seldom missed, and is frequently extracted from a hole or crevice. The cuttle, however, evidently objects to the prawn's rostrum, and always strikes at it from the side, not from the front.

The other case which has recently attracted attention in the aquarium is that of the red mullet, six of which have been living in good condition since August 28th. The mullet is provided with a pair of stiff barbels, about $1\frac{1}{2}$ inches long, attached beneath the apex of the lower jaw. When the fish is swimming above the bottom these feelers are folded backwards and lie in a ventral groove between the edges of the opercula, and in this position are not visible. But the fish does not swim for long, at brief intervals it settles on the bottom, and immediately turns the barbels downwards and forwards, and rakes in the gravel of the bottom with them, keeping them in rapid motion. The barbels are so stiff and strong that they rake into the gravel with considerable force, and in this way the mullet finds worms or shrimps on which it feeds. Even when food is given to the fish on the surface of the gravel, so that there is no need to search for it, the barbels are always used to feel every morsel before the jaws seize it.—J. T. C.

Growth of Fishes in Aquarium.—In the number of this Journal published in November, 1892, particulars were given concerning some dabs and flounders reared in the aquarium. These fish were examined again in the spring of this year, with the following results. Of the dabs twenty-three were taken from the tank and examined on March 3rd, these being apparently all that survived. Fourteen were females ranging in length from $4\frac{1}{4}$ inches to $8\frac{1}{4}$ inches, and nine were males from $4\frac{3}{8}$ inches to $7\frac{1}{4}$ inches. To give the lengths in centimetres in order to compare with the measurements of the preceding year they were:

14 females	. . . .	10·7 cm.	to 20·8 cm.
9 males	. . . .	11·0 ,,	18·3 ,,

With the exception of two females $7\frac{1}{4}$ and $8\frac{1}{4}$ inches long, which appeared to be ripening, no signs of spawning were seen in any of these fish, and none were afterwards found to become ripe. This evidence indicates that in the dab as in the flounder few specimens become ripe at two years of age.

The flounders in the small tank, three years old, were examined on the same date. There were only nine of them examined, those which were ripe the preceding year having been removed, and several killed in the interval. There were found—

3 females	. . . .	$8\frac{3}{4}$ inches	to $12\frac{7}{8}$ inches.
6 males	. . . .	$7\frac{5}{8}$,,	$10\frac{1}{2}$,,

Three of the males were ripe, and the other three probably became ripe later in the season. Two of the females were nearly ripe, and the smallest was killed and found to be still immature.

The flounders in the large tank mentioned in the previous paper were examined on May 13th. There were fifty altogether surviving out of sixty-five counted in the spring of 1892. Thirty-two of the fish were measured and examined; the sizes ranged from 5 inches to 11½ inches. As it was late in the season many of these fish may have finished spawning, only two females showed reproductive activity, one was ripe, and another nearly so. Owing to pressure of other work it was not possible to give more attention to these experiments, but I have thought it worth while to record the sizes and the indications as to the relation between age and breeding.—J. T. C.

Rearing of Fish-larvæ.—From the ripe flounders among the number reared in the aquarium and then three years old last spring I took a number of healthy eggs, and fertilised them. The first lot were hatched on April 20th. They were kept in one of the boxes belonging to the Dannevig apparatus, placed in one of the laboratory tanks. On the 22nd I turned the larvæ out of the box into the tank, protecting the overflow pipe by means of a bolting cloth screen, and keeping a slight but constant inflow of water into the tank. On the 24th the yolk was almost entirely absorbed, and I put in as food some of the minute suspended particles obtained by stirring up finely minced worm in a jar of sea-water. The little fish took this food readily, and could be seen deliberately pecking at the particles in the water. They lived and seemed healthy until April 28th, but then began to diminish in numbers, and on May 1st few were to be seen.

Another lot of eggs procured from the same source were hatched on April 29th, and turned into a tank arranged in the same way two days afterwards. They began to feed on May 4th, and lived well until May 9th, when the numbers began to diminish. I found the dead ones sticking to the screen which protected the outflow. On May 13th two were seen still alive, fourteen days old, and after this date none were left.—J. T. C.

OBJECTS

OF THE

Marine Biological Association 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.

Professor HUXLEY, the President of the Royal Society, took the chair, and amongst the speakers in support of the project were the Duke of ARGYLL, Sir LYON PLAYFAIR, Sir JOHN LUBBOCK, Sir JOSEPH HOOKER, the late Dr. CARPENTER, Dr. GÜNTHER, the late Lord DALHOUSIE, the late Professor MOSELEY, Dr. ROMANES, and Professor 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.

The Laboratory and its fittings were completed in June, 1888, at a cost of some £12,000. Since that time investigations, practical and scientific, have been constantly pursued at Plymouth. Practical investigations upon matters connected with sea-fishing are carried on under the direction of the Council; in addition, naturalists from England and from abroad have come to the Laboratory, to carry on their own independent researches, and have made valuable additions to zoological and botanical science, at the expense of a small rent for the use of a working table in the Laboratory and other appliances. The number of naturalists who can be employed by the Association in special investigations on fishery questions, and definitely retained for the purpose of carrying on those researches throughout the year, must depend on the funds subscribed by private individuals and public bodies for the purpose. The first charges on the revenue of the Association are the working of the sea-water circulation in the tanks, stocking the tanks with fish and feeding the latter, the payment of servants and fishermen, the hire and maintenance of fishing boats, and the salary of the Resident Director and staff. At the commencement of this number will be found the names of the gentlemen on the staff. In no case does any one salary exceed £250.

The Association has at present received some £20,000, of which £5000 was granted by the Treasury. The annual revenue which can be at present counted on is about £1820, of which £1000 a year is granted by the Treasury, the remainder being principally made up in Subscriptions.

The admirable Marine Biological Laboratory at Naples, founded and directed by Dr. Dohrn, has cost about £20,000, including steam launches, &c., whilst it has an annual budget of £7000.

The ASSOCIATION IS AT PRESENT UNABLE TO AFFORD THE PURCHASE AND MAINTENANCE OF A SEA-GOING STEAM VESSEL, by means of which fishery investigations can be extended to other parts of the coast than the immediate neighbourhood of Plymouth. Funds are urgently needed in order that this section of the work may be carried out with efficiency. The purpose of the Association is to aid at the same time both science and industry. It is national in character and constitution, and its affairs are conducted by a representative Council, by an Honorary Secretary and an Honorary Treasurer, without any charge upon its funds, so that the whole of the subscriptions and donations received are devoted absolutely to the support of the Laboratory and the prosecution of researches by aid of its appliances.

The reader is referred to page 4 of the Cover for information as to membership of the Association.

CONTENTS of NEW SERIES, Vol. III, No. 2.

NOTICE.

The Council of the Marine Biological Association wish it to be understood that they do not accept responsibility for statements published in this Journal, excepting when those statements are contained in an official report of the Council.

TERMS OF MEMBERSHIP.

		£	s.	d.
Annual Members	per ann.	1	1	0
Life Members	Composition Fee	15	15	0
Founders		100	0	0
Governors		500	0	0

Members of the Association have the following rights and privileges: they elect annually the Officers and Council; they receive the Journal of the Association free by post; they are admitted to view the Laboratory at Plymouth, and may introduce friends with them; they have the first claim to rent a place in the Laboratory for research, with use of tanks, boats, &c., and have access to the books in the Library at Plymouth.

All correspondence should be addressed to the Director, The Laboratory, Plymouth.