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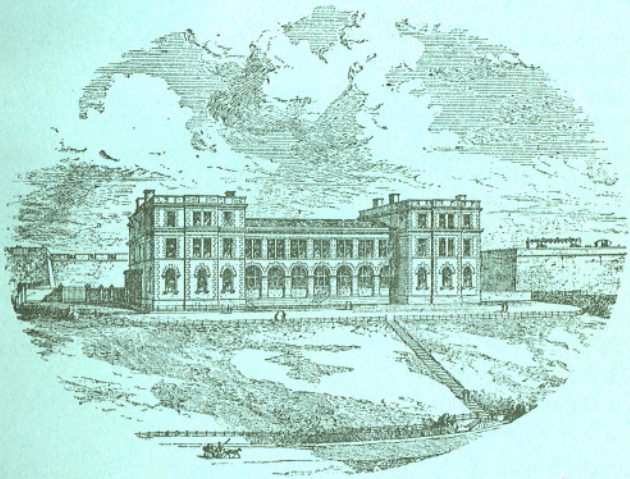
Journal

OF THE

MARINE BIOLOGICAL ASSOCIATION

OF

THE UNITED KINGDOM.



THE PLYMOUTH LABORATORY.

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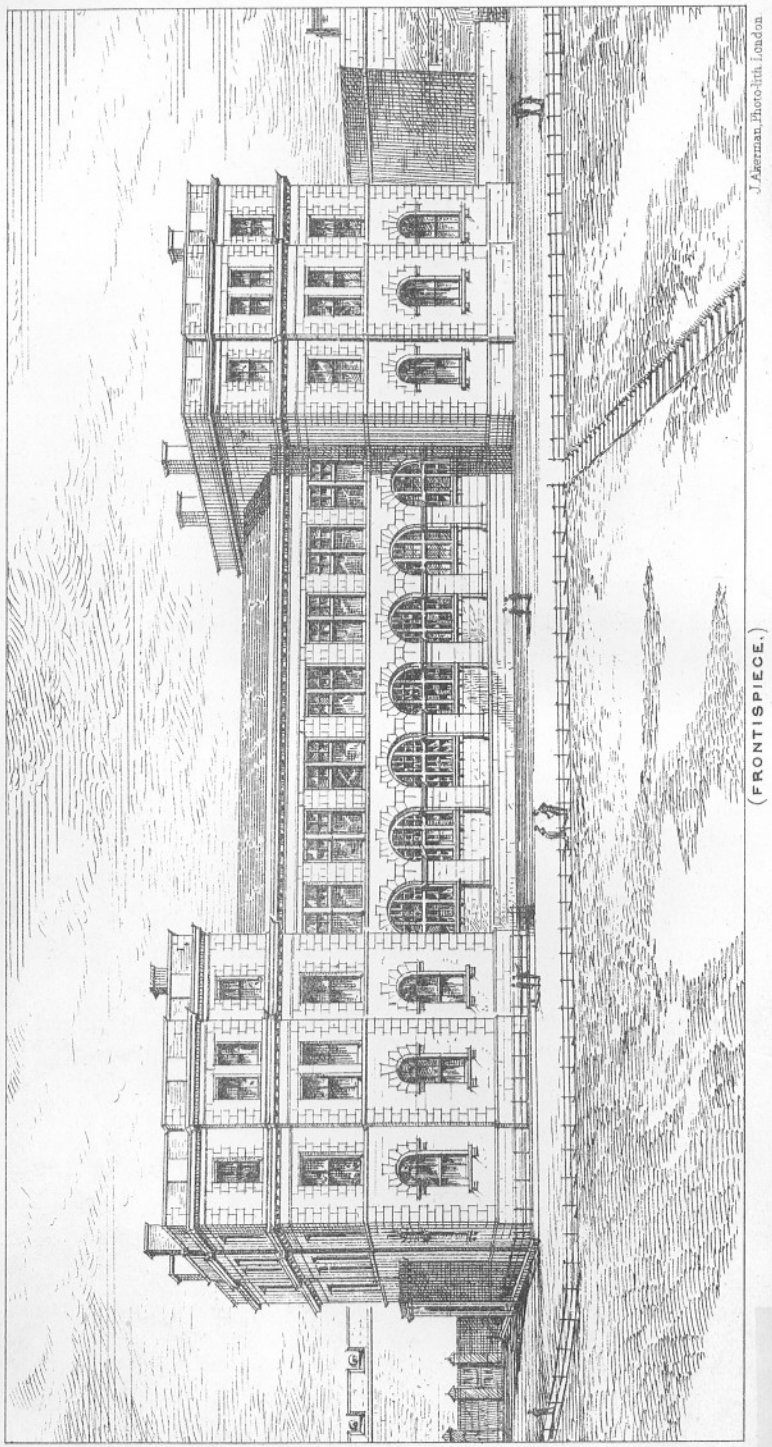

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(FRONTISPIECE.)

PREFACE

TO THE

Journal of the Marine Biological Association.

THE Council of the Marine Biological Association of the United Kingdom has determined to issue to its members notes and reports concerning the work of the Association in the form of a Journal, which will appear at intervals, determined by the amount of material ready for publication. It is not proposed to limit the contents of this Journal to formal reports, nor to publish in it lengthy scientific memoirs, but to include within its pages, besides the official statements of the Council, brief records of observations relating to the marine biology and fisheries of the coasts of the United Kingdom which may appear to have a definite bearing upon the work actually in progress under the auspices of the Association. With this object in view the Council of the Association invite communications from fishermen and naturalists, which may either be printed in full in this Journal or form the subject of a note.

The Journal will contain the annual and other official reports of the Council of the Association, and will form a means of communication between the Council and the members of the Association.

The first number of the Journal contains a list of the Officers, Governors, Founders, and Members of the Association, and the Annual Report of the Council for the year 1886-87. It also contains a description with plans of the Plymouth Laboratory, and an account of the Fishing In-

dustry of Plymouth, prepared by Mr. Walter Heape at the request of the Council of the Association, with the view of furnishing to naturalists information concerning the food-fishes taken off Plymouth and their mode of capture, which is necessary as a preliminary to those "accurate researches leading to an increase of our knowledge as regards the food, life-conditions, and habits of British food-fishes and molluscs," which the Association was founded to promote.

A list of the Fauna and Flora of Plymouth Sound, so far as known at the present date, *i. e.* before the Association has commenced its operations, will be published in the next number of the Journal. It will be one of the objects of the naturalists working at the Plymouth Laboratory to extend this list, and to ascertain the relations to one another and to physical conditions of the various organisms therein included, especially of those which are either themselves commercial fishes or serve as the food of such fishes.

Communications intended for the Journal should be addressed to the undersigned.

E. RAY LANKESTER,
Hon. Sec. M. B. A.,
University College, Gower Street,
London, W.C.

August, 1887.

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Millar, John, *Bethnal House, Cambridge Road, E.*	1	1	0	*ann.*
Mitchell, P. Chalmers, *McLean Place, Dumfermline*	1	1	0	*ann.*
Mocatta, F. H., 9, *Connaught Place, W.*	15	15	0	*C.*
Mond, Ludwig, 20, *Avenue Road, Regent's Park, N.W.*	15	15	0	*C.*
Moore, Thomas John, C.M.Z.S.L., Curator Free Public Museum, *Liverpool*	1	1	0	*ann.*
Morgan, C. Lloyd, *University College, Bristol*	1	1	0	*ann.*
Morris, John, 13, *Park Street, Grosvenor Square, W.*	21	0	0	*C.*
Morrison, Alfred, 16, *Carlton House Terrace*	52	10	0	*C.*
Nevill, Lady Dorothy, 45, *Charles Street, Berkeley Square, W.*	1	1	0	*ann.*
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	£	s.	d.	
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	£	s.	d.
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Gay, F. W., 113, *High Holborn, W.C.*	2	2	0
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Hooker, Sir Joseph, K.S.I., C.B., *Royal Gardens, Kew*	10	10	0
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[*Note.*—An asterisk is placed opposite the names of Subscribers to the University Funds who are also Members of the Association.]

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I desire to make a Donation of £ to the Funds of the Marine Biological Association, and enclose cheque for that amount payable to the Treasurer of the Association.

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I desire to become a MEMBER *of the Marine Biological Association, and enclose cheque for*

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- *One Guinea for my first Annual Subscription.*

(Erase one of these two lines.)

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The History of the Foundation of the Marine Biological Association of the United Kingdom.

In the 'Times,' March 31st, 1884, appeared the following article:

Biological station, some may be inclined to think, is simply Aquarium "writ large." The two certainly do coincide to some extent; a biological station as a rule implies an aquarium, but it includes a great deal more. In the early days of public aquaria, some twenty-five years ago, and down indeed to more recent times, attempts were made to utilise these institutions for scientific purposes, and biologists hoped that great results would follow from their establishment. It was in 1860 that the late Mr. Lloyd designed an aquarium for Paris, and two years later a similar one for Hamburg. Others soon followed, both in this country and on the Continent, nearly all of them constructed on the method devised by Mr. Lloyd, and several of them under his direct superintendence. Probably the earliest on a large scale in this country was the well-known establishment at the Crystal Palace, to the management of which Mr. Lloyd succeeded on the death of Mr. J. K. Lord. Others soon followed at Brighton, Manchester, Southport, Westminster, Yarmouth, Edinburgh, Rothesay, and many other towns in this country; not to mention Vienna, Dresden, Frankfort, New York, San Francisco, Melbourne, and other places abroad, with the planning of

most of which Mr. Lloyd had something to do. At the Crystal Palace, Brighton, Birmingham, and elsewhere, efforts were made to make these aquaria serve the purposes of scientific research, and at the same time to keep them open to the public as places of entertainment and some little instruction. In some of them naturalists' rooms or laboratories were established, and experiments and observations attempted with a view to adding to our scientific knowledge of the creatures whose graceful movements the public never tire of admiring. But the great essential of all such institutions was and is that they should pay. They were regarded by shareholders and managers as simply forming part of their big show, not to be compared in attractiveness to nigger minstrels, Lulu, or a Chinese juggler, but still useful as a bait to catch certain classes of the public. Naturally the views and aims of the management and of the presiding naturalist clashed, and the latter had either to adapt himself to the leading purpose of the establishment or to resign. At all events, it finally became evident to biologists that science could expect little help from the ordinary aquarium, which was no more than a handmaid to the amusement of the public. To accomplish her noble purposes she must be mistress. We believe the French were the first to recognise this important truth, and to establish a station solely for the purpose of investigating the habits, organisation, and surroundings of the denizens of the ocean. Now they have quite a number of such stations in operation—as, for instance, at Roscoff, Concarneau, Villefranche, and Cette. The Austrian Government maintains a similar station at Trieste, while in America the John Hopkins University has one at Beaufort, and Professor Alexander Agassiz another at Newport. The Dutch have for several years had a travelling laboratory erected during the summer months at different parts of their coasts. But undoubtedly the finest institution of the kind is that founded ten years ago at Naples by a German biologist, Dr. Anton Dohrn, to the work of which we have at various times referred in our columns. The Naples station is indeed an international institution, for although

it is subsidized to the extent of £1500 a year by the German Government, its workers and much of the rest of its income, which in all amounts to about £5000 a year, come from all parts of the world. The University of Cambridge maintains a table for one of its students, as does also the British Association. America has always one or two investigators working under Dr. Dohrn, while various European countries have their representatives. Not only has the Naples station its tanks and its laboratories, but it maintains steam launches and boats of various kinds, diving apparatus for investigating the sea bottom, dredges and trawlers, sailors and fishermen trained as collectors, and issues regularly a series of handsome 'Transactions,' comparable to the publications of our "Challenger" expedition. The advances made in the special department of biology connected with fishes since the establishment of the Naples' station has been immense, and has had besides important bearings on other departments of the same branch of science. In this country no regular station of the kind has existed until within the last few months, when, under the auspices of the Scottish Meteorological Society, one has been established in an old quarry at Granton on the Firth of Forth, near Edinburgh. Already the naturalists at Granton have done good work in investigating the habits of the economical fishes, and especially the herring, and some of the results of their work were described to the Royal Society last Thursday by Professor Cossar Ewart, of Edinburgh. For several years the British Association has had a committee to superintend the working of a Scottish zoological station; but the station has been peripatetic and temporary, maintained only during the summer months at different parts of the Scottish coast; nevertheless it has done excellent work. British naturalists have been long convinced that both from a scientific and economical point of view it is high time that a permanent station on the model of that of Naples were established at some suitable point on the coast of England. The success of the recent Fisheries Exhibition has encouraged this prevalent feeling, and has led our leading scientific men to

take definite steps to place England in this respect on a level with other countries. As we have already announced, a meeting will be held to-day in the rooms of the Royal Society to carry out this object. This will be accomplished by founding a society having for its purpose "the establishment and maintenance of a well-equipped Laboratory at a suitable point on the English coast, similar to, if not quite so extensive as, Dr. Dohrn's zoological station at Naples." Among the supporters of the movement are the most influential naturalists in the kingdom. Professor Huxley, P.R.S., will preside, and others who have promised to be present are Professor Flower, Professor Moseley, Sir Lyon Playfair, Sir John Lubbock, Professor Michael Foster, Professor Ray Lankester, Dr. Günther, Dr. W. B. Carpenter, Mr. Gwyn Jeffreys, Dr. P. L. Sclater, and Mr. W. S. Caine, M.P. (one of the Commission on Trawling). With such powerful support it seems to us that the object in view is sure to be accomplished. Both from an economical and scientific standpoint the utility, indeed the necessity, of such an establishment appears obvious. Already the Granton station has done good service to the Scottish fishermen; but even if no ends were to be served by such a station except those of pure science, these in our estimation are so important as to justify the movement which has secured such influential support. The utility in its highest, and even in its lowest, sense of encouraging scientific research may now be taken as recognised in all civilized countries. All the most valuable "practical" discoveries have been made by men who were not seeking for them, but whose sole aim was to satisfy a noble inquisitiveness. Our Government recognises the necessity of encouraging science in its magnificent establishments at Bloomsbury and South Kensington, and in its subsidy of £5000 a year to the Royal Society for purposes of research; and none but chronic grumblers would grudge another £1000 a year to the support of the proposed station, which indeed may be regarded as an almost indispensable adjunct to the Natural History Department at South Kensington. The necessity for research in this direction was recognised at

the final meeting of the Fisheries Exhibition Commissioners, when they voted £3000 for the formation of a Royal Fisheries Society. They have still £2000 in reserve, and as the exhibition was as much scientific as economic it seems only natural that part of this should find its way to help in the construction of a station whose sole purpose would be the investigation of the habits and organisation of the fishes of our British waters. On every side we are told that something must be done for the improvement of our fisheries; science has done so much in recent years to improve every other department of industry that, in our opinion, it is quite worth while asking her to do something for a department which is of growing economical importance. She must, however, be allowed to do it in her own way, and the names of those who are to take part in the meeting of to-day are a sufficient guarantee that any funds with which the future society will be entrusted will not be abused. The movement is one which certainly deserves public support and the countenance of the Government.

It is intended to erect the proposed Laboratory at a point as rich as possible in respect of its marine Fauna, and at the same time in proximity to important fishing grounds. No locality, we are told, has yet been decided, but both Torquay and Weymouth have been suggested as presenting the desired combination. There can be little doubt that Monday's meeting will be the first step to the accomplishment of the great object in view, in the near future.

The meeting was duly held in the afternoon of March 31st, 1884, in the Rooms of the Royal Society, and the report of it, which has been reprinted in the following pages, was largely circulated.

Report of the Foundation Meeting of the Marine Biological Association.

Professor Huxley, President of the Royal Society, who presided, in opening the proceedings, said: A great number of gentlemen who would have been glad to be present in support of the object of the meeting have been unable to appear. The Right Hon. Joseph Chamberlain, M.P., has written a letter cordially approving of the objects of the Society, and hoping it will be strongly supported. Mr. Burdett-Coutts, who has taken a very great interest in the Fisheries Exhibition, expresses his warm approval of the scheme, and offers a handsome subscription. Mr. Duff, M.P., who is greatly interested in sea fisheries, and the Marquis of Hamilton, one of the most active members of the Fisheries Exhibition Commission, also write to express their regret at being detained by business so that they cannot be here to-day. There are also letters from Lord Derby, from Sir Thomas Dakin (Prime Warden of the Fishmongers' Company), and from Dr. Dohrn, of Naples, who has carried out a similar scheme to that which this meeting has in view, viz. the celebrated Zoological Station of Naples. Dr. Dohrn speaks of the project with warm approval. Admiral Sir Erasmus Ommaney and Dr. Acland, of Oxford, write to express their regret at being absent, the movement being one in which they take great interest. In supporting what I understand to be the object of the proposal before us, which I may say is not in my hands, but chiefly in those of Professor Lankester, I simply express the interest in it which biologists feel, and the desire of the Royal Society to foster the new undertaking, which appears to promise well for the good of science. The establishment of laboratories for observation of the Fauna and Flora of the sea has now taken place in most civilized

countries, and is, in fact, a necessary consequence of the great change which has taken place in the whole of the aims of biological science. The study of development, commenced in a serious way half a century ago, and the further progress and ramifications of that line of inquiry, which has been extended to the mode of existence of all living things by Mr. Darwin, has caused a complete change in the methods of biological science, and consequently, in the methods by which biological investigation is pursued. In order to understand the living being now, it is no longer sufficient to be acquainted with its outside, as in the days of our forefathers, or even with its inside, so far as obvious anatomy is concerned, as was the case with the immediately preceding generation. We now, in order to understand the being, relations, and affinities of an animal, have to go back through the whole course of existence beyond, in order to trace out the successive stages of development from the egg; and this can now be done with a precision and accuracy which in my young days we had no conception of. But though from a purely scientific point of view this is one great reason for establishing laboratories of the kind now proposed, a more directly practical reason exists. We possess great fisheries, which are more or less regulated by legislation, and which are of great importance to very large masses of the population. Hitherto—certainly within the last thirty years—such regulations have been made in an almost entirely haphazard manner, because of the want of knowledge of the habits, the mode of life, the mode of production, &c., of the animals which are economically useful. At the present time it is within my knowledge that a great deal of vehement opposition to particular modes of fishing has been due to the absolute ignorance of the fishing population of some of the primary facts of the mode of life and reproduction of our food fishes; and it is of essential importance that those who wish to regulate fisheries should rest their arguments and their reasonings upon a definite and solid foundation, and upon a complete knowledge and sound observation of the mode of life and development, and so forth, of the animals which constitute the staple of our fishing

wealth. These are the two objects which the proposed Society has in view. I wish to say very emphatically that in my opinion there is no possibility of any rivalry or conflict of aims between the Society which is now to be founded, and the one whose formation was announced by H.R.H. the Prince of Wales, at the meeting of the Committee of the International Fisheries Exhibition the other day, the object of which was to be simply practical, in the ordinary sense of the word, and related to the collection of statistics, the condition of fishermen, and so on. An important part of the functions of the Royal Fisheries Society would be an inquiry into the habits and modes of life of food fishes, and I sincerely trust that when both societies are established, our Biological Society, so far from being a hindrance or rival to the larger society, will be only too ready to take up that particular part of the work germane to its purpose, viz. the habits and mode of life of the food fishes, so that the two societies will be able to work in harmony towards one common end.

The CHAIRMAN then called upon the DUKE OF ARGYLL to move the first resolution as follows :—"That in the opinion of this meeting there is an urgent want of one or more laboratories on the British coast similiar to those existing in France, Austria, and America, where accurate researches may be carried on leading to the improvement of zoological and botanical science, and to an increase of our knowledge as regards the food, life, conditions, and habits of British food fishes, and molluscs in particular, and the animal and vegetable resources of the sea in general."

The DUKE OF ARGYLL said,—I consider it a great honour to have the privilege of moving this resolution. I suppose that the fact of our being called together to-day to form a society implies a discovery on the part of those who have taken the lead in the matter that the work is not likely to be taken out of their hands. I mean out of the hands of voluntary societies by the Government. I am afraid that the British Government has always stood behind other Governments, whether monarchical or republican, in the promotion of scientific discovery. In America, I believe,

the Government takes a more active and direct part in the promotion of biological and other scientific discovery. At the same time, on the whole, perhaps we have not much reason to complain, for in recent years the expenditure of the English Government on purely scientific objects has been very large, and I have been long enough a member of Governments to know that every year, when the Chancellor of the Exchequer comes to make up his Budget, there is considerable pressure brought to bear upon him in the matter of reduction of taxation, and of the growing burden of the Civil Service estimates, and therefore, though after a time we may hope for the assistance of the Government, yet it is hardly to be expected that the Government will take this enterprise out of our hands at once. At the close of the last Fisheries Exhibition I had the pleasure of being present at a conference where a hope was expressed that some portion of the surplus—then expected to be a large one—from the Fisheries Exhibition might possibly be applied to this purpose. You have all seen, from a speech of the Prince of Wales, that a very large part of the latter fund is likely to be applied to another purpose, which is no doubt most legitimate, and which I admit to be excellent, namely, the support of the widows and orphans of those fishermen who lose their lives on our coasts. Therefore we cannot look to this source for funds. Now, coming to the terms of the resolution, and to the objects which have been explained by Professor Huxley, I notice that there are mixed together in this resolution the desire to contribute to the enonomic uses of science, and to the purposes of pure biological research. I feel some doubt whether, on the mere ground of economical application, the Society will be necessary. Economic interests can take care of themselves. There are already many agencies in this country through which most of the facts can be ascertained as regards our food fishes. Some have been already ascertained by our distinguished President (Professor Huxley), and a paper has been contributed lately to the Royal Society by Professor Ewart in relation to one of the most important questions connected with the economics of food fishes, VIZ.

the spawning of the herring. It is quite true that a great many of the objections which have been made to the operation of certain modes of fishing have been entirely due to mistaken ideas as to natural history, as, for instance, the supposed loss caused to the spawn of the herring by the system of fishing known as trawling. A good number of my own people have been for centuries almost entirely dependent upon the herring, and, strange to say, within the last twenty years the shoal of herring have almost deserted the upper portion of Loch Fyne, where there had been for generations most lucrative fishing. The poor fishermen hold that this desertion is owing to the employment of a special mode of fishing, but it really arises from causes which no man knows, as yet. These poor people believe that this decline in the yield of the herring is due to the new mode of fishing introduced twenty-five years ago, and which is locally termed "trawling," though totally different from what is termed trawling in England. It is really fishing by the use of a seine net. The fishermen think that trawling breaks the shoals, scaring the herring and intercepting their passage to Loch Fyne. Another objection is, that a seine net drags up quantities of spawn, but this is found to be impossible, for the spawn shed on a stone adheres firmly to it, and the action of the trawl net cannot possibly disturb the spawn, which has been discovered clearly to be deposited by the female fish so as all to adhere to the bottom.

I am strongly of opinion that, in starting our Society, we should in the main look to the interests of biology as a science. For my own part, I can sincerely say that I came here to move this resolution as a means of promoting biological research. I look upon biology as by far the highest of all the branches of natural science. I know that there are some persons who will not accept that proposition. Some prefer the more exact sciences, in which they can obtain results supported by positive demonstration, and capable of methodical proof. There are many persons who decry researches in biology on the ground that they are less certain and exact, and that they are accompanied

very often by hypotheses not capable of demonstration. I may say that I have no sympathy with that feeling. You cannot in the pursuit of science get rid of hypotheses. They are absolute necessities and instruments of research. The experiments conducted by our new Society will go far to prove or disprove many of the hypotheses which are held in respect to the origin and development of life. I remember thirty years ago reading in a very remarkable book, which made a great sensation at the time,—a book written by Hugh Miller, a man of considerable genius, not only on account of his command of literary style, but also on account of that which Professor Tyndall has so much emphasised, "the scientific use of the imagination;" I remember, I say, seeing in this book, which was published some six or ten years before Darwin's 'Origin of Species,' and when the author had to deal with the theory of descent in the older forms in which it appears in the 'Vestiges of Creation,' that the author ventured to suggest that the flat fishes showed every indication of being a degenerate branch of the round fishes. I thought at the time that that was one of the wildest theories that could be conceived. It was connected with the recently revived theory of possible degradation from a higher organization. It now turns out from various observations in aquaria in America, Sweden, and elsewhere, that this strange imagination was perfectly correct, and that there is good evidence for the belief that the flat fishes have been derived from the round fishes. The young of the common flounder, I believe, is born or hatched in the round condition. This is a remarkable indication of how pursuits such as are contemplated by this Society may be of the greatest assistance to scientific men in regard to the history of life.

Granting that biology is one of the very highest branches of natural science, I think I am right in saying that the sea is the area in which and out of which we can best get at some of the secrets of organic life. The sea, I may say, is more rich in the variety of forms of life than the land. I sometimes use the dredge from my yacht, and I never empty the contents of the dredge without standing in

astonishment at the enormous fertility and variety of life brought to the service—fishes, crustacea, and zoophytes, of every sort, and the lowest forms of sponge-life are brought up at haphazard, with immense numbers of molluscs and cuttle-fishes upon almost every occasion. It is impossible in these circumstances not to be struck with the immense fertility of the sea. There are special circumstances affecting marine life which make it an especially valuable field for observation. Many specimens are almost crystalline in transparency, and one can see the insides of the animals without wounding their outsides; there is thus this great advantage, that in the study of biology we get rid of those painful discussions which have been raised in regard to vivisection, because, quick as the sympathies of modern society are with every form of suffering, it has not yet occurred to anyone to object to the vivisection of a jelly fish. I hope and believe that by the operations of a society like that which it is proposed to establish some of the most important questions of physiology may be settled without vivisection.

The Right Hon. Sir Lyon Playfair, K.C.B., seconded the resolution. He said,—The motion is one which commands my hearty sympathy. It is an extraordinary fact that while other nations having far less interest in the sea than the United Kingdom, have established, either by private generosity or by public aid, laboratories for the study of marine life, England has not made even a beginning in this important work. The need for such laboratories is recognised, and an effort has lately been made in Scotland to found one, which already promises success. Though the promise of practical utility from such laboratories is very great, that is not the first or the only thing to be considered. Laboratories of this kind, in which the habits of all kinds of marine life should be studied, ought primarily to be established—not with a view to practical uses, but with the main purpose of advancing science for its own sake. Science so studied rewards a nation a thousandfold in the most unexpected practical applications; but without science there are no applications. It is only when

the streams of science are full that their overflowing produces fertility to the land upon their banks. The marine laboratories, such as those we wish to see founded, should not primarily be established to bring an increased supply of fish to our frying-pans and fish-kettles. Their main purpose should be to examine the development and habits of all forms of marine life, so as to give the biologist a better insight into the laws which govern their existence. I would take as an example the laboratory of my friend Mr. Agassiz, at Newport, in Rhode Island. He is a man of ample fortune, and spends it nobly in the advancement of science. His laboratory for studying marine biology is purely a scientific one, and the idea of practical utility has probably never crossed his brain. Yet it is one of the invariable consequences of the fulness of science that it does reward the nation or individual who prosecutes it in a disinterested spirit with many material advantages. Perhaps you will allow me to draw an illustration from my frequent visits to America of how science can, and does, repay the study of marine life. The American Government gives much support to a Commission of Fisheries, under the presidency of Professor Baird. The Commission's object in this case is practical, though the practical results are attained by scientific methods and scientific study. These have already repaid the State a thousandfold its wise expenditure. I have only time to give two instances. The cod is a most important fish for the coast of North America; but the cod loves the colder coasts of British America more than the warmer shores of the United States. The grey cod used to be only a winter fish in the bays of the States; for in summer it goes to Newfoundland, to get the cooler waters of the Arctic stream. Nothing would appear more hopeless than to alter the habits of fish; but science is never discouraged as long as she works within natural laws, and even this has been accomplished. The cod is a most prolific fish, as a full-sized one weighing 99 lbs. has as many as 9,000,000 eggs. The artificial incubation of these is now so well understood in the hatching ponds of the States, that it is carried on with perfect success. Let us

assume that only fifty full cod are used for artificial incubation, then the young produced would be 450 millions. Now, the whole catch of cod by human agencies on the coasts of North America is only 150 millions, so that fifty cod, so treated, would more than suffice to produce that number. Man, however, is an insignificant factor in the destruction of fish, for they have many enemies even of their own kind to encounter. The blue fish, which abounds on the American coasts, is a cruel tiger of the sea. It does not swallow other fish for food, but it snaps a mouthful out of one fish and then attacks another in a like way, eating, it is believed, its own weight of fish for food daily. This, and the other enemies to the young cod, interfered greatly with the labours of the artificial incubation; but persistence has been rewarded with success. The cod thus artificially hatched are attached to the place of their birth, and do not seem to know their way to the coasts of Newfoundland; and so they keep to the shores of the States, and are now freely caught in summer, being called by the fishermen "Commission cod." If I do not tire you, let me give one other instance. The American shad is a fish greatly esteemed by our Transatlantic kin. It only spawns on the sea coasts at a temperature within a few degrees of 60° F. If cold rains lower the temperature to 55°, or if hot weather raises it to 65°, the shad run out to sea to spawn. Formerly, after a cold or hot spell of this kind, the fishermen knew that in the fourth year after it there would be a famine of shad, but this occurs no longer; for the Commission vessels now follow the shad to sea, secure their eggs, and hatch them artificially. So no famine is now known. Although I would have preferred to support the motion for marine laboratories more on the ground of their importance to abstract science than to show those who look to practical applications the enormous benefits which come from a study of the habits of marine life, yet had I time, I could refer to the important applications made recently in the United States on the subject of oyster cultivation, and to the valuable and interesting paper of Professor Cossar Ewart on the spawning of herring in Scotland—a subject familiar

to the Chairman and less familiar to myself, though we both served in a Commission on the herring fishery. Those who love science for its own sake will largely promote it by aiding to establish marine laboratories in this country, and those who know science only through its useful applications to man may feel fully confident that any encouragement which they give to this undertaking will be repaid a hundredfold in proximate, if not in immediate, benefits to the human race.

The Earl of Dalhousie, in supporting the resolution, said that he did so especially in relation to the practical part of the question. Professor Huxley had referred to the wonderful hypotheses of the fishermen on the British coast in regard to the habits and movements of fish. He (the speaker) had been Chairman of a Commission appointed to inquire into certain difficulties between fishermen who used nets and lines, and those who used trawls. He informed himself, as far as he could, of all that was practically known in regard to the fish. He devoured a large number of blue-books, &c., and was sorry to say that ignorance with regard to the habits of the fish appeared to be by no means confined to the poor fishermen of the coast. The complaint was, that all along the coast the fish have deserted the inshore districts, and gone to sea—and nobody knew why. If the Americans had been able to bring the cod so far, it ought to be in the power of the Society now about to be formed to devise means of bringing the fish inshore after they had gone out to sea. As a testimony to the great importance which was attached to the foundation of the proposed Society, he might mention that since he had entered this room he had seen present every member of the Government Commission on Trawling, of which he had spoken.

Professor Flower, F.R.S., P.Z.S., Director of the British Museum (Natural History), also supported the resolution. He quite agreed with the Duke of Argyll that they could hardly complain of the Government when they saw the magnificent manner in which our national collections of zoology were housed. But before they could exhibit their

specimens they must catch them, and he ventured, in addition to the admirable arguments of the mover and seconder, to suggest that these laboratories would be the means of supplying not only our great national museums but all the local museums throughout the British Islands with specimens which would bring home to all the population in the country a knowledge of the wonderful forms of sea life. It was quite impossible at the present time to get a really systematic collection of specimens. This alone would be a good reason for establishing such laboratories as the new Society contemplated.

Dr. W. B. Carpenter, C.B., F.R.S., then moved :—"That it is desirable to found a Society, having for its object the establishment and maintenance of at least one such Laboratory at a suitable point on the coast, the resources of the Laboratory, its boats, fishermen, working rooms, &c., being open to the use of all naturalists under regulations hereafter to be determined." He had for a great many years taken a great interest in this particular subject, and would like to supplement what Sir Lyon Playfair had stated in regard to the American work of this kind, by reading the programme laid down in the very first report which Professor Spencer Baird, who had the organization of this Commission in the year 1874, had issued :—

Extract from the First Report of the United States Commission of Fish and Fisheries (1873), pp. xiii, xviii.

> "The objects of the investigation, as authorized by Congress, were, *first*, to determine the facts as to the alleged decrease of the food fishes; *secondly*, if such a decrease be capable of substantiation, to ascertain the causes of the same; *thirdly*, to suggest methods for the restoration of the supply; and *fourthly*, to work out the problems connected with the physical characters of the seas adjacent to the fishing localities, and the natural history of the inhabitants of the waters, whether vertebrate or invertebrate, and the associated vegetable life.
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> "The history of the fishes themselves would not be complete without a thorough knowledge of their associates in the sea, especially such as prey upon them, or in turn constitute their food.
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> "Furthermore, it was thought likely that peculiarities in the temperature of the water at different depths, its chemical constitution, the percentage of carbonic acid and of ordinary air, its currents, &c., might all bear an important part in the general sum of influences upon the fisheries; and the inquiry, therefore, ultimately resolved itself into an investigation of the chemical and physical characters of the water, and of the natural history of its inhabitants, whether animal or vegetable. It was considered expedient to omit nothing, however trivial or obscure, that might tend to throw light upon the subject of inquiry; as without such thorough knowledge it would be impossible to determine with precision the causes affecting the abundance of animal life in the sea, and the methods of regulating it."

Turning to the scientific object of these inquiries, Dr. Carpenter remarked that he recollected the very beginning, he might almost say, of the modern mode of the investigation of development. He could remember the sensation produced among naturalists by the publication of the researches of Vaughan Thomson, a retired army surgeon living at Cork, which first taught them something of the development of crustacean life, which showed them what had been regarded as independent animals—the Zoœa—were really the young of the common crab, and who pointed out that still more remarkable fact, that the barnacles and sea-acorns were really modified forms of crustacea. These opinions were all pooh-poohed, and papers were published by the Royal Society to show that Mr. Thomson was all wrong, but yet his researches proved perfectly correct. He remembered hearing while at Edinburgh nearly fifty years ago, that Sir John Dalyell, a man of property and of scientific habit of mind, was engaged in biological investigations. Sir John Dalyell got information from all the fishermen round Scotland, and made most wonderful observations. His extraordinary discoveries were not believed by anybody. They related to the development of Medusæ from

polyps. These researches were not published until after their substantiation by foreign naturalists, though they had been discovered long before by Sir John; and so he might go on to show how large a proportion of the valuable work which had given them new ideas of marine animal life had been inaugurated in this country. He would especially refer to an incident which took place at the first meeting of the British Association at Southampton, to which Edward Forbes brought an *Amphioxus* which he described in his inimitably humorous way, pointing out how it was a vertebrate animal without a vertebral column, how it belonged to the red-blooded order and had white blood, and how its pharynx was the pharynx of an Ascidian. They all now looked upon the *Amphioxus* as the sole survivor of the marvellous group which formed the link between the Vertebrata and the Invertebrata. These were the studies which formed the life-blood of biological science, and considering what had been done in this country previously it would now be shameful if we were to allow ourselves to fall behind in these inquiries. He knew Professor Agassiz' laboratory at Newport and all the admirable laboratories sustained by the John Hopkins University of Baltimore, and by the biological station at Naples and other places, and in order to persuade the Government that such things as these were really of national importance and deserving of national encouragement, it was for all interested in biological inquiry to do their very utmost to sustain an organization which would show what even one station well worked could do.

Sir John Lubbock, Bart., F.R.S., was glad to second the resolution as President of the Linnean Society and as a Trustee of the British Museum. A great deal more biological work might be accomplished with some organized assistance, such as that proposed in the foundation of a well-equipped Laboratory. There were as good fish in the sea as ever came out of it, and he thought there were many interesting and good ones, from a scientific point of view, that had never come out of it yet. He trusted that the inauguration of this Society might be the means of supply-

ing many interesting contributions to the British Museum, and also to the Royal, the Linnean, and other societies. The proposal was also of great practical importance, and he hardly knew whether the results were likely to be of greater utility from a scientific or practical point of view.

Dr. Albert Günther, F.R.S., Keeper of the Zoological Collections of the British Museum (Natural History), had spoken to many friends, both scientific and non-scientific, and had generally met with a great desire to assist an undertaking like the present one, which promised such great benefits for science, and such practical advantages for the people. It was but human that most of them desired to have the idea taken up by a society in the management of which they might have a voice. In the successful management of the proposed zoological observatories a good many different qualifications would be required. It was not a zoological station alone, but a biological one, which it was proposed to establish, and therefore for the interests of botany as well as of zoology. A good deal of technical knowledge of dredging, &c., would be required. All those qualifications could in no way be better combined than on such a basis as was promised by the council of a representative society, to which men of various qualifications would be elected. Before he came to that meeting he did not feel quite sure whether the proposal would meet with such general approval as had been the case. He had now no doubt about the success of the movement. It was much better to establish these laboratories by means of a society than by the isolated enterprise of a few individuals.

In the absence of the Lord Mayor, who had expressed his intention of being present, but was detained by a meeting in the City, Sir Joseph Hooker, K.C.S.I., F.R.S., moved:—"That this meeting does hereby agree to constitute itself such a Society under the title of 'The Society for the Biological Investigation of the Coasts of the United Kingdom.'" This was, he said, an effort which would have the hearty appreciation and strong support of the scientific bodies of the country. It was an important fact that the British coast was the richest area in the world for seaweeds.

There was no country in the world which had contributed so much to the knowledge of algæ as England. He thought there were no scientific bodies who would not take the liveliest interest in the efforts of the new Society, and that its foundation was full of promise for the future of biology.

Professor Moseley, F.R.S., observed that it was only by means of a regular station, at which systematic work could be carried out continuously, that any progress could be made in the investigation of the conditions of our coast. The work already done had been done in an unconnected way. The difficulty of investigating some of our commonest animals would be understood when he mentioned that a scientific friend of his for many years had wished to work out the development of the common limpet, of which as yet nothing was known. This animal was one of the most important of the Mollusca, both scientifically and commercially. His friend had been to the coast at various seasons to get the eggs and watch their development, but had failed, and up to this day this most important piece of work had never been accomplished. Under the new Society they would, during the very first year of the continuous working of a laboratory, get to know pretty thoroughly the development of the limpet. He did not think that any investigation not of a strictly scientific character was of much value with regard to practical results. It was only by the most thorough scientific work that we should ever arrive at the increasing of our supplies of oysters and lobsters. This year most interesting results have been obtained in the United States with regard to the oyster. With regard to the furtherance of biological science generally, the more they understood animal life the more they found that all animals had gone through a littoral phase. Animals may have originated in the open sea, but all animals seem to have passed through a littoral stage. From the littoral condition of animals are derived all the animals of the deep sea. All terrestrial animals have come from the shores. Even in man himself there were structures in the embryonic state only to be explained on the

theory that his ancestors had lived in the waters of the seashore.

Dr. Sorby, F.R.S., said that some years ago he was anxious to assist in such an institution as that now proposed, and also to bear some of the cost. He hoped now to render some assistance to the new Society, seeing that he lived half the year in his yacht, carrying on investigations, some of which he intended soon to communicate to the Royal Society. He was desirous of taking an active part in the work of the Society.

Sir William Bowman, F.R.S., moved:—"That the following gentlemen be requested to act as a provisional council, and report to an adjourned meeting, to be held on Friday, May 30th, as to the constitution and organization of the Society, and other matters, and in the meantime have power to admit suitable persons to the membership of the Society; further, that Professor Lankester be asked to act as Secretary, and Mr. Frank Crisp as Treasurer *ad interim*." Those named were the Duke of Argyll, the Earl of Dalhousie, Lord Arthur Russell, the Lord Mayor, the Prime Warden of the Fishmongers' Company, the President of the Royal Society (Professor Huxley), the Presidents of the Linnean (Sir John Lubbock), Zoological (Professor Flower), and Royal Microscopical Societies (Dr. Dallinger), Dr. W. B. Carpenter, C.B., F.R.S., Mr. W. S. Caine, M.P., Mr. Frank Crisp, V.P. and Treas. L.S., and Sec. R.M.S., Mr. Thomas Christy, F.L.S., Mr. Thiselton Dyer, F.R.S., C.M.G., Mr. John Evans (Treasurer of the Royal Society), Dr. Albert Günther, F.R.S., Sir Joseph Hooker, K.C.S.I., Professor Michael Foster (Secretary of the Royal Society), Professor Ray Lankester, F.R.S., Professor Ewart, F.R.S.E., Professor Milnes Marshall, Professor Moseley, F.R.S., Mr. John Murray, F.R.S.E., the Rev. Dr. Norman, F.L.S., Sir Lyon Playfair, K.C.B., Mr. George J. Romanes, F.R.S., Professor Burdon Sanderson, F.R.S., Dr. Sclater, F.R.S., Mr. Adam Sedgwick, Mr. Percy Sladen, F.L.S., Dr. H. C. Sorby, F.R.S., and Mr. Charles Stewart, F.L.S.

Mr. George J. Romanes, F.R.S., seconded the resolution,

saying that he thought he should not be able to express his view more strongly than by saying that in his opinion the proceedings of that afternoon had been taken many years too late. When we remembered our great maritime power, that our coasts extended for tens of thousands of miles, and in all latitudes, and that England was mistress of the seas, it seemed to him nothing short of a national disgrace that we alone should have been so long content with having hitherto done little or nothing in the way of systematic investigation of the marine zoology of our own shores. But if such had been our amazing apathy in the past, the best they could do was to retrieve the error by striking while the iron was hot, viz. by constituting themselves a Society, with an executive committee. The list of names was one of very great force, and it would be difficult to add to its force. Professor Flower had said that each speaker should contribute one point to the discussion. He (Mr. Romanes) should like to observe that there was one function of the proposed Laboratory which had not received the attention it appeared to him to deserve; he meant the investigation of invertebrate physiology. In the invertebrate forms of life we saw life in its simplest shape, and in the shape which best admitted of observation and experiment, with the view of throwing light upon most of the great questions relating to the processes of life. Where were they to look for the material for this investigation? Unquestionably to the sea, which was the great magazine of such life. He therefore looked forward with some confidence to the time when it would certainly not be considered the least important function of the newly-formed Society to investigate the physiology of the invertebrate forms of life.

Professor Lankester moved a vote of thanks to Professor Huxley for taking the chair, which was seconded by Sir Joseph Fayrer. Before putting the vote, Professor Lankester mentioned that it was hoped that they might raise a fund of from £6000 to £10,000 for the purpose of starting one Laboratory, and it would now be possible for individuals who took an interest in the proceedings of the

Society, to send to the Treasurer, Mr. Frank Crisp, cheques for £100 or £1000 to start the fund. If those who believed in the utility of the Society, and its projected Laboratory, were prepared to subscribe generously to the Laboratory Fund, the anticipations of those who had spoken so hopefully of the work taken up by the Society would be speedily realised.

At the first Annual Meeting in June, 1885, of the Association thus founded, subscriptions to the amount of £8000 were announced. At the second Annual Meeting in June, 1886, the subscriptions amounted to nearly £15,000, and at the third Annual Meeting in June, 1887, the approaching completion of the Laboratory on the Citadel Hill at Plymouth, and the commencement of active work, formed the subjects of the Council's report.

Report of the Council of the Marine Biological Association for the year 1886-87.

PRESENTED AT THE THIRD ANNUAL GENERAL MEETING OF THE ASSOCIATION, HELD ON JUNE 24TH, 1887, IN THE ROOMS OF THE LINNEAN SOCIETY, BURLINGTON HOUSE, LONDON.

I. The Council has met during the past year six times. Its attention has been chiefly occupied with the superintendence of the building and the fitting of the Laboratory at Plymouth, and with making arrangements for the future work of the Association in connection with the Laboratory. A Committee of the Council have been actively engaged in preparing plans for the fittings of the building, and the plans thus carefully devised have been adopted by the Council. It is expected that the Laboratory will be ready for partial occupation in the present summer, but the tanks and circulation of sea water cannot be completed for some months to come. The Council has every reason to express satisfaction with the progress which has been made with the building, and with the attention given to its construction by Mr. Inglis, of Plymouth, the engineer to the Association.

II. The Council has determined to employ a skilled Naturalist at Plymouth (in addition to the Resident Superintendent), to carry on investigations into the natural history of British Marine Food-fishes, under the direction of the Council. It has been determined to assign a salary of £250 a year to the Naturalist so employed, and an advertisement has been printed in 'Nature' and the 'Athenæum' inviting applications for the post. The applications are to be sent in before or on June 30th, and the Council will make the appointment in July.

III. On the application of the Council the Government Grant Committee of the Royal Society has placed a sum of

£250 at the disposal of a committee, consisting of the President and Secretary of the Association, the Chairman of the Council, and Mr. Adam Sedgwick, F.R.S., for "the investigation of the Fauna and Flora of Plymouth Sound at the Plymouth Laboratory." The committee who have the disposal of this grant have not yet made arrangements for its expenditure. For their purposes the Committee will have the use of the appliances of the Laboratory of the Association as soon as they are sufficiently advanced to be of service, whilst the researches conducted under the auspices of the Committee will be of essential value to the Association in its endeavours to carry out the purposes of its foundation, viz.: "to promote accurate researches leading to the improvement of Zoological and Botanical Science, and to an increase of our knowledge as regards the food, life-conditions, and habits of British Food-fishes and Molluscs."

IV. The Council has to report further substantial additions to the funds of the Association from the Mercers' Company, and from the Skinners' Company; also from the Cambridge Committee, and from several private individuals. The Treasurer's report shows that during the year there was received from Donations and Subscriptions £4240 2*s*. 6*d*., and from Interest on Investments £224 9*s*., whilst there was paid, to the Contractors £2660, for Salaries £266 4*s*. 6*d*., and for Sundries £121 5*s*. 7*d*. The Donations assured, but not yet received from all sources (exclusive of the annual grant of £500 a year for five years, to be paid by Her Majesty's Government during the years 1888—92) amount to £3800, a total estimated balance of nearly £12,000.

V. The Council has accepted, in accordance with Bye-law 17, the donations of £500 from committees acting on behalf of the Universities of Oxford and of Cambridge respectively. In pursuance of the provisions of that Bye-law the University of Oxford has nominated Dr. J. Burdon Sanderson, F.R.S., Professor of Physiology in the University, as a Member of Council of the Association. The University of Cambridge has similarly notified the nomination of Dr. Michael Foster, F.R.S., Professor of Physiology in the University, as a Member of Council.

VI. In order to prepare the way for the further work of the Association at Plymouth, Mr. Walter Heape, M.A., the Resident Superintendent of the Laboratory of the Association, has at the request of the Council drawn up two reports, entitled respectively 'Notes on the Fishing Industry of Plymouth,' and 'Preliminary List of the Fauna and Flora of Plymouth Sound.' Mr. Heape has also, acting under the direction of the Council, hired a trawler and commenced an inquiry into the natural history of the common sole, which will be prosecuted with increased vigour as soon as the Laboratory arrangements are complete. Some experiments on the cultivation of the sole in a "mulletry," or fish-pond open to the tidal-water, were also commenced by Mr. Heape in the month of April, but are necessarily not yet in a condition for report.

VII. The Council has decided to issue to Members of the Association, in the form of a Journal, to be published at intervals, the Annual Reports of the Council, together with such papers as those prepared by Mr. Heape, and other information which the Council desires to place in the hands of the Members of the Association. It is thought that such a Journal may serve not only for the circulation of the official publications of the Council, but also as a means of inquiry and exchange of information amongst those who are interested in Marine Biology in its relation to the Sea Fisheries of the United Kingdom. The first number of the Journal will contain the present Report, a list of the Officers, Council, and Members of the Association, Mr. Heape's 'Notes on the Fishing Industry of Plymouth,' and an illustrated description of the Laboratory on the Citadel Hill, now approaching its completion.

VIII. One of the most important appliances which the Marine Biological Association must possess in its Plymouth Laboratory is a first-rate Biological Library. Before making purchases the Council have decided to ask the Members and friends of the Association to assist in the formation of this Library by gifts of books. It is probable that many who will read the present Report have in their possession duplicate copies of illustrated works on the British Fauna and

Flora, and of recent or classical monographs on important groups of animals and plants, as well as of works on fish and fisheries in general. Those who do not possess duplicates of such works may nevertheless be able to lighten their own book-shelves and to benefit the Association by presenting to its Library copies of such books as they seldom make use of. The Library will be the first room completed and fitted in the Laboratory Building, and accordingly the Secretary of the Association will be glad to hear at once from any person who may propose to make presentations of books as suggested above. The hearty thanks of the Council will be due and will be given to those who may thus assist the work of the Association. A list of donors of books will be permanently displayed in the Library of the Plymouth Laboratory.

IX. During the past year the Council has received applications for assistance and advice in regard to matters relating to the general purposes of the Association from various public bodies. It has been in correspondence with the Russian Embassy, the Agent-General for the Colony of New Zealand, and the Inspector of Fisheries of the Board of Trade. The Council desire to take this opportunity of stating that, in view of the national and representative character of the Association, it appears to them important that it should be generally known that they are willing and anxious to co-operate with individuals or associations in any part of the British Islands who are engaged in the study of the natural history of marine fishes, or in researches in Marine Biology.

X. The Council records with deep regret the death of one of the Vice-Presidents of the Society, the distinguished naturalist, Mr. George Busk.

XI. The Council does not propose any alteration in the list of Officers, Vice-Presidents, and Council for the ensuing year.

The following names will therefore be submitted to the meeting for election:

For President—Professor Huxley.

For Vice-Presidents—The Duke of Argyll, K.G., F.R.S.;

the Duke of Sutherland, K.G.; the Duke of Abercorn; the Earl of Dalhousie, K.T.; Lord Walshingham, F.R.S.; Professor Allman, F.R.S.; Sir John St. Aubyn, Bart., M.P.; Sir Edward Birkbeck, M.P.; W. H. Flower, Esq., C.B., F.R.S.; Sir John Lubbock, Bart., M.P., F.R.S.; and Prof. Alfred Newton, F.R.S.

As Elective Members of Council—Prof. Moseley, F.R.S. (Oxford), Chairman; C. Spence Bate, Esq., F.R.S. (Plymouth); Professor Jeffrey Bell, F.Z.S. (British Museum); W. S. Caine, Esq., M.P.; W. T. Thiselton Dyer, Esq., C.M.G., F.R.S. (Royal Gardens, Kew); John Evans, Esq., D.C.L. (Treasurer, R.S.); A. C. L. G. Günther, Esq., F.R.S. (British Museum); Professor Herdman (Liverpool); E. W. H. Holdsworth, Esq.; Professor McIntosh, F.R.S. (St. Andrew's); Professor Milnes Marshall, F.R.S. (Manchester); G. J. Romanes, Esq., F.R.S.; P. L. Sclater, Esq., F.R.S. (Sec. Zool. Soc.); Adam Sedgwick, Esq., F.R.S. (Cambridge); Professor Charles Stewart, F.L.S.

As Hon. Treasurer—Frank Crisp, Esq., V.-P. L.S., and

As Hon. Secretary—Professor E. Ray Lankester, F.R.S.

XII. The Council have again to express their sense of the great boon conferred upon the Association by the Council of the Linnean Society in permitting the meetings of the Association to be held in the rooms of the Society.

Notes on the Fishing Industry of Plymouth.

By

Walter Heape, M.A.,

Resident Superintendent of the Plymouth Laboratory of the Marine Biological Association.

In the following Notes on the Fishing Industry of Plymouth the information obtained is divided into three sections, which are again subdivided as follows:

I.—Methods of fishing, localities fished, and fish caught. There are eleven different methods of fishing carried on in Plymouth:

1. Beam trawling. 2. Drift-net fishing. 3. Moored-net fishing. 4. Seine fishing. 5. Bultering, or long-line fishing. 6. Hand-line fishing. 7. Eel spearing. 8. Mullet trapping. 9. Crab and lobster fishing. 10. Shrimp and prawn fishing. 11. Oyster, mussel, and cockle fishing.

II.—Industries connected with the fishing trade carried on in Plymouth:

1. Boat building. 2. Sail making. 3. Rope making. 4. Fish-line making. 5. Net breeding. 6. Fish curing. 7. Fish-skin curing. 8. Fish-oil manufacture. 9. Ice manufacture.

III.—Methods of ownership, wage, apprenticeship, insurance, and sale of fish:

[Note.—Mr. Heape's notes are intended to furnish information which will be useful as a preliminary to the investigations to be carried out in the Plymouth Laboratory when it is completed. They are necessarily not the result of original observation, but are compiled from various sources. They have not been published in any shape before the present date, August 8th, 1887.—E. R. L.]

1. Payment of trawlers. 2. Payment of drifters. 3. Payment of hookers. 4. Systems of payment compared. 5. Insurance of trawlers. 6. Insurance of drifters and hookers. 7. Methods of selling and buying fish.

I.—Methods of Fishing. Localities Fished and Fish Caught.

1. *Beam Trawling.*

Trawling Smacks.—The boats used for beam trawling in Plymouth average about forty-three tons (43·62) ; they are cutter or yawl rigged, and are manned by a skipper, two men, and a boy ; they are, as a rule, very fast sailers and excellent sea boats.

In confirmation of this latter statement it is most satisfactory to be able to state that, in spite of the heavy weather frequently encountered by the smacks, and the great traffic carried on over a considerable portion of the fishing grounds, during the last seven years there have been but two trawlers lost, one at sea and one in the Sound. Both losses were due to collision. Two lives only have been lost during this time, both these being lives of men drowned in the former of these two accidents.

There are seventy-seven trawlers now sailing from Plymouth, for the most part owned by fishermen, many of whom are skippers of their own boat.

For some years the size of trawlers has been on the increase, the newer vessels being the largest in the port, viz. fifty-five tons. At the present time, however, there is a tendency on the part of the fishermen to prefer smaller boats, about forty tons. Those of them in favour of this change assert—

1. That there is less wear and tear in the smaller than in the larger boats, and the cost of keeping the boat in good order is consequently proportionately less in the smaller than in the larger boats.

2. That the small boats catch, in spite of the smaller sized trawl they are obliged to use, as much fish as the larger boats ; the reason of this according to my informants, being, that the smaller sized boats trawl more regularly than the larger boats, increase or decrease of wind during trawling having less effect upon them than upon the vessels of greater tonnage.

In explanation of this, I may state that only sufficient sail is made upon a vessel towing her trawl to enable her to drag it at a certain speed, say from one to three knots an hour. Any sudden and considerable increase of wind driving the boat too rapidly, lifts the trawl off the bottom, so that the fish escape underneath, while a falling off of wind on the other hand, stops the boat altogether, or causes it to trawl too slowly and to make the trawl dig too much into the ground and pick up too much sand or weed. These variations of the wind act more readily upon the larger than upon the smaller vessels, hence the latter are considered to trawl more regularly than the former, and to catch quite as much fish.

3. That the crew of three men and a boy, while ample for the smaller boat, is scarcely sufficient for the large boat, and yet the difference is not sufficient to oblige the latter to ship an extra hand. The smaller boats are, therefore, more readily handled.

4. That the smaller boats cost less than the larger in the builder's yard.

The obvious advantages of a larger boat are :

1. Increased speed in getting out to the fishing ground and home with fish ; and, therefore, increased time for fishing and command of the early market to some extent.

2. The power of using a larger-sized trawl, covering more ground than the trawl of a smaller vessel ; and

3. Greater storage capacity.

If trawling here was conducted, as in the North Sea, on the "fleeting system ;" if the trawlers travelled further to sea and remained longer from home, the larger vessels would be a necessity. A North Sea trawler may be as much as eighty tons or even more.

System of Fishing.—The fleet system of fishing is not in use in the Channel. That is to say, there are no "carriers," steam, or sailing vessels which collect fish from the trawlers on the fishing grounds and bring it to market.

Each smack carries its own fish home. Hence fishing is always carried on comparatively near the shore, and the area fished over by boats landing their fish in Plymouth is necessarily small. This system is called the "single boating system."

Why the fleet system of fishing is not carried on here I do not know, but one of the reasons advanced why it should not be is, that gales in the Channel, especially when from the south-west, are accompanied by very much heavier seas than are usual in the North Sea, and the dangers attending the fleeting system would be greater here than they are even in the North Sea.

The chief danger to be encountered by men fishing on the fleeting system is the exposure in small open boats while carrying the fish from the smacks to the "carrier" which is to take it to market. This work has to be done in all weathers, and is probably the most dangerous work encountered by fishermen.

Steam Trawlers.—There are no steam trawlers in Plymouth, and a recent attempt to introduce two such vessels here has, I am informed, not met with encouragement.

The fishermen are not favorable to steam trawlers, but do not fear competition from them.

They are of opinion that the expenses attending steam trawling, both the orginal cost of the vessel and the working expenses, are more, in proportion to the catch of fish, than the expenses of sailing smacks. They are also of opinion that a steam trawler, although able to fish in calm weather when the sailing smacks are becalmed, would be unable to fish in the heavy seas frequently encountered in the Channel by their cutters and yawls, whose sails only keep them sufficiently steady for trawling purposes.*

* In Falmouth there are six steam vessels, which are used both as steam trawlers and, when required, as tugs. I have yet to learn the fishing grounds they frequent and the effect of rough weather on their fishing returns. I understand, however, that they do not bring in a good return for their original cost.

The Trawl.—The trawl is of the ordinary pattern.

Beam.—Runners.—A wooden "beam," usually made of elm, of 44 to 47 ft. long, according to the size of the boat using it, is fixed on two iron "runners"—the "trawl-heads"—and by this means raised 2 to 3 ft. from the ground.

Net.—A purse-shaped net, open at both ends and about 85 ft. long, is attached, the upper edge of its mouth to the beam of the trawl, the lower edge to a rope—the "ground rope"—which is in its turn fastened to the lower portion of the runners. By this means the mouth of the net is kept open. The hinder end of the net, which is much narrower than the mouth, is closed during trawling by a rope, which is tied round it; and when the trawl is hauled up with the fish in it, it is hung suspended over the deck, this rope is cast loose, and the catch falls out on to the deck.

Net breeding.—The trawl nets are made or "bred" by the fishermen themselves while at sea. They are made of hemp twine, and are prepared for work when completed by steeping them in a hot solution of tar. The mesh of the net varies from about 4″ square at the mouth to 1½″ at the hinder or "cod" end of the net.*

Wear of Net.—The upper part of the net, or "back," lasts—with good luck, *i. e.* if no anchors or wrecks or rocks are come across—for twelve months. The lower part, or "belly," on the other hand, is usually worn out in four months, and this in spite of the fact that it is guarded by extra netting; the lower part of the "cod end" of the net wears out faster than the other lower portions on account of the collection of material at that end and consequent heavier weight on the ground.

Spans.—Two ropes called the "spans" or "bridles," each about fifteen fathoms long, are attached one to each trawl-head and to these "bridles" is attached the "trawl-warp" by which the net is towed.

* For details of the structure of the trawl net, "pockets," "valves," &c., see No. 11.

Size of Trawl.—The trawl is hauled on board Plymouth trawlers generally if not always on the port side, and the beam of the trawl is of such a length that when hauled on board one of the runners is fastened just ahead of the aftermost stay, and the other made fast on a level with the extreme end of the stern of the vessel.

Accordingly, a fifty ton trawler will use a trawl with a 46 ft. beam, and this is found to be about the size of trawl which such a vessel can tow and work most satisfactorily. A smaller vessel will use a smaller trawl.

Trawling.—The trawl is towed in the direction of the tide, and owing to the complicated tides of this portion of the Channel, great experience and the closest observation is required.

As an example of the complication of the currents in the neighbourhood, it may be mentioned that the tide flows in the Channel between the mainland and the Eddystone for three hours and half after it has turned at the Eddystone, and for three hours after high water in the Sound (No. 14).

A breeze of wind is required for satisfactory work, in fact, the weight of the trawl when partially full is so great that in a light breeze the smack cannot tow it.

The length of the tow-rope is so adjusted that the trawl should drag as lightly as possible over the ground without "lifting." The shorter the tow-rope the more weight is taken off the ground.

The hardest work in connection with this method of fishing is the hauling up of the trawl. The trawl hawser is, by means of a winch, hauled in over the bows of the boat, which is laid to during the process.

In summer weather, when the fishing ground is covered with sand and "scruff"* and the sea smooth, the labour of hauling up the trawl is very great. The net gathers a great amount of mud, weed, and "scruff" at such times, which is a dead weight to lift, and the operation may take a couple of hours. With a slight sea running, however, the boat pitches, and each time she dips a fathom or so of slack rope can be quickly wound in without trouble.

* See page 53.

In favorable weather, hauling in the trawl takes about an hour. As much as three tons of fish is at times brought on board in a single haul, but probably the average weight of fish would be about four to five cwt. Several smacks in Brixham are fitted with a donkey engine to do the work of hauling in the net, and one Plymouth smack is provided with this convenience, but it is not usual in the boats on this part of the coast as it is on board the large trawlers on the east coast.*

Day Trawling.—Most of the trawling grounds are within a few hours' sail of Plymouth. In favorable weather the trawlers generally leave port between 4 and 6 a.m. and return during the following afternoon or night, from 4 to 12 p.m., sailing again the next morning at 4 a.m. This they do from Monday morning until Friday night, if the weather remains suitable for so long. Saturday and Sunday the men spend ashore.

Night Trawling.—The Brixham trawlers (Brixham is the largest trawling port on the Channel coast) on the other hand trawl more during the night than during the daytime. The following reason has been given for this: more "prime" or "first-class" fish is caught at night than during the day, the greater number of "coarse" fish, or so-called "offal" fish, being caught during the daytime. At Brixham there is but a small market for coarse fish, while in Plymouth there is a much more ready sale for that class of fish.

If night work is more productive than day work it is much more dangerous. A vessel with her trawl down is helpless and runs considerable risk of being run down by large steamers and vessels at night. This risk on the Plymouth fishing grounds is probably greater than on the grounds mostly frequented by the Brixham smacks.

Summer Fishing, &c.—In the summer season, when trawl fish is scarce in the Channel, most of the Brixham boats go

* It appears that the reason why a steam winch is not shipped on board Plymouth smacks generally is, that if it was used, a larger share of the proceeds of the fishing would be absorbed by the boat-owner and there would be less available for the fishermen, while at the same time the usual crew would be required to work the vessel.

to the North Sea to fish, and boats have gone there from Plymouth.

During the last three summers some Plymouth smacks have gone over to the south coast of Ireland to fish. In 1885 twenty-one boats went there, and they had considerable success; but in 1886, although they report excellent trawling grounds and abundance of fine fish, they did not make as much money as the few boats which remained on the home grounds. This was partly owing to the calms which prevailed off the Irish coast during last summer, and the inability to trawl on that account, and partly to the fact that the few boats (only thirty) which remained in Plymouth found a ready sale for the limited supply of fish they brought to market.

When the boats fished off the Irish coast they clubbed together, and divided equally the proceeds of their fishing. Some of the company were fitted with bunkers, in which the fish was packed in ice, and they were used in turn to carry the fish from the fishing ground to Plymouth.

Although as a rule the trawlers are engaged in fishing all the year round, yet in summer time some of them are used as small coasting cargo boats, chiefly for the carriage of potatoes between Ireland, Scilly, and Tenby.

Trawling Grounds.—The trawling grounds in the neighbourhood of the port may be grouped into two districts, the one within a line drawn from the Eddystone to Dodman Point, the other outside that line. A line of rocks runs between these two points, over which it is, except in a few places, impossible to trawl, and thus forms the two districts.

It is, of course, essential that trawling grounds should be free from rocks or other obstructions, wrecks, &c.; and, indeed smooth ground, if it is formed of rock and not covered with sand, will chafe and tear the net, and cannot be trawled over.

Variation of Condition of Ground.—The condition of the inner ground trawled over varies greatly, according to the time of the year.

During the summer months, when there is but little wind and sea, the trawling ground becomes covered with sand and

mud, masses of seaweed and beds of so-called "scruff;" the latter are composed of a few oysters in clumps, great quantities of pecten, and polyzoa (Mucronella and Salicornariadæ I have seen in very considerable masses hauled up in the trawl), to such an extent in fact, that the trawl net is sometimes unable to bear the weight when being hauled out of the water and breaks away with all it contains. In the late autumn, winter and early spring months, on the other hand, when storms are prevalent, the ground becomes cleared of these obstructions and after trawling for six or eight hours the net may be hauled in with not more than one or two cwt. of débris.

This frequent alteration of the bottom of the sea, causing as it does variation in the kinds of fish caught and in the invertebrate Fauna, will be of great interest to investigate. It may be added that most of the scruffs lie west of the Eddystone rocks and parallel to the coast line.

In the following account of the trawling grounds fished by the Plymouth smacks it must be understood, that the localities mentioned for each season of the year are the favourite fishing grounds for that season; but smacks are so dependent upon the wind and weather that it is not possible for them always to reach or remain on their favourite grounds.

It may be taken as a general rule that in a strong north wind the smacks fish near in shore; when the wind is strong from the north-east they choose ground east of the Sound; when strong from the north-west they take westerly ground. Southerly winds are the most favorable. The trawlers of Plymouth fish, with the rarest exceptions, in at least twenty fathom water; the average depth fished in is probably between thirty and forty fathoms, while fifty fathoms may be considered as the maximum.

Date.	Marked on Chart.	Position and Direction.	Ground.	Fish Caught.
June and July . .	...	...	...	Very little fish caught. Boats go to Scilly, Ireland, and Tenby, to carry potatoes, and to Ireland off South Coast to fish.
July	A.	Eddystone to Dodman Point	Shelly and hard	Soles, rays, flatfish, gurnard.
,,	B.	Fowey Harbour to Mewstone, within three miles of shore	Mud	Whiting and flatfish, especially plaice.
,,	C.	Bolt Head to Raeme Head or Mewstone	Mud or sand	Whiting and flatfish.
,,	D.	Start Bay, inside Skerry Bank	Sandy	Plaice and soles.
,,	E.	On Skerry Bank and southwards. *N.B.*—Skerry Bank slopes gradually on west side, and abruptly on east side. Can trawl from Start Bay over Bank to the outside, but not back again.	Shelly outside	Soles.
,,	F.	Dartmouth Harbour, N.E., to off Beer	Sandy	Flatfish and whiting.
,, *Night* . . .	G.	Mewstone to Fowey, outside	Shelly	Bream, red mullet, thornback, gurnards, brill, and rarely turbot.
,, *Night* . . .	H.	Dartmouth Harbour, S.E. by E., to N. edge of East Scruffs	...	Red mullet and bream.
,,	I.	Pendennis Castle to the north of Helford River	...	Plaice and soles (Small steam trawlers from Falmouth used to and sometimes now fish these spots in the summer months.)
,,	J.	Gerran Bay	...	Plaice and soles
,,	K.	Verryan Bay	...	Plaice and soles

Aug. to Christmas	A. to H.	As given for July	As for July, except where muddy or sandy or shelly they become clearer and harder towards last months of year	Turbot and brill appear.
Nov. to Christmas	L.	East Rutts to Fowey Harbour, inside Eddystone, or if wind will not serve then outside Eddystone	Shelly outside	Hake now taken.
Christmas to Feb. (end of Feb.)	M.	Twenty to forty miles S. by E. of Plymouth to point where Eddystone bears N.N.W., trawl W. until open St. Anthony's Light (Falmouth Harbour)	...	Tub, sole, dory, brill, turbot, gurnard, and ray. Long-finned gurnard caught here.
,,	N.	Thirty miles S.S.E. of Start Point and trawl E. nearly as far as Portland ("French ground"), used by Brixham trawlers chiefly	...	Mullet, ray, gurnard, and pout.
March to June (end of June)	O.	Twenty miles S. and by E. of Michael's Mount to Wolff Rock	...	Common flatfish, gurnard, and ray, in large quantities. Turbot, brill, dory, and tubb. In May hake taken.
,,	...	A few boats may fish over ground given for July to Christmas, but nearly all shoot nets only over ground mentioned above.	...	...
,,	P.	Bolt Tail to Dodman Point.	...	Tub, red mullet, grey gurnard.

Trawl Fish.—The following is a list of the fish caught by trawlers which are used for food :

ELASMOBRANCHIA :	
Raia alba	Ray.
„ circularis	
„ batis	Skate (may weigh as much as four cwt.).
„ clavata	Thornback.
TELEOSTEI.—*Acanthopterygii :*	
Capros aper	Boar fish.
*Trigla lyra	Piper.
„ obscura	Long-finned gurnard (M.).
„ cuculus	Red gurnard.
* „ hirundo	Tub.
„ lineata	Streaked gurnard.
„ gurnardus	Grey gurnard.
*Mugil capito	Grey mullet.
*Mullus barbatus	Red mullet.
*Zeus faber	Doree.
*Scomber scomber	Mackerel.
*Cantharus lineatus	Black bream.
*Pagellus centrodontus	Common sea bream.
*Labrax lupus	Bass.
Caranx trachurus	Scad, or horse mackerel.
Anacanthini :	
*Rhombus maximus	Turbot.
* „ lævis	Brill.
*Solea vulgaris	Sole.
„ lascaris	Lemon sole.
„ variegata	Thickback.
Pleuronectes limanda	Dab.
„ platessa	Plaice.
„ flesus	Flounder.
Arnoglossus megastoma	Merry sole.
„ laterna	Megrim.
*Hippoglossus vulgaris	Halibut.
*Gadus morrhua	Cod.

Anacanthini :	
*Gadus æglefinus	Haddock.
„ pollachius	Pollack.
„ merlangus	Whiting.
„ luscus	Bib, or pout.
*Merlucius vulgaris	Hake.
Molva vulgaris	Ling.
Physostomi :	
Conger vulgaris	Conger.
Clupea pilchardus	Pilchard.
„ alosa	Alewife, or shad.
Ganoidei :	
Acipenser sturio	Sturgeon. Generally two or three caught each year, Oct.—Dec.

Those marked with an * in the foregoing list are considered to be "first-class" fish, "prime," or "head fish." The remainder are called "second-class" fish, "seconds," or "offal" fish, and are of less value than the former.

Movements of Fish—Summer and Winter.—With regard to the movements of fish, speaking generally, it may be said, fish draw near to the shore as the year advances from spring to summer. The summer fishing is carried on near to the land, and the trawlers haul their nets as near to the rocks as they dare to go.

In the winter months, and especially when snow falls, the fish go away into deeper and warmer water, consequently, the fishing ground is farther away from port.

Night and Day.—Again, fishermen say that at night more soles are caught than during the daytime, while round fish rise from the bottom at night, and therefore more are caught during the daytime than at night. During the day the soles and flatfish are believed to "sand" themselves, *i. e.* cover themselves over with sand.

In the North Sea it is said that night fishing is more profitable than day fishing, because haddock (*Gadus ægle-*

finus), cod (*G. morrhua*) and ling (*Molva vulgaris*) rise from the ground during the daytime and sink again at night (No. 1).

As a rule in the Channel but little flat fish is found on shelly ground.

Effect of Storms.—It is a matter of general remark among trawlers that immediately after heavy south-west storms, the fish ordinarily caught on the trawling grounds in fine weather, between the Eddystone and Raeme Head and to the eastward, are not to be found there; their place being taken by rock-fish, conger (*C. vulgaris*), bass (*Labrax lupus*), bream (*Pagellus centrodontus*), pout (*Gadus luscus*), ling (*Molva vulgaris*), &c., and with these fish larger quantities of kelp. It would appear probable that the rock-fish are driven from their usual habitat by the danger of the force of the water upon the rocks, and seek safety on smooth ground (the trawling ground), but with regard to the fish usually found on this ground (flatfish, gurnard (*Trigla*), mullet (*Mugil capito*), whiting (*Gadus merlangus*), hake (*Merluccius vulgaris*), &c.), which are not caught there for a short time immediately after such storms, the fishermen do not know what becomes of them, but assert they go into deeper water.

It must be noticed further that large soles and plaice, the finest of which are to be found near rocks in fine weather, are caught in increased numbers on the smooth ground away from rocks, after storms have occurred. Should this be true—and there appears to be no room for doubt that my informant, who is an experienced trawler, speaks correctly—it would follow that the effect of storms is felt at greater depths than is usually believed.*

The depths of the rocks from which the conger, ling, &c., have been driven is, say from ten to thirty fathoms. But from depths of forty fathoms, stones, lumps of coal, &c., are brought up in the trawl, bearing every appearance of having been in constant movement, while trawls which have been lost in

* It has been calculated (No. 13) that a wave 300 feet long, and 6 feet from crest to trough, will cause an alternating current of 2 feet a second on the ground at a depth of six fathoms.

that depth of water in heavy weather, have been found a considerable distance from the place where they were lost, with their "runners" bright as if they had been towed along.

Bellamy (No. 3 *b*) states the effect of south-west storms is to drive the generality of fish to deep water.

Breeding of Fish.—Of the breeding habits of fish there is but little known by the fishermen. From June to October Whitsand Bay is found to be full of small young flat fish of various kinds, and would appear to serve, if not as a breeding ground for these fish, at any rate as a nursery for their young during these months. Soles are taken full of roe about March near Plymouth, and in April and May in Mounts Bay.

Besides fish the trawlers catch the following marketable commodities:

Crabs (*Cancer pagurus*).—Sometimes caught in considerable numbers, more by night than by day, however. The fishermen believe it buries itself in the sand during the day.

Squid (*Loligo*).—Caught in very considerable numbers; it is the favourite bait of the hook and line fishermen.

"*Queens*" (*Pecten*).—They are used for food and bait. During calm summer weather they are brought up in the trawl in very great numbers.

2. *Drift-net Fishing.*

There are not a great many "drift-boats" owned in Plymouth, although a considerable trade is carried on, on the fish quay, in drift-net fish landed here from boats belonging to other ports. The centre of the drift-net fishery in the west country is at Penzance.

Boats.—From Plymouth about twenty boats, averaging, say, twenty tons each, sail regularly to fish for mackerel (*Scomber scomber*), or herring (*Clupea harengus*) or pilchard (*Clupea pilchardus*). These boats are lugger-rigged, and are manned by a skipper, four hands and one boy.

Besides these there are, say, twenty-five smaller boats, "hookers," between ten to twenty tons each, dandy rigged and manned by a skipper and three men, which fish with a few

drift nets for herring and pilchard during the season when those fish frequent these shores.

During the herring and mackerel seasons there may be from 150 to as many as 300 or 400 sail, belonging to other ports, which bring their catch to Plymouth each day.

Fishery.—Drift fishing is carried on at night; the early part of the night and the very early morning, being considered the best times.

Shooting Nets.—The nets, which vary in size and size of mesh according to the kind of fishery, and even of the district fished, when "shot," lie to windward of the boat; they are buoyed and weighted in such a manner that they hang straight down from near the surface and drift with the current. The boat to which they are attached drifts with the nets, sail being taken off, and when heavy mackerel nets are used the mast is "stepped."

As the boat lies to leeward of the nets, and the wind acts more on the boat than on the nets, the former drifts faster than the latter, and so hauls them "taut." The nets hang like a wall in the water, and the fish coming against them try to swim through the meshes, and are caught by the gills.

The method of "shooting the nets" among Plymouth boats is as follows:—The nets are shot on the lee side of the boat while it is going before the wind. Eventually the boat brings up to leeward of the nets, generally arranging they shall lie on the starboard side.

Method of Fishing.—The nets are shot about sunset, and an hour or so afterwards the first one or two nets are hauled in to see if there are any fish in them. Should fish be about they may be left until near daylight, or hauled about midnight and shot again, and again hauled in before daylight. If fish are not in the nets when they are examined they haul them in and cruise to find a better place, and may shoot and haul the nets several times before finding fish.

"Briming."—In summer, at times when there is no moon, the fish may be found by the phosphorescent light they cause when disturbed.

The boats cruise about, and every now and then the men jump heavily on the deck. If fish are near, this disturbs them, and they can be traced darting along far down in the water by means of the phosphorescent light which their movement causes in the small marine organisms. This light is at times so brilliant, that it actually flashes through the water, and is reflected onto the sails of the boat. The phosphorescence is locally known as "briming."

Nets Made.—The drift nets are not made, or "bred" as it is called, in Plymouth; they are obtained chiefly from Porthlevin, Bridport, St. Ives, and Scotland. They are made of cotton, and are sent from the manufacturer "white." The fisherman then treats them in one or other of the following ways:

Nets Prepared.—They are first steeped in a hot solution of catechu for one to twelve hours, and dried by being squeezed between two rollers (as in a mangle). They may be steeped and then dried in this way three or four times. They are then steeped in a hot solution of tar and dried in the air. After going through the tarring process they may be tanned in bark liquor as much as three or four times before being used. This latter tanning process is gone through once perhaps every two months, or even less, according to the amount the nets are used.

Mesh.—The sizes of the mesh of the different kinds of nets used and their lengths, vary in different ports of the west country. Unless, therefore, a port is specially mentioned in the following accounts of nets, they must be considered as referring to Plymouth only.

Mackerel Fishing.

Time of Year.—Mackerel fishing is carried on nearly all the year round, from January to June, and then again from September to November. There may be an interval of eight or nine weeks in the summer during which mackerel are not caught, but often this time is reduced; the late fishing, on the other hand, may, instead of lasting three months, be continued only two or three weeks.

As a rule, but few fish are caught during May and June,

but the supply and the time the fish arrive off the port vary greatly each year.

Boats.—Besides the boats of the port, boats which hail from other ports, and which land mackerel here during the time of year when they are most plentifully caught in the neighbourhood, may be estimated at 150 to 400.

The ports from which they sail are as follows:

East Country Boats.—Yarmouth, Lowestoft, Brighton, Folkestone, Rye, and Newhaven.

West Country Ports.—Looe, Mevagissey, Falmouth, Porthleven, Newlyn, Mousehole, Fowey, Penzance, and St. Ives.

A few boats also come from Guernsey, Scotland, and the Isle of Man.

Nets.—The mackerel nets in use here are three fathoms deep, and the mesh 1·44″ to 1·38″ across, or twenty-five to twenty-six meshes to the yard.

Cornwall boats fishing for mackerel off Scilly use nets with a mesh of 1·44″, or twenty-five meshes to the yard; but many boats in other ports and some in Plymouth use nets whose mesh is 1·3″ across, or twenty-seven to the yard.

Each boat shoots sixty to eighty nets of sixty yards each; that is to say, a "fleet" of nets is two to three miles long.

Nets "Shot."—The nets are buoyed by corks at intervals of about a yard, and, because mackerel swim high in the water when in shoals, the top or "back" of the net lies nearly upon the surface of the sea. It is on account of the mackerel nets lying so near the surface, and in consequence of the great length of net "shot," that great losses are experienced in this fishery. A sudden storm may almost completely ruin a fleet of nets, and a steamer or vessel cuts through them frequently.

In order to be able to recover nets which have been so cut through by vessels, a line, the "foot-line" by which the nets are hauled in, is attached to each net, and hangs six fathoms below them. This line, being 54 feet below the surface, is well out of reach of any vessel's keel.

Fishing Grounds.—The ground fished by boats bringing their catch to this market may broadly be stated to be, the whole extent of water from the coast between Start Point and Dodman Point to a parallel line drawn, forty miles south of the coast.

Winter Fishing Ground.—In January (*i. e.* during the "winter fishing"), as a rule, the boats go to the ground furthest away from the coast; as the season advances the fish approach the shore, and the fishing is nearer home.

Summer Fishing Ground.—During the "summer fishing" season the fish are generally found from four to twelve miles from the coast.

The early fishing is to the eastward, the late fishing to the westward of the port.

It will be understood these remarks are only approximately correct, owing to the variable supply of fish and the somewhat irregular course of their migrations.

Fishery Productive.—This fishery appears to be very productive, and no falling off in the supply of fish is, I believe, reported.

Herring Fishing.

The herring fishing for this port lasts from November to the end of January.

Boats.—The boats from other ports, which may number about 200, fishing here at this time hail from west country ports.

Nets.—The herring nets are each 120 yards long and three fathoms deep, twelve nets forming a "fleet," which is, therefore, nearly a mile long. The mesh is 1·125″ or 1·058″ across, *i. e.* thirty-two to thirty-four meshes to the yard in some cases; many boats, however, use smaller meshed nets, about ·97″ across or thirty-seven meshes to the yard. This latter is about the mesh used for pilchards, and these nets are practically pilchard nets, and may be used to catch both fish.

Nets "Shot."—The nets are buoyed at intervals of five to seven fathoms, and the "back" of the net lies about three and a half fathoms below the surface; this distance is varied, however, according to the depth of the water fished and the depth at which the shoals are swimming.

On account of the depth at which the nets lie, and their consequent safety from accident by being cut by passing

vessels, it is not considered necessary to provide for their safety by hanging a foot-rope below them. The "foot-line" lies, therefore, on the "back" of the net.

Another reason and one which renders this arrangement of the foot-rope necessary is, that at times the water fished is so shallow that the nets themselves have to be hauled nearer the surface (the lines by which they hang from the floats being shortened), to prevent them dragging along the bottom.

Fishing Grounds.—The grounds fished extend from the Mewstone to Bolt Tail from one to eight miles from the shore.

Fishery —For the last two years this fishery has not been so good as usual.

Pilchard Fishing.

The pilchard fishery is very variable in extent, and the times during which it is carried on is also quite uncertain.

If there is a good supply of fish it lasts about from July to Christmas, and is divided into two sections:

1. A summer fishery, lasting during July and August.
2. A winter fishery, from September to Christmas.

Boats.—Besides Plymouth boats, about 120 small boats belonging to west country ports, Mevagissey, Falmouth, Looe and Polperro, bring fish to this market.

Nets.—The pilchard nets are each 120 yards long, and a fleet consists of twelve to fifteen nets forming a line of nearly a mile in length. They are six fathoms deep, and those used for the summer fishery have meshes ·95″ across or thirty-eight to the yard, while those used for the winter fishery have meshes 1″ across or thirty-six to the yard. Old shrunken herring nets are frequently used for the pilchard fishery.

Fishing Grounds.—The grounds fished are as follows:—

1. During the summer fishery, between Raeme Head and Looe Island, near in shore. The fish work their way eastward towards the autumn; and

2. During the winter fishery the nets are shot off Plymouth, and, may be, as far east as off Bigbury Bay, but chiefly from seven to eight miles south to south-south-west of Plymouth Sound.

Condition of Winter Fishery.—For the last two winter seasons pilchards have been now and then so cheap on the quay, that fishermen have taken their catches out to sea and thrown them overboard rather than sell them for the small sums offered. They have been sold as cheap as 2s. per 1000 recently, and indeed, now (November, 1886), boats are fishing with only half a fleet of nets in order to reduce the catch and keep up the price of the fish. These boats are endeavouring, by fishing with hook and line for hake, to make their work pay.

Condition of Summer Fishery.—The summer fishery for pilchards, on the other hand, has largely decreased in Plymouth. It has been taken out of the hands of the Plymouth fishermen by the fishermen of Looe, whose boats appear to be more suitable for the work. At this latter port the increase of boats in the last few years is estimated at 30 per cent.

3. *Moored-net Fishing.*

Boats.—There is but little fishing of this description practised by Plymouth boats. A few of the line fishing boats during the herring season carry on moored-net fishing. These are chiefly Cawsand Bay boats.

Nets.—The nets are similar to drift nets; but instead of drifting with the tide, they are moored by means of grapnels, and are "shot" in the direction in which the tide runs.

Fish.—The fish caught is the herring.

Ground Fished.—The ground where the nets are set is almost confined to the mouth of Cawsand Bay.

4. *Seine Fishing.*

Seine fishing is carried on all down the coast as far as Land's End. The seine is used to catch mackerel, pilchards, sprats (*Clupea sprattus*), and mullet (*Mugil capito*), but not herrings.

The great centre for this method of fishing is at St. Ives, on the west coast of Cornwall.

There are several kinds of seines.

Seine Proper.—The seine proper is a long net, deeper in the middle or "bunt" than at the ends ("sleeves" or

"wings"). A large seine is about two hundred fathoms long and ten fathoms deep at the "bunt."

Method of Fishing.—It is carried in two boats, which lie in wait for shoals of fish near the land.

The fish are, during the time this fishery is carried on, swimming near the surface of the water, and a shoal is readily observed by means of the colour, or, especially in the case of pilchards, by the oily appearance of the water covering them.

The two boats row round the shoal, or as much of it as the length of their net will allow them to compass, shooting the net as they go; the two ends of the net are brought together and it is hauled to the shore, where it is moored, the fish contained therein being taken out as required with smaller seines called "tuck seines."

Tuck Seine.—A tuck seine is, say, seventy fathoms long, but much deeper in the "bunt" than an ordinary seine, so that it may be hauled in under the fish and raise them to the surface, to enable the men to get them out of the water.

Ground Seine.—A third kind of seine, the ground seine, is used here. It is much smaller than the seine proper, and is used close to the shore. A rope attached to one end is left on shore, a boat then rows in a semicircle, and the net is shot as the boat goes along. Finally, both ends are brought ashore and the net hauled bodily on to the land. These nets may be quite small, and are readily worked. Their structure, although differing in detail, is very similar to the large seine.

Mackerel Seining.—Mackerel seining is carried on from June until the end of July all along the coast from Start Bay to Land's End. Most of the seines here are owned in Cawsand, at the mouth of the Sound. This is a favourite place for carrying on the fishery, and there the seine boats, full of nets, may regularly be seen lying near the mouth of Cawsand Bay, waiting for a shoal of fish.

Pilchard Seining.—Pilchards are seined during the summer. At Cawsand this fishery is carried on on a small scale.

It is said that some years ago the pilchard fishery at Cawsand was conducted on a very considerable scale, and the large cellar accommodation in some of the houses of the village is a partial proof of this; now, however, there is but little business done. All along the coast, from the Land's End to the Lizard, this fishery is conducted, and at St. Ives it is an important industry.

Mullet Seining.—Mullet seining is carried on up the estuaries all through the autumn.

Sand Smelt Seining.—Sand smelts (*Atherina presbyter*) are seined in the estuaries about September.

Sprat Seining.—Sprats are seined both in the Sound and along the coast.

Ground Seine Fish.—Ground seine fishing is carried on along the rocks of the Sound at low water, bass (*Labrax lupus*), mullet, &c., being caught. These nets are from about twenty to fifty fathoms long.

5. *"Bultering" or Long Line Fishing.*

Boats.—There are, say, sixty boats following this method of fishing. They are mostly about twelve tons, are "dandy" rigged,* and manned by a skipper and three men.

About thirty-five of these boats regularly fish with long lines, but the remainder, say twenty-five and these are the largest of the fleet, fish for herring and pilchard with drift nets during the season these fisheries are carried on here. These boats carry only a small "fleet" of drift nets, suitable for herring and pilchard, and do not fish for mackerel.

Besides the home bulterers, boats from Looe, Polperro, and other ports in the neighbourhood bring fish to this market at times.

"Bulters."—The bulterers fish by means of long lines or "bulters," of from about 2500 fathoms length and less. To these lines hooks are attached at intervals of 1½ fathoms, by means of "snoods" about 3 feet long, made of strong fishing line. There are therefore about 1666 hooks on a line 2500 fathoms long.

Lines "Shot."—The lines are "shot," or laid down at

* A "dandy" rigged boat is somewhat similar to a yawl, but differs in certain details, the most obvious of which are the position of the mizzenmast—it is stepped right aft—and the kind of sail which it carries—a lug-sail.

right angles to the direction in which the tide runs, so that the snood carrying the hook may be washed free from the main line, and they are attached at either end to buoys of cork, which carry a flag to show their position.

Times of Fishing.—The lines are "shot" at any time *after* sunset, left for some time, and hauled in again when the several directions of the wind and tide render it possible to do so. A "weather-going tide," as it is called, is necessary to enable these long lines to be hauled in, *i. e.* a tide which runs against the wind. A "lee tide" is one running with the wind, and the bulter cannot be hauled in while such a combination of forces lasts. On this account much delay may be experienced.

Plymouth Bulters.—The Plymouth bulters use longer lines than any other boats on this portion of the coast, but the North Sea long-liners use much longer lines than they do here. A North Sea bulter may be 7200 fathoms long and carry as many as 4680 hooks (No. 11).

Lines.—The lines in use here are obtained from various places in Ireland and Scotland, and from London, as well as from local manufacturers. They are generally used in the same condition as they arrive, but they may be "barked" or "tarred." They are made of manilla or of sisal, an imitation of manilla.

Hooks.—The hooks are supplied from France or from Redditch.

Grounds Fished.—The grounds most frequented by the bulters with the longest lines are situated:

1. Far out in the Channel, from a point forty miles south of the Eddystone to a point twenty to thirty miles south of the Lizard.

2. Close to the land in the region of the Lizard and even round Land's End, and as far north as St. Ives.

3. Off Start Point, from fifteen to twenty miles south.

These boats also visit Guernsey, Brighton, and other places for a few weeks at a time to carry on their trade.

The smaller bulterers with shorter lines, shoot the latter all along the coast both west and east of Plymouth Sound, and round about the rocks of the Eddystone, the Hand

Deeps, and in places along the line of rocks extending from the Eddystone to Dodman Point, which I have already mentioned (p. 8) in my account of the trawling grounds in this neighbourhood.

The ground fished in mid-channel is composed of rubble, the stones being about half the size of a man's head, or thereabouts, and is locally known as "titi" ground.

The bulterers can shoot their lines upon this class of ground without fear of being disturbed by the trawlers, the ground being too rough for them.

Near home, where the exact positions of large rocks are known, and when the weather is clear enough to enable the fisherman accurately to take his marks, the lines are shot as near as possible to these rocks, and probably the finest fish are caught in these spots.

Fish Caught.—The following fish are those usually caught by this method of fishing:—Conger (*Conger vulgaris*), ling (*Molva vulgaris*), ray and skate (*Raia alba, circularis, batis,* and *clavata*), cod (*Gadus morrhua*) in small quantities, and a few pollack (*Gadus pollachius*).

Bait.—The bait used by bulterers is chiefly squid (*Loligo*); but they also use pilchard, mackerel, herring, garfish (*Belone vulgaris*), whiting (*Gadus merlangus*), gurnard (*Trigla*), chad (the young of *Pagellus centrodontus*), bream (*Cantharus lineatus*), and dogfish (*Scyllium canicula*); according to the season and in case of scarcity of squid.

During the spring—about Lent—when many trawlers are fishing in Mount's Bay, and there is but a small supply of squid and great competition for what there is to be sold, the bulterers fall back on "fish-baits," and pilchard is perhaps the best of these.

At this time of year the long-line fishermen even go as far as Falmouth, Mevagissey, Looe, and other ports along the coast to buy bait.

Price of Bait.—The price of bait varies very greatly. Squid, when very plentiful, may be as low as 6*d.* a maund, but during Lent has been known as much as 12*s.* a maund. Pilchard in the same way varies from 6*d.* to 5*s.* per 100.

Amount of Bait Used.—Some idea of the amount of bait

which might be used may be gathered from the fact that it takes 1000 pilchards or six maunds of squid to bait a long bulter. A maund of squid will weigh, say, 56 lbs.

Say sixty boats average 2000 fathoms of line, *i. e.* 1333 hooks per boat. They will consume 288 maunds of squid or say 144 cwt. (over seven tons) in baiting their lines.

Value of Bait Used.—

This amount represents in value at 6*d.* a maund .	£	7	4	0
„ „ 12*s.* „ .	172	16	0	

or, they will use 48,000 pilchards, which represents in money—

at 6*d.* per 100 .	£ 12	0	0
at 5*s.* „ .	120	0	0

In the case of a single boat. When squid are cheap it costs 3*s.* to bait a long bulter with 1666 hooks, when dear £3 12*s*, whereas pilchards cost from 5*s.* when cheap to 50*s.* in the dearest times, to bait a long bulter.

An average is not easy to calculate, but from the accounts of two hookers which have been very kindly submitted to me, it appears that about £100 a year per boat is spent on bait ; that is to say, bait for sixty boats of the same size for the year would cost £6000.

Making allowance for boats laid up at various times, the smaller size of some boats, and the fact that certain of them do not use their lines all the year round, the sum spent on bait for the year by Plymouth boats may be estimated at not less than £4500. The bait question is therefore a serious one.

Squid (*Loligo*).—The supply of squid depends, as I have stated, upon the trawlers. After a spell of rough weather the hookers having no bait must wait until the trawlers can go out and bring some, then if calms or storms should at once come on the bait spoils, and again when fine weather comes they have to wait until the trawlers have made a trip and brought in bait before they can go out to fish.

This obviously entails great loss of time and money, and renders the bait question one of extreme importance for the hooking trade of the port.

Attempts have been made to preserve squid in salt or ice but they do not appear in this condition to attract the more

valuable fish, conger. This fish, contrary to the general opinion, appears to be a very particular feeder. It will take into its mouth and bite, but as a rule ultimately reject, any but fresh bait.

Whelks (*Buccinum undatum*).—Whelks are not found here in abundance and do not occupy the important position among bulter baits here that they do among the North Sea cod fishermen. They are tough and make excellent bait for bulters. It must be recollected that, owing to the length of time the bulter is under water, quite a different kind of bait is required for this fishery to that required for the hand-line fishery. Mussels (*Mytilus edulis*), "queens" (*Pecten*), and such soft bait is only of use on hooks that are let down into the water and pulled up again in a few minutes ; a prolonged immersion would render them too soft for the hook to hold them, and even a comparatively short time on a bulter-hook is enough to render them unattractive as bait.

Condition of Fishery.—With regard to the condition of the bulter fishery the men consider they do not catch as much fish now as they used to do twenty or even eight years ago, although their gear is eight times as long as it used to be, and the boats are larger, better, and more numerous. It is their opinion this is due to over-fishing, and as a proof of this they point out that very much smaller conger are exposed for sale on the Quay now than used to be the case. It is said that Plymouth is more deeply interested in this fishery than is any other port in the west country.

6. *Hand-line Fishing.**

Boats.—There are, say, 110 small boats, most of them under five tons, and 100 small rowing boats under one ton, engaged in this fishing.

As a rule they fish for particular kinds of fish, going to particular grounds for the various kinds of fish according to the time of year, tide, weather, and so forth.

Hand Lines, Bottom Fishing, Railing or Whiffing.—The

* Besides the information derived from practical fishermen included in this section of my report, I have freely used the publications of Bellamy (No. 33, *b*), Lord (No. 17), Young (No. 25), Wilcocks (No. 24), and Brooks (No. 5).

fishing is carried on by means of lines held in the hands and let down from the boat, in the case of bottom fishing when the boats are anchored; or held in the hand or fastened to rods which are fixed, in the case of "railing" or "whiffing," when the boat is sailed or rowed through the water. The latter method is used for fish which are feeding near the surface, as do the mackerel when the shoals have broken up.

Whiting Fishing (*Gadus merlangus*).—The most important hand-line fishery carried on here is the whiting fishery.

Season.—It commences about April, or may be earlier, and lasts until the end of the year.

Boats.—Between Christmas and April, many of the larger hand-line boats are laid up—(in Cawsand at the entrance to the Sound, which is almost altogether a whiting fishing village, nearly all the boats are laid up)—and the hands ship in hookers, or go fishing with crab pots in smaller boats. A few of the larger boats, however, fish for herrings with a few herring drift nets during these three months.

Ground.—The whiting ground may generally be said to be from seven to ten miles outside Plymouth; but these fish are caught anywhere from a point outside the Mewstone from which one can see well up Yealm Gut, to twenty miles away.

In spring the ground frequently taken lies south-east of the Eddystone; later on in the year the fish are to be caught north-east of the "Stone." Small whiting are very generally caught in the Sound.

Time of Year.—The fishery lasts from April to Christmas.

Bait.—The chief bait used is mussels (*Mytilus edulis*), lug-worms (*Arenicola piscatorum*), pilchards (*Clupea pilchardus*), mackerel (*Scomber scomber*), garfish (*Belone vulgaris*), and other kinds of fish, such as chad (young of *Pagellus centrodontus*).

Hake Fishing (*Merlucius vulgaris*).—Great numbers are taken with hook and line during the winter pilchard fishery, when these fish can be obtained readily for bait. It is a frequent occurrence for drift fishermen while their nets are out for pilchards to fish with hook and line for the hake which come in search of the pilchard. These fish feed, and therefore take the hook best, at night. They vary from 5 to 12 lbs.

Haddock Fishing (*Gadus æglefinus*).—When fishing for haddock with hand lines the best bait is squid with a large mussel on the point of the hook.

Cod Fishing (*Gadus morrhua*).—The codfish caught here are comparatively few, and they are not to be compared with the North Sea cod for either condition or flavour.

Bait.—The best bait to use is squid, mackerel, herring, or pilchard.

Pollack Fishing (*Gadus pollachius*).—*Ground in the Sound.*—The positions in the Sound and its neighbourhood where pollack are found are numerous.

1. On the east side all along the shore at a depth of about three fathoms, and round the Mewstone, especially off the "Mewstone," "Leek Beds" and "Batten Bay."
2. On the north side under the "Hoe," and between "Drake's Island" and the main land.
3. In the Hamoaze at the "Pollack Rocks."
4. On the west side all along the shore (except far in Cawsand Bay) and round Penlee Point, especially at Barn Pool, and off "the Bridge," Picklecombe Point, and Penlee Point.
5. On the south side from "the Tinkers" to the east end of the Breakwater. From the "Knap" Buoy round the west end of the Breakwater and along its south side.

Movements of the Fish.—The majority taken within the Breakwater are small fish; mature fish ($2\frac{1}{2}$ to 10 lbs.) are taken only at certain times. From spring to midsummer mature fish are taken off the Mewstone and the Tinkers, until the higher temperature drives the fish to deeper water, where they are caught in the offing; they visit the shallows only at intervals.

In September, the large fish return to the shallows and in autumn are caught especially in Barn Pool and between Drake's Island and Mill Bay in twenty-three fathoms of water. The largest fish caught in the harbour, are, as a rule, caught at night.

Bait.—The best bait for ground fishing is living sand-eels (*Ammodytes lanceolatus* and *tobianus*); the professional fisherman uses the rag-worm (*nereis*) generally. For whiffing artificial baits are used.

Rod and Line Fishing.—Pollack fishing is also carried on off the rocks, when rock-fish or sand-eels are used for bait, with a rod and line.

Time of Year.—Pollack fishing commences in May and continues throughout the fine weather.*

Mackerel Fishing (*Scomber scomber*).—*Ground.*—The best places for ground fishing are from Batten to Bovisand, and in the Hamoaze.

Bait.—The bait used with the greatest success is pilchard, squid, and mussels.

Whiffing.—The positions for mackerel "whiffing" are the same as those given on the map for pollack.

Railing.—"Railing" for mackerel is carried on in the summer. The boats are sailed about three miles an hour.

Bait.—The best bait appears to be some shining object, such as slips of tin or attractive pieces of cloth.

Bass Fishing (*Labrax lupus*).—*Rod and Line.*—Bass are fished for with rod and line off the rocks at Raeme Head, Penlee Point, Bottle-nose Point, and at either end of the Breakwater, by throwing out the line, to which is attached a spinning bait, and drawing it back along the surface.

Bottom Fishing, Bait.—Bottom fishing is carried on also for bass with squid or pilchard, or sand-eel for bait.

Times of Year.—Bass enter the harbours in summer. July is the best month for fishing, but they are caught up to the end of September. Outside the Sound the fishing off the rocks begins about May.

Whiffing.—Whiffing for bass is carried on over the same ground marked on the map, frequented by fishermen of pollack and mackerel.

Pouting Fishing (*Gadus luscus*).—*Time of Year.*—Pouting are in their best condition in November and December, but are taken all through the winter and in spring. The best places to fish for them are :

Grounds.—The Mallard Buoy, near Mount Batten at low water or on the flood tide. West Hoe Terrace during the flood tide. Near the White Buoy, at the east end of Drake's Island, on the top of the flood tide. At Millbay Pier at low water. In a deep pit off the "Flat Rock." In Firestone Bay, on a flood tide. In Cawsand Bay, and off Bovisand Pier. Inside the Breakwater along its west half, and by the Panther Buoy.

* For positions, see fishing map (p. 76). The dotted lines represent the best courses for whiffing, the crosses and stars the best places for ground fishing.

Bait.—The baits generally used are sea-worms (*Arenicola piscatorum* and *Nereis*), mussels, and the "tail end" of the hermit crab (*Pagurus*).

Bream Fishing (*Pagellus centrodontus and bogaraveo*).—*Grounds.*—Bream are caught on the whiting grounds.

Bait.—The best baits are rag- or lug-worms, sand-eel, mackerel, pilchard, herring, mussel, or limpet (*Patella vulgata*).

Chad Fishing. (*Pagellus centrodontus*, Young Sea Bream.)—*Time of Year.*—Chad fishing begins in August.

"Float Line," and Bottom Fishing.—They are fished for when swimming near the surface with a "float line," and are fished for on the bottom also.

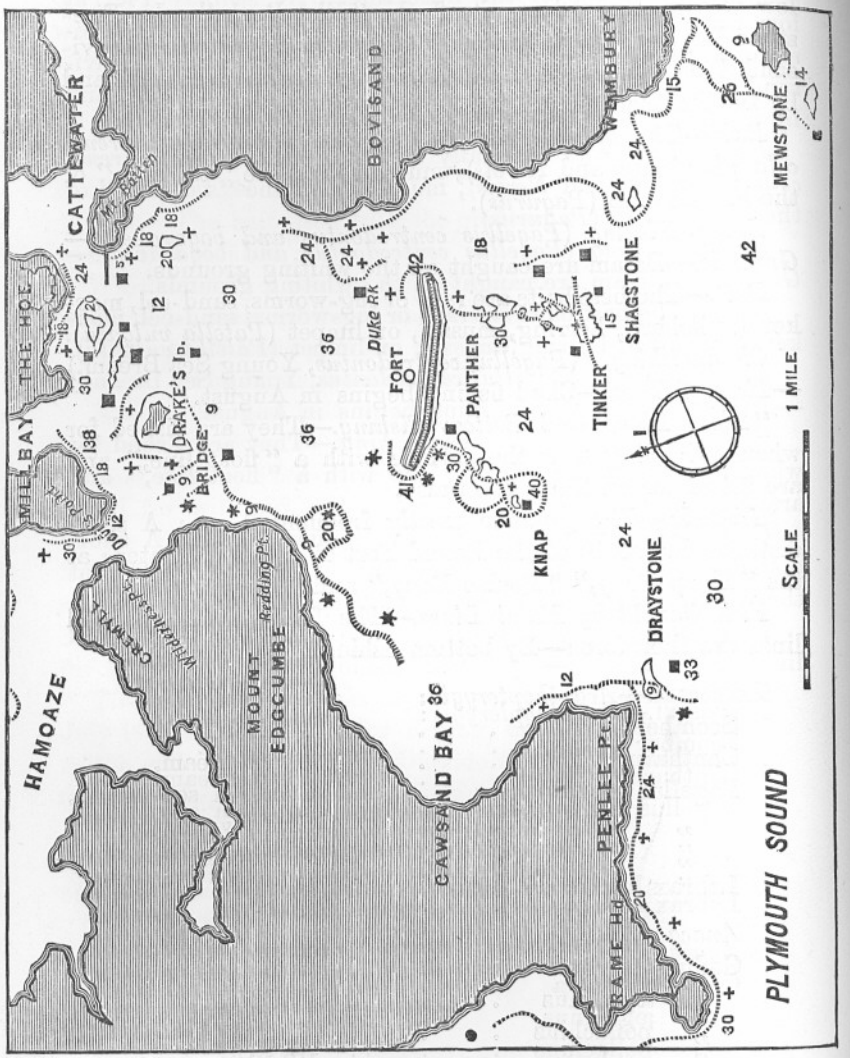
Grounds.—The grounds mostly frequented are: A short distance due south of the Round Fort at the Breakwater; at the "Knap Buoy," "Penlee Buoy," and "Shagstone."

Fish Caught by Hand Lines.—The fish caught by hand lines are therefore :—By bottom fishing :

TELEOSTEI.—*Acanthopterygii* :	
Scomber scomber . . .	Mackerel.
Cantharus lineatus . . .	Black bream.
Pagellus centrodontus . .	Common sea bream.
,, ,, . . .	Chad (young).
,, bogaraveo . .	Spanish bream.
Labrax lupus	Bass.
Anacanthini :	
Gadus morrhua . . .	Cod.
,, æglefinus . . .	Haddock.
,, pollachius . . .	Pollack.
,, merlangus . . .	Whiting.
,, luscus	Pouting.
Merlucius vulgaris . . .	Hake.

By whiffing : pollack, mackerel, and bass.

Fishing Map of Plymouth Sound, after map published in C. and R. Brooks's 'General Guide to Sea Fishing' (No. 5).



The depth is marked in feet thus 30. The best places to fish for pollock, bass and mackerel is shown by the dotted line. The crosses show places to fish in ebb tide, the stars show places to fish in flood tide.

Bait.—The baits used for hand lines are: Fresh squid (*Loligo*), which is supplied by trawlers, this is the best; dried squid and salted squid are also used, but with little success; mussels (*Mytilus edulis*), obtained by a limited number of mussel fishers from the bottoms of hulks, &c., from beds up the Hamoaze, and from off the stones of the Breakwater; "queens" (*Pecten*), supplied by the trawlers in large quantities in summer; mackerel (*Scomber scomber*), herring (*Clupea harengus*), and pilchard (*Clupea pilchardus*), obtained from drift fishermen; garfish (*Belone vulgaris*), obtained from drift fishermen generally; chad (*Pagellus centrodontus*), &c., fished for with hand lines; sand-launce or sand-eel (*Ammodytes lanceolatus* and *A. tobianus*), obtained by raking the sand at low water, or in some places by seining, an excellent bait; hermit crab (*Pagurus*), the soft part of the body of the animal is used; white sand-worms (*Nereis versicolor*), and rag-worms (*Nereis lineata ?*), two species of Nereis which are found in the mud of creeks, &c., at low water, the latter is the favourite worm bait; lug-worm (*Arenicola piscatorum*), found by digging in sand at low water; and the earthworm (*Lumbricus*).

For whiffing the following baits are used: Strips cut from the tail end of mackerel, herring, pilchard, garfish, chad, &c.; strips of the skin of bass, gurnard, ray, &c.; strips of salt pork; pieces of parchment, cloth, and tin; but the best bait of all is the sand-launce, which is put on the hook alive. Artificial baits are used, the best of these being an imitation sand-launce made of india rubber. This is mostly, if not exclusively, used by amateur fishermen.

Mussel Bait.—It is noticeable that mussels are not used to the same extent here as they are in the North Sea.

There is a very considerable industry connected with the supply of mussels for bait in the North Sea, and it is calculated (No. 8) that 1000 tons of mussels will catch £41,000 worth of haddock, cod, and whiting in the North Sea.

An apparatus (No. 9) for storing, keeping alive, and fattening molluscs has been patented, and mussel farms instituted in several places on the northern coasts of the kingdom, with, I understand, fair financial success. As

before observed, the method of fishing by means of long lines (bulters) is not favorable to the use of soft baits like mussels; but it would appear that, for hand-line fishing in this district, fish and worms are more extensively used for bait than mussels.

Pecten.—Pecten and mussels may perhaps be considered to be fairly equally in demand. The former is considered to be a very fragile bait, but there is a good supply of it.

Condition of Fishery.—The condition of this fishery is, as far as I can learn, good. Excellent and large fish are caught plentifully on the whiting ground, which is the chief fishery.

7. *Eel-spearing.*

Eel-spearing is carried on in the mud of the Tamar in the early part of the year.

The eels (*Anguilla vulgaris*) come down the river to spawn in the harbour about August, and they hibernate about Christmas in the mud of the estuaries. There are, however, eels in the harbour which do not migrate and do not hibernate, and they are reputed to be the best and finest tasted (No. 3 *a*).

8. *Mulletries.*

Some time ago several mill ponds communicating with the Hamoaze by means of gates were utilised as mulletries I am informed. The mullet (*Mugil capito*) were allowed to enter the ponds with the tide, and the gates were then closed and the fish caught with seines.

A pond, "The Mulletry," situated at Weston-Mill Lake, beyond Keyham, which is entirely cut off from the Hamoaze except by a sluice, has more recently been used for storing mullet; the fish being caught in the Hamoaze with a seine and placed in the pond until required for market.

Now, however, neither the mill ponds nor "The Mulletry" at Weston-Mill Lake are used commercially as fish ponds.

9. *Crab and Lobster Fishing.*

Ground.—Crab (*Cancer pagurus*) and lobster (*Homarus vulgaris*) fishing is carried on everywhere along the coast, mostly perhaps about Start Point. Off the Lizard there are one or two small steam launches engaged in this fishing.

Inside the Sound, and in deep water, up to thirty or forty fathoms, outside the Sound as well as along the neighbouring coast, the crab and lobster fishers of this port lay their pots.

Pots.—"Pots" only are used.

Bait.—The bait generally used is gurnard (*Trigla*), wrasse (*Labrus mixtus*), and ray, gurnard being the best for lobster.

Time of Year.—Summer is the chief time for this fishery. In the winter months there is but little done owing to the loss of pots in bad weather. Inside the Breakwater the fishery may be carried on from February to November, rarely in the intervening months. Outside the Breakwater, in deep water, the pots are laid only from about April to August.

The male crabs are about six times more valuable than the female crabs.

Condition of the Fishery.—The crabs are said to be decreasing, but lobsters are not thought to be decreasing as much as crabs.

From 1850, when there were eight boats fishing between the Plym and Bolt Tail there was a considerable increase in the fishery up to 1876, when there were 100 boats fishing this part of the coast. Since then there does not appear to have been much increase, if any. During this interval there has also been an increase in boats fishing in the Sound (No. 20).

10. *Shrimp and Prawn Fishing.*

Shrimps (*Crangon vulgaris*) and prawns (*Palæmon serratus*) are fished for in the Sound with small trawls, which are towed by small boats, either rowed or sailed slowly along.

The supply varies greatly according to the weather.

The chief ground is that lying immediately behind the Breakwater.

11. *Oyster, Mussel, and Cockle Fishing.*

Oysters (*Ostrea edulis*).—Very few oysters are now trawled in the Channel by the Plymouth trawlers. Sometimes, as I have already pointed out, a few clumps of oysters are brought up with the "scruff," which is so plentiful in the summer months.

Cattewater Beds.—Plym Beds.—There used to be oyster beds up the Cattewater, near Laira Bridge, up the

Plym, and in Cattewater Harbour, opposite Queen Anne Battery, they used to be abundant; there are, however, no beds now—a few isolated oysters may be picked up here and there. This failure of the Cattewater beds is, by some, attributed to over-dredging, but it would appear more probably to be due to the refuse from china-clay works pouring down the river and choking the beds.

It is said (No. 2) that the mineral sand and clay, which is so frequently brought down by the South Devon rivers, forms, with the chemical constituents of the sea water, a compound which destroys oysters. Scott states, speaking of the Devonshire oyster fisheries, that in 1864 there were practically no Devonshire oysters, and he considers this due to over-dredging (No. 22).

Tamar Beds.—Up the Tamar, at the mouth of the St. Germains River, there are, however, still oyster beds, though I cannot learn that they are in a flourishing condition.

In the Sound.—In the Sound, opposite West Hoe Terrace, at the foot of the Hoe, oysters are being laid down for storage, I am told.

Mussels (*Mytilus edulis*).—Mussels are plentifully obtained from the hulks lying in the Cattewater and the Hamoaze, and from the stones of the Breakwater. They are also dredged in large quantities in the lower reaches of the Hamoaze, and are then bedded on a bank near Saltash Bridge.

Cockle Beds (*Cardium edule*).—Cockle beds exist both up the River Plym, near Laira Bridge (to the north of it), and on a bank bare at low water, which lies in the centre of the Tamar river, some little distance north of Saltash. Only a very small trade is carried on in these shell-fish.

II.—Industries connected with the Fishing Trade carried on in Plymouth.

This subject may be subdivided into—

1. Boat building. 2. Sail making. 3. Rope making and fishing-line making. 4. Net breeding. 5. Fish curing. 6. Fish-skin curing. 7. Fish-oil manufacture. 8. Ice manufacture.

Boat Building.—The chief industry connected with the fish trade which is carried on in Plymouth is boat building; sail making and rope making is also conducted here on a sufficient scale to supply the boat builders.

Nets.—Nets for drift fishing are not "bred" here, but the trawlers themselves make their own nets.

Lines.—Lines for hooking are made here, but fishermen do not exclusively rely on local manufacturers.

Fish Curing.—Fish curing is carried on, on a small scale only, and would, in my opinion, be well worthy of the attention of capitalists.

Fish Skins and Oil.—A small trade is also carried on in fish skins and fish oil, but these are at present on a very small scale.

Ice.—An ice manufactory exists.

1. *Boat Building.*

There are about fifteen boat builders in Plymouth and Devonport. Six of these build trawlers, three build drift boats, five build hookers, and several build rowing boats.

Trawlers.—Trawlers are built in Plymouth, chiefly for the Plymouth fishery, but boats have been built for the North Sea, and for other ports on the south coast besides Plymouth. Only a few, however, have been so disposed of, and none have been bought out of Plymouth for some few years. Trawlers have been obtained for the Plymouth fishery from Brixham and Galmpton, but, as may be seen from the Table on p. 38, only a few.

Trawler Measurements.—The following are the measurements of two recently built trawlers, and eight boats have been constructed of forty-two to forty-seven tons, with the same proportions.*

Measurements of.	Trawler Y.	Trawler Z.
Length	73·6 feet	70·4 feet
„ over all	81 „	...
„ load water-line	70 „	...
Breadth extreme	16·75 „	17·5 „
Depth	9·65 „	9·4 „
Tons	49 tons	47 tons
Displacement	110 „	...

Cost.—The cost of such boats, including iron ballast spars, rigging, sails, and net, is from £750 to £1000.

* I am indebted to Mr. Watson (No. 34) for these measurements.

The following Table shows the number of trawlers built in Plymouth and other places since 1870 which are sailed from this port.

From this Table we learn that from 1870 to 1886 39 new trawlers have been sailed from Plymouth, and that of these 34 have been built in Plymouth, 3 in Brixham, and 2 in Galmpton.

Trawlers Built in	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882	1883.	1884.	1885.	1886.	Total.
Plymouth	1	5	...	...	...	...	1	3	5	5	5	2	3	1	2	...	1	34
Brixham	...	...	1	1	...	...	...	...	...	...	1	...	...	...	...	...	...	3
Galmpton	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	2
Total	1	5	1	1	...	...	1	3	5	5	7	2	4	1	2	...	1	39

Drift Boats.—Drift boats are chiefly built in Penzance and St. Ives; a few are built in Porthleven, and Looe, and three boat builders in Plymouth also build them.

Hookers.—Hooking boats are built here in five yards and are also obtained from St. Ives.

2. *Sail Making.*

Sail making is carried on, I understand, on a sufficient scale to supply the wants of the port. The sails, which are supplied to the fishermen *white*, are tanned by them in order to make them last the longer.

Trawlers tan their sails with a solution of bark. Drifters, on the other hand, tan the sails of their boats with a solution of catechu, the same as they use for their nets.

3. *Rope Making and Fishing-line Making.*

These industries are carried on in Plymouth. In the case of fishing lines, however, the fishermen use, besides those made by local manufacturers, lines obtained from Ireland, Scotland, and London. The lines are sometimes "tanned" or "barked" by the fishermen themselves for preservative reasons.

4. *Net Breeding.* *

Trawl Nets.—Trawlers breed their own nets, and the method used by them for preserving the net has already been mentioned on p. 49.*

Drift Nets.—Drifters do not obtain their nets in Plymouth; particulars as to where the nets are made and how they are prepared by the fishermen here have already been given on p. 61.

5. *Fish Curing.*

Herring, Hake, Haddock.—Two or three small establishments are engaged in curing herring, hake, and haddock, but the business is only on a very small scale.

Pilchards.—A couple of establishments are concerned in the preservation of pilchards. Some few years ago pilchards were sent by rail and sea from Plymouth to be salted at St. Ives, Newlyn, and other Cornish ports. Now about half the pilchards landed here are cured on the spot.

* The cost of a trawl with spans and hawser is £51.

* Devonshire pronunciation of braiding

Pickling of Pilchards.—The new process of pickling the fish is carrried on here. Pickled fish, although perhaps not so much liked as salted fish, keep very much longer and are more profitable property. Salted pilchards *must* be disposed of soon after curing, while pickled fish can be stocked. Fish will keep in brine seven or eight months without deteriorating.

The pickling process is as follows:—The fish are thrown into vats and covered with brine; if judiciously renewed the brine will preserve the fish until required, when they are packed in barrels and shipped. Considerable pressure, by means of screws, is applied during packing, and the bottoms of the barrels being perforated, the oil contained in the fish is pressed out and escapes into vessels placed below to receive it. Fish so treated are called in the trade pickled or marinated pilchards.

Salting Pilchards.—Pilchards are salted in the following manner:—They are placed in layers, a layer of fish and a layer of salt, until the heap rises three to five feet high; they are left thus "in bulk" as it is called, for, say, thirty days, during which the brine and oil drain from them into pits; they are then sifted free of the remaining dry salt, washed, and packed in casks under pressure (No. 10). Such fish are known as "fumados" or "fair-maids."

Export Trade in Pilchards.—About 5000 hogsheads of pilchards are exported from Plymouth per annum. There are about 3800 fish in a hogshead, and therefore about 19,000,000 fish are cured here,—a very small quantity in comparison to the number passing through the Cornish curing establishments (No. 6).

Pilchard Oil.—The pilchard oil is used by rope and varnish makers and for preparing leather and mixing with paint.

6. *Fish-skin Curing.*

Two small fish-skin curing establishments are in existence here, one of these being on an exceedingly small scale.

Skate and Ray Skin.—The skin of skate and ray is cleaned by a chemical process and dried; in this condition it is sent away to merchants in other parts of the kingdom.

The Trade.—How it is cleaned and to whom it is sent from here is known only to those concerned in the trade; while its ultimate destination and the purposes for which it is used is not known by those engaged in its preparation.

It is certainly used by brewers for "fining" beer, and that may be its only use.

7. *Fish-oil Manufacture.*

Fish Oil.—Besides pilchard oil, which has already (p. 84) been spoken of, oil is prepared from the livers of skate, ray, cod, and hake. The livers are boiled down and the oil collected.

Uses.—The oil is used for rope making and ship building, &c., while the refuse solid matter, which at one time was used for soap making, is now unsaleable. There is only a small business carried on here in this manufacture.

9. *Ice Manufacture.*

Ice is manufactured in an establishment on the Fish Quay —the Ice Manufacturing Company—by the ammonia process. Ice is also obtained from Norway, and stored here by the Ice Manufacturing Company, who have accommodation for 550 tons, and by an ice merchant.

III.—Methods of Ownership, Wage, Apprenticeship, Insurance, and Sale of Fish.

This section may be divided into—

1. Payment of trawlers. 2. Payment of drifters. 3. Payment of hookers. 4. Systems of payment compared. 5. The insurance of trawlers. 6. The insurance of drifters and hookers. 7. Methods of selling and buying fish.

Owners.—Smacks are frequently owned by several individuals, who, as shareholders in the vessel, are paid in proportion to the amount of money invested, out of the receipts of the fishing. Not a few are, however, owned by individuals who are generally boat builders, fishermen, or others connected with the fishing trade.

"Working out" Trawlers.—Trawlers are at times built without orders, as a speculation by the builder, and facilities offered to young and energetic fishermen to enable them to

become the owners of the vessel. The following method is usually adopted. A young man who is qualified, and is "second hand" on board some other boat, is offered the post of skipper on board the new vessel, and he undertakes to "work her out." He pays over year by year, out of his earnings, a proportion of the value of the vessel until a certain sum is in the hands of the builder, who then accepts a mortgage on the boat and the skipper becomes the owner and pays off the mortgage in instalments.

As will be seen in the following account, as skipper *and* owner he receives four and a half shares of the net proceeds of the catch.

Payments.—The men are paid on the share system, according to the value of the fish caught; the proportions of the shares varies, however, in the different kinds of fishing.

Insurance.—There are clubs for the insurance of trawlers, and of drifters and hookers managed entirely by the fishermen themselves in a very excellent fashion.

Fishermen.—The men who go fishing from this port are *bonâ fide* fishermen, they are not landsmen shipped during the fishing season and who work ashore during the rest of the year: such is the case with a great proportion of the crews of fishing boats on the Scotch coast during the herring season and on the east coast of England, but here the men are brought up to the fishing business and understand all the details connected with the craft as only such men can.

Boys.—The few apprentices who are shipped on board these boats are well treated, the boys generally engaged are sons or relations of the skipper, owner, or one or other member of the crew of the smack in which he sails, and they are paid by a proportionate share of the value of the catch.

A complaint of ill-treatment made by a boy is, I understand, unknown here, and the good feeling and kindness existing was very favorably commented on by the committee appointed in 1883 to inquire into these matters (No. 21). The fishermen bear a character for thorough honesty and kind-heartedness, which I myself have every reason to believe is not exaggerated.

1. *Payment of Trawlers.*

The crews, a skipper, two men and one boy, find their own food while on board the smack.

Trawl Fish.—The net value of the catch of trawled fish is divided into seven shares. Of this the owner or owners of the boat have three; the skipper one and a half; the second hand one; the third hand one; the boy a half.

Hook Fish.—In case fish is caught by hook and line on board the trawler, as may be the case if the boat is becalmed, the catch is divided into five shares. Of these the owner has one and a half; the skipper one; the second hand one; the third hand one; the boy a half.

Salvage.—In case of salvage, the sum received is divided into six shares. The owner has two and a half shares of the net amount of salvage paid; the skipper one; the second hand one; the third hand one; the boy a half.

Expenses.—All expenses connected with the boat and fishing gear, both renewals and repairs, are borne by the owner or owners of the vessel.

Stocker.—Besides these payments made to the crew there are certain perquisites the payment of which appears to be thoroughly understood, but which varies somewhat in different boats. The perquisites are locally known as "stocker." There are two kinds of stocker: (1) "men's stocker;" (2) "boy's stocker."

(1) *Men's Stocker.*—Men's stocker consists of thickbacks (*Solea variegata*), queens (*Pecten*), male crabs ("he crabs"), lobsters, and possibly other produce.

(2) *Boy's Stocker.*—Boy's stocker consists of squid (*Loligo*) and female crabs ("she crabs").

The men's stocker is divided into three shares: and of these the skipper has one; the second hand one; the third hand one.

The boy's stocker is divided into two shares; of which the third hand has one and the boy one.

The third hand has therefore a share of both men's and boy's stocker, but he may be paid about 2*s.* 6*d.* a week instead of receiving boy's stocker.

"*Pleasure Boy.*"—In case the trawler is a specially large vessel an extra hand may be employed, who is known as a "pleasure boy." He is paid wage by the owner and the crew, all joining in the payment; generally he is paid 2*s.* 6*d.* a week, and this sum is deducted from the net proceeds of the catch before it is divided into shares.

"*Extra Boy.*"—On the other hand, in case the skipper is an old man, he may take an "extra boy" to help him in his work; in this case the boy is paid by the skipper alone.

Apprentices.—There are but few apprentices in Plymouth. In 1884, when the "Fishery Boats Act" came into force, there were five apprentices; since that date only ten others have been bound. The apprentice lives with his master when on shore, and all food, &c., is found for him ashore and afloat. He is generally bound to serve until twenty-one years of age if he begins young, but if he is, say, eighteen years of age when he commences, a special arrangement is made as to the term he shall serve. An apprentice commences his service as "boy," but he may become third hand, or even second hand, before his term of service is over. The following are the payments made to him while he remains apprentice:

Payment of Apprentice.—While serving as boy he receives from his master 6*d.* a week, and has besides half share of the "boy's stocker." His master takes the half share of the catch belonging to the "boy," and half share of the "boy's stocker."

While serving as third hand he receives from his master 1*s.* a week, and has besides half share of boy's stocker, and one third share of men's stocker; he also has one quarter share of salvage in case there is any. His master takes the third hand's share of the catch, *i. e.* one share; also half a share of "boy's stocker," one sixth share of men's stocker, and three quarters share of salvage due to the third hand.

While serving as second hand he receives from his master 2*s.* a week, and has besides one third share of men's stocker, and one quarter share of salvage; his master taking the second hand's share of the catch, *i. e.* one share, two thirds share of the second hand's stocker, and three quarters share of his salvage money.

Earnings of Apprentice.—The apprentice is obliged to deposit his earnings with the officer of the Mercantile Marine, and is allowed from these earnings, during the first and second year of his service, 1*s.* a week "spending money," and during the remainder of his term 2*s.* a week. This is all the money he is allowed to have. Naturally the boy does not make a full return of his earnings; if he did so, it is calculated that at the end of his term of apprenticeship he would have about £25 to £50 in the hands of the Mercantile Marine officer.

On completion of his term of apprenticeship to his master's satisfaction he receives three suits of clothes, one pair of boots, one great coat, and £1 1*s.**

2. *Payment of Drifters.*

Plymouth Drift Fishermen.—The value of the catch is divided into eleven shares. Of these the owner has five and a quarter; skipper, one and a quarter; second hand, one; third hand, one; fourth hand, one; fifth hand, one; boy, half.

The owner finds the boat and all the gear, and makes good all repairs and losses.

On account of the greater comparative value of the nets employed in drift fishing, the owner has a considerably greater proportion of the gross amount of the catch than the owner of a trawler is allowed.

Cornish Drift Fishermen.—With the Plymouth system it is interesting to compare the system of payment adopted by Cornish drift fishermen. The latter is, in fact, a co-operative system, and is probably directly derived from the most primitive co-operative method.

The owner of a boat forms an "adventure" for each fishing season. For instance, in the mackerel season, the owner gets together a crew for his boat, who undertake to man his boat for the season.

* I am indebted for most of this information to Mr. W. H. G. Deacon, the Superintendent of the Mercantile Marine Office in Plymouth (No. 31).

The "adventure" is divided into a number of shares, which vary in number according to the fishery prosecuted and the net-carrying power of the boat.

A mackerel boat of fifteen tons carries a skipper, six men, and a boy as crew.

In this case the adventure is divided into thirty-fourths, of which $\frac{1}{34}$ths = one share.

The owner who finds the boat and its gear and makes good damage, &c., sustained by it has . .	2 shares	= $\frac{4}{34}$ths.
The skipper who acts as ship's husband, and who makes a certain amount in that way has . . .	1 „	$\frac{2}{34}$ths.
The six men have *each* 1 share	6 „	$\frac{12}{34}$ths.
The boy	$\frac{1}{2}$ „	$\frac{1}{34}$th.
The nets	$7\frac{1}{2}$ „	$\frac{15}{34}$ths.
	17 shares	= $\frac{34}{34}$ths.

The nets are usually brought on board by the men engaged. One man may bring two nets, another one net, and so forth. The owners of the nets are paid in proportion to the number of nets they bring on board out of the sum ($\frac{15}{34}$ths) which is set apart for the nets. By this arrangement the undertaking has essentially the character of a co-operative society.

Cornwall is, I believe, the only county in England where this method is carried out by the fishermen.

The numbers of shares, as I have before said, in an adventure, vary according to the fishery and the net-carrying power of the boat, and this makes the agreements all the more complicated. There appears, nevertheless, to be an excellent understanding between the several parties who enter into these engagements every year, and a dispute is of very rare occurrence (No. 30).

3. *Payment of Hookers.*

Shares.—Among hookers the details are again different. The gross catch is divided into five and a half shares. The owner of the boat has one and a quarter shares; the skipper, one and a quarter; second hand, one; third hand, one; and fourth hand, one.

Until recently the owner took one and a half shares and

the skipper and three men one share each; now the owner divides his half-share with the skipper.

Men's Food.—The question of the men's food is treated differently on board hookers to what it is on trawlers. Any food which the crew may wish to have while fishing off the port they must find themselves; but if they go away to fish in other parts of the coast their food is considered as an expense attending the adventure, and its value is subtracted from the net proceeds of the trip before they are divided into shares. By this means the owner pays a proportion of the keep of the men while fishing away from home.

"*Stocker.*"—Perquisites are claimed by hookers in most cases; but the fish claimed for such "stocker" varies indefinitely, and the amount of it allowed for stocker differs according to the arrangements each owner may make with his crew. Some owners allow no stocker at all; others allow the skipper to sell a small "lot" of fish on his own account, or on account of the crew. As a general rule it may be said that if a few ling or pollack, two or three hake or conger only are caught during one day's fishing, this small lot may be disposed of by the skipper.

No particular fish is, as a rule, considered by hookers as their perquisite.

4. *Systems of Payment Compared.*

The method of paying fishermen entirely by proportions of the proceeds of the catch of fish is, I am informed, universal in Cornwall and Devon, and, according to Professor Leone Levi (No. 16) is also in use in East Coast fishing ports.

Another system is, however, practised, at any rate in some of the latter ports (No. 23). According to this method, the owner pays a certain wage to the skipper and men, who receive besides, a share of the value of the catch.

In the Scotch herring fishery ports, the skipper is paid according to the catch, and the men paid wage. This was the case at Grimsby in 1877 in certain cases (No. 17 *b*), and in the North Sea Cod Fisheries a similar practice prevails now (No. 4).

There are therefore three systems of payment in use among fishermen.

1. Payment by share. (A) When men are paid for work only (Plymouth trawlers). (B) When men are paid not only for work done but for fishing material supplied (Cornish drift fishers).

2. Payment by wage.

3. Payment partly by wage and partly by share.

As far as the greater number of men are concerned this latter method would appear most advantageous, viz. that they should have a small fixed income under all circumstances. They would thus be enabled to live when the trade is very unremunerative, but they would be stimulated to work hard in order to increase their income by sharing in the proceeds of the fishery as well.

Improvidence, Poverty.—There would appear to be a considerable number of fishermen in the port who do not recognise the importance of laying by money during good times, and in consequence of the irregular nature of the trade in which they are concerned and the enormous fluctuations in the price of fish, there are without doubt a large number of cases of poverty and distress amongst them during bad seasons.

In spite of this, however, the system of payment by share only, in use here, is considered by the better fishermen themselves, and by others who take an interest in the welfare of these men, to be by far the best system of payment, and calculated at any rate to make men independent, careful of money, hard workers, and watchful, shrewd fishermen.

5. *The Insurance of Trawlers.*

Mutual Insurance.—There is a mutual insurance club for trawling vessels, composed of the owners of vessels, and managed by a president and committee elected once a year from amongst themselves.

Rates.—The club insures for total loss only, the policy being limited to £300, for which there is an annual subscription of £1.

For a 1st class trawler (a new boat and until 10 years old) the policy is for	£300
For a 2nd class trawler (from 10 to 15 years old) . . .	250
For a 3rd class trawler (from 15 to 20 years old) . . .	200

and there may be a further reduction for a boat more than twenty years old.

The exact times when the club determines to reduce its liability on any vessel, depends upon the committee of the club, who examine the vessels from time to time and class them in accordance with their age and condition.

Brixham.—At Brixham the trawlers can insure for total and for partial loss.

6. *The Insurance of Drifters and Hookers.*

Insurance.—The insurance of these boats is on a much smaller scale. The maximum amount of a policy is £60, and the subscription 15*s.* a year. The club is managed in the same way as the trawlers' insurance club, the committee having power to determine the value of the policy any boat may take out. The maximum amount for which these boats may be insured is so small that several owners of the best boats will not insure their vessels.

The club, however, is in a flourishing condition.

7. *Methods of Selling and Buying Fish.*

Auction.—Fishermen place their catch in the hands of fish salesmen, who sell it, by auction, either to fish hawkers, local fishmongers, or fish buyers for London and other markets.

The auctions are of two kinds; either the lot is handed over to the highest bidder as in ordinary auction transactions; *or*, the lot to be sold is put up at a fancy price, the auctioneer reducing it until he reaches a figure which is accepted. This latter method is called "Dutch auction" and is very general on the east coast.

Commission.—The fish salesman charges 5 per cent. commission and guarantees the debt to the fishermen.

Discount.—All buyers of fish of a value of 20*s.* or more are allowed a discount of 2½ per cent. by the salesman, who thus makes 2½ per cent. on the amount he sells.

Trawl Fish.—Trawl fish is sold as follows:—"Head" or "prime fish" is sold by the catch in lots, except hake, which is sold by the dozen. "Offal" or "seconds" is sold by the maund*, skate and ray by the "lot," which may be any number.

Drift Fish.—Drift fish is sold:—Pilchards, per 126; herrings, per 126; mackerel, per 120.

Hook Fish.—Hook fish is sold:—Congers, per cwt.; ling, per dozen; skate and ray, per "lot" of any number; whiting, per dozen; pollack, per dozen; turbot, per fish.

List of Publications referred to.

No. 1. *Ansell.*—"On Trawling" ('Literature of International Fishery Exhibition,' 1883).
„ 2. *Anson and Willett.*—"Oyster Culture" ('Lit. of Int. Fish. Exhib.,' 1883).
„ 3*a*. *Bellamy.*—'The Natural History of South Devon' (1839).
„ 3*b*. *Bellamy.*—'Guide to the Fish Market' (1862).
„ 4. *Bertram.*—"The Unappreciated Fisher Folk" ('Lit. of Int. Fish. Exhib.,' 1883).
„ 5. *Brooks.*—'General Guide to Sea Fishing.'
„ 6. *Cornish.*—"Mackerel and Pilchard Fisheries" ('Lit. of Int. Fish. Exhib.,' 1883).
„ 7. *Edinburgh, H.R.H. the Duke of.*—"The Sea Fisheries and Fishing Population of the United Kingdom" ('Lit. of Int. Fish. Exhib.,' 1883.
„ 8. *Harding.*—"Molluscs, Mussels, Whelks, &c., used for Food or Bait" ('Lit. of Int. Fish. Exhib.,' 1883).
„ 9. *Harding.*—'Specification No. 15,891." Apparatus for Storing, Keeping Alive, Fattening and Protecting from the Force of the Sea, Edible Molluscs.
„ 10. *Houghton.*—"Natural History of Commercial Sea Fishes" ('Lit. of Int. Exhib.,' 1883).
„ 11. *Holdsworth.*—'Sea Fisheries,' 1877.
„ 12. *Holdsworth.*—"Apparatus for Fishing" ('Lit. of Int. Fish. Exhib.,' 1883).
„ 13. *Hunt.*—"Notes on Torbay" ('Transactions of the Devon Assoc.,' 1878).
„ 14. *Inglis.*—"Plymouth Sound—its Tidal Currents" ('Trans. of the Plymouth Instit.,' 1877).

* The weight of a maund of flatfish is, say, 70 lbs.; of round fish, say, 6 lbs.

No. 15. *Inglis.*—"Harbour Accommodation in the West" ('Trans. of the Plymouth Instit.,' 1885).
„ 16. *Levi, Prof.*—"Economic Condition of Fishermen" ('Lit. of Int. Fish. Exhib.,' 1883).
„ 17. *Lord.*—'Sea Fish and How to Catch them' (1862).
„ 17*b*. *Lundie.*—'Statistics of Sea Fishery at Great Grimsby" (1877).
„ 18. 'Report of Select Committee on the British Channel Fisheries' (1833).
„ 19. 'Report of the Commissioners appointed to Inquire into the Sea Fisheries of the United Kingdom' (1866).
„ 20. 'Report on Crab and Lobster Fisheries of England and Wales, Scotland and Ireland' (1877).
„ 21. 'Report of the Committee appointed under a minute of the Board of Trade to Inquire into, &c., Relations between Owners, Masters, and Crews of Fishing Vessels, &c.' (1883).
„ 22. *Scott.*—"The Fisheries of Devonshire" ('Trans. of the Devon Assoc.,' 1864).
„ 23. "Systems of Wage of the North Sea Fishermen" ('Fish Trades Gazette,' No. 165, 1886).
„ 24. *Wilcocks.*—'The Sea Fisherman' (1884).
„ 25. *Young.*—'Sea Fishing as a Sport' (1865).
„ 25*b*. 'Board of Trade Journal.'

I am, moreover, especially indebted to the following gentlemen for information contained in these notes:

No. 26. *Captain Bate* (Fisherman).
„ 27. *Mr. R. Bunt* (Fisherman).
„ 28. *Mr. R. Cload* (Fisherman).
„ 29. *Mr. G. Coles* (Fish Salesman).
„ 30. *Thos. Cornish, Esq.* (Letters to W. F. Collier, Esq.).
„ 31. *W. H. G. Deacon, Esq.* (Superintendent of the Mercantile Marine Office, Plymouth).
„ 32. *Mr. Johns* (Fisherman).
„ 33. *Captain Short* (Sutton Harbour Master).
„ 34. *H. B. Watson, Esq.* (Ship Builder).

To *Mr. Coles* my best thanks are due for a very large proportion of the facts included in Part I.

Description of the Laboratory of the Marine Biological Association at Plymouth.

By

Walter Heape, M.A.

The Laboratory which is now in the course of erection at Plymouth for the Marine Biological Association, is situated between the south wall of the "Citadel" and the Sound, at a height of 95 feet above the level of the sea. The site, which has been granted to the Association by the War Office, occupies the whole length of King Charles's Curtain, 265 feet, and extends southwards from the Citadel wall 240 ft., giving a surface of, say, 63,600 feet.

A road lies between this plot of land and the sea, and private access to a small section of the seaboard is provided for by means of a tunnel 7 ft. 6 in. high and 6 ft. 6 in. wide, which leads from the area surrounding the cellars, beneath the road, to the rocks below.

The building (*vide* Frontispiece) is placed 90 feet from the wall of the Citadel, and is about 60 yards from high-water mark. It is in the form of two blocks, which are each 34 ft. 6 in. long by 42 ft. wide and three stories high (40 ft.), and a central connecting portion 70 ft. long by 34 ft. 6 in. broad and two stories high (30 ft.). The east, south, and west fronts are built entirely of dressed limestone, which has been excavated on the spot; but on the north front the window- and door-dressings are of brick.

The roof of the central portion is peaked and covered with slate; that of the two blocks is flat and covered with lead.

Below the western block cellars have been excavated (Plate III) 14 ft. deep, surrounded by an area 6 ft. 6 in. wide

on the north and 4 ft. wide on the west and south sides; further the excavation has been extended between the cellars and the Citadel wall to form two reservoirs for salt water, each 37 ft. 6 in. long, 21 ft. 6 in. wide, and 13 ft. deep, and each capable of holding 50,000 gallons. The roof of a portion of each of the reservoirs (Plate I, *r*) is 6 ft. higher than the remainder and is fitted with a gangway (*t*) to enable a man to walk inside. These reservoirs are built of concrete and coated with a special asphalte supplied by Messrs. Leete, Edwards, and Norman, of London; they are arched in with brick and completely covered over.

The arrangement of rooms in the building is as follows:

Cellars.—The cellars (Plate III) are 13 ft. high, and consist of an engine room, 20 ft. by 16 ft.; a boiler room, 20 ft. by 11 ft.; an engineer's room, 13 ft. by 11 ft.; a coal cellar, store room, and w. c. Access to the cellars is provided for by means of steps down into the area on the north side.

Ground Floor, West Block.—The rooms on the ground floor (Plate I) are 12 ft. high. The main entrance to the building is in the centre of the west face of this block, and leads, on the one hand, by means of a straight passage 6 ft. wide direct into the aquarium, and, on the other hand, by means of a staircase 9 ft. wide to the first floor. A urinal is placed leading from the landing of this staircase. On the south side of the entrance are two rooms to serve as kitchen and bedroom for the caretaker of the building; these rooms are each 14 ft. by 12 ft., and between them is a pantry 9 ft. by 6 ft. On the north side of the entrance the scullery and offices for the caretaker, the staircase leading to the first floor, and a "Receiving Room" 20 ft. 6 in. by 16 ft. are placed.

Centre.—The central part is occupied by the aquarium from the east end of which a door leads into the

East Block.—On the north side of this block is Laboratory II, 17 ft. 6 in. by 16 ft.; on the south side Laboratory III, 15 ft. by 9 ft. The remainder of this floor of the block is occupied by the kitchen and offices of the Superintendent's residence. The main entrance to the residence

is in the centre of the east face of the block, it leads into a passage from which direct communication with the aquarium is provided. A staircase 7 feet wide leads to the first floor. A back door is placed on the north side.

First Floor, West Block.—The rooms on this floor (Plate II) are 11 ft. high. The staircase opens onto a landing above the entrance hall, and from this point a staircase communicates with the second floor, and a passage 6 ft. wide leads into the main laboratory. On the north side of this passage is the Physiological Laboratory, 20 ft. 6 in. by 16 ft.; on the south side the Chemical Laboratory, 22 ft. by 14 ft., and a small room communicating with the latter, 8 ft. by 14 ft., which is designed to serve as a photographic room. These two laboratories are entered through doors which open into the passage. At the end of the passage a door leads into the

Centre.—The main laboratory occupies the whole of the first floor of this portion of the building. It is provided with seven large windows on each side, which reach from a point 2 ft. 6 in. from the floor to a height of 10 ft. from the floor. The roof is a collar-beam roof with tie-rods leading down to the feet of the principals. It is 16 ft. from the floor to the ceiling along the centre of the room. The floor is especially constructed of Dennett's arching to ensure freedom from vibration as much as possible.

East Block.—The rooms on this floor are a dining room, pantry, and study for the Superintendent, and an office from which a door leads directly into the main laboratory.

Second Floor, West Block.—The rooms on this floor (Plate IV) are 10 ft. high. The staircase and passage are the same as on the first floor. On the north side of the passage is a lavatory, 16 ft. by 8 ft., for the convenience of workers in the laboratory, and a private workroom, 16 ft. by 12 ft., while the whole of the south side is occupied by the library, a room 30 ft. 6 in. long and 16 ft. wide.

East Block.—This floor is occupied by bedroom accommodation, &c., for the Superintendent and his servant. A small staircase 2 ft. wide will lead from the second floor on to the flat roofs of each block.

Fittings.

The Tank-room.—The tank-room is fitted with tanks of slate and of glass fitted in cast-iron frames, and water is supplied to these tanks through vulcanite piping. The system it is proposed to use for keeping the sea-water in good condition is known as the "circulating system." It was introduced into England by Mr. Lloyd, and is in use at the Crystal Palace and, I believe, all the inland aquariums. The Naples Zoological Station and various continental aquariums have also adopted this method of keeping the water continually in a satisfactory condition.

The system is briefly as follows:—By means of pumps the water is forced from the reservoirs through vulcanite pipes into the tanks. The pipes are placed about 2 feet above the level of the water in the tanks, and the water is forced through nozzles, the bore of which is from, say, one eighth to one quarter inch diameter, and regulated with a tap. Jets of water are thus forced into the tanks from some little distance above, and air in a state of very fine division is carried by the jet deep into the water of the tank, and distributed through it. By this means all decomposing organic matter is oxidised and the water constantly kept in a condition satisfactory for maintaining life. The force of the jet of water is regulated by the speed of the pumps and by valves placed in the main pipes, according to the amount of aeration required. The water overflows from the tanks into so-called "circulating reservoirs," which are placed below them but above the level of the water in the main reservoirs, and through these it is conducted to a culvert (Plate I, *p*) which conveys it back again to the main reservoirs, to be again pumped up into the tanks.

This is not the place to enter into a discussion of the relative value of the various methods now in use for keeping aquaria in good condition, but I would point out that the advantage of the method adopted by the Association is that the water is kept *constantly* in good condition.

A series of nine tanks are placed along the whole length

of the south wall of the aquarium. They are all 4 ft. wide and 4 ft. deep. One of them (*k*) is 15 ft. long, two (*l l*) are 10 ft. long, and the remaining six (*j*) are 5 ft. long. The circulating reservoir below this row of tanks is 2 ft. 6 in. wide and 3 ft. 6 in. deep. The circulating reservoirs are built of concrete and brickwork, and the internal surface covered with a special asphalte. The tanks are supported on the walls of the circulating reservoirs; each tank is provided with an overflow into the circulating reservoir and an overflow into the tank next to it, the level of the tanks being so arranged that the water flows from east to west. These overflows are so arranged that they can be used or not as desired, and thus any tank can be isolated.

A second series of three tanks is placed along the north wall. Two of them are 5 ft. deep and 9 ft. wide, one of these (*f*) being 15 ft. 6 in. long, the other (*g*) 30 ft. 6 in. long, while the third (*h*) is 5 ft. deep, 5 ft. wide, and 15 ft. long. The circulating reservoirs below are 3 ft. 6 in. deep and 7 ft. wide. The overflows are arranged like those on the south side. The height of the top of these tanks from the floor is 7 ft., while on the south side the top of the tanks is 6 ft. 6 in. above the floor level.

A third series (*e*) of five "table tanks," each 9 ft. 9 in. long, 2 ft. 3 in. wide, and 1 ft. 9 in. deep, is placed down the centre of the room. They are supported upon the walls of a circulating reservoir 1 ft. wide and 3 ft. deep, and being only 4 ft. above the floor level their contents can be examined from above.

The water in each of the circulating reservoirs flows at the west end into a culvert (*p*) which conducts it back to the main reservoir; the culvert is of concrete, lined with asphalte, and covered over with slate.

It will be convenient to include in this description of the aquarium a series of twelve small tanks, which are placed in a double row in the main laboratory (Plate II, *k*). They are supplied by the pumps with water, which flows again into the main reservoir. Each of these tanks is 1 ft. 6 in. deep, 2 ft. 3 in. wide, and 5 ft. long. The pipes are of vulcanite. A supply of water is also conducted through pipes

of the same material to Laboratories II and III, to the Physiological (Plate II), Laboratory, and to the "Receiving Room (Plate I)."

The Engine Room.—The engine room (Plate III) contains two patent "Otto" gas engines, one of two horse power (*b*), and the other of four horse power (*a*); two patent rotary pumps ("Forbes and Edward") in duplicate, each capable of circulating 7500 gallons an hour (*d*), and two similar pumps capable of circulating 2000 gallons per hour (*e*). These pumps are of vulcanite, and all the pipes, cocks, taps, &c., concerned with the circulation of the sea water are also of vulcanite. Vulcanite and rubber hose is used to convey the water from the reservoirs to the pumps. The two large pumps supply the tanks in the aquarium, the two smaller pumps the tanks in the Laboratory. In consequence of the necessity to circulate the water continuously, the engines and pumps have been supplied in duplicate.

For the renewal of water in the reservoirs a Shone's ejector placed at low-water mark has been provided. This ejector is supplied with compressed air from a receiver in connection with a compressor attached to the four-horse power engine in the basement of the building. This engine will thus perform as required the double function of circulating the water through the pipes and tanks of the aquarium and laboratory, or renewing the supply of salt water in the main reservoir from the sea. By this arrangement the necessity for a distinct pumping engine and house on the rocks, here exposed to the waves, is avoided.

The engine room also contains a special receiver for compressed air (*c*), which is distributed to the main laboratory in pipes for the purpose of aerating small aquaria containing minute organisms.

Receiving Room.—Materials for workers in the laboratory and to stock the aquarium will be brought by the fishermen into the "Receiving Room" (Plate I). This room is on the ground floor in the western block above the engine room, and communicates directly by means of doors with the yard outside and with the aquarium, and, by means of a lift, with the floors above it. The room is fitted with a

large sink (*a*), with tables upon which the sorting of material and the dissection of large animals can be carried on (*b*, *b*, *c*) —one of these tables (*c*) is supplied with a slate top—and with sufficient shelves (*d*). A supply of fresh and salt water, and a coil for heating water, is placed over the sink.

The room is lighted with a pendant in the centre, having two burners, and with brackets on the walls.

Main Laboratory.—Along each side of the main laboratory are seven compartments (*m*)—each 10 ft. long and 8 ft. wide—formed of wooden partitions on either side, 7 ft. high, and by a curtain suspended on a rod behind. Each of these compartments is fitted along the window with a bench (*o*) 9 ft. long, 4ft. 3 in. wide, and 2 ft. 6 in. high, and an earthenware sink (*n*) 1 ft. square and 8 inches deep. On the one side is placed a chest of drawers and cupboards (*r*), 4 ft. 6 in. long, 3 ft. high, and 1 ft. 8 in. deep, and the whole of the other side is occupied with a set of shelves (*p*) conveniently arranged to hold small and large bottles. The sink is supplied with fresh water; gas nozzles are conveniently placed on the bench, and a gas bracket on the central pier of the window-frame. Between these compartments on either side of the laboratory is a space 14 ft. wide. The eastern portion of this space is occupied with the series of twelve small tanks (*k*) already mentioned in the description of the aquarium fittings. They occupy a space 4 ft. 6 in. wide and about 30 ft. long. In a line with these tanks is a slate-topped table (*j*), 14 ft. long and 5 ft. 8 in. wide, along the centre of which is a partition 2 ft. high supporting a shelf. Water and gas taps are placed at intervals along the table. A large sink, 5 ft. long and 2 ft. wide is placed at one end of this table, and another sink, supplied with drying board, hot-water coil, &c., is fixed along the western wall of the room (*l*, *l*). A cupboard 3 ft. high is placed beside this latter sink and shelves above the cupboard.

Besides the gas brackets in each compartment, and one above the sink just mentioned, the room is lighted by three double-burner pendants hanging at intervals down the centre of the room.

The Chemical Laboratory.—A bench runs along the windows 3 ft. 3 in. above the floor and 3 ft. wide (Plate II, *e*). Four stoneware basins are let into the bench at intervals, and fresh water conducted to each. Shelves are placed against the window-piers above the bench, and cupboards and drawers along its whole length beneath.

A slate-topped table, 8 ft. long, 3 ft. wide, and 3 ft. 6 in. high, is placed in the middle of the room (*d*), and contains four rows of drawers of different sizes, each row consisting of five drawers. A sink, 6 ft. long, with drying-board, table, and shelves, occupies the east wall of the room (*c*); shelves are placed along the north wall (*h*), and a stink-cupboard (*g*) and blow-pipe table (*f*) alone the west wall.

The room is lighted by a central pendant and by brackets on the window-piers, and gas nozzles for india-rubber tubing occur at intervals along the main bench, on the pendant above the central table, in the stink cupboard, &c.

The Physiological Laboratory.—There are two sinks in this room, each 3 ft. by 1 ft. 6 in.; one of these is of glazed earthenware, and is supplied with salt as well as with fresh water, the other is of wood lined with lead (*a*, *a*). A large cupboard, 8 ft. 8 in. long, 6 ft. high, and 15 in. deep, with air-tight glass doors, is fitted against the south wall (*b*) and shelves on the east wall. Two substantial tables, 6 ft. by 3 ft. and 3 ft. high, and one table, 6 ft. by 4 ft. and 3 ft. 3 in. high, are also supplied; these tables are not fixtures, but can be moved about as desired.

The gas supply is similar to the chemical room.

The Library.—The library, on the second floor of the west block, is fitted with shelves along the east, west, and north walls (Plate IV, *a*), and supplied with writing-tables and chairs.

Laboratories II and III.—Gas and salt-water and fresh-water pipes are carried into these rooms, but the fittings have been deferred for the present (Plate I).

Heating.—The greater part of the building is heated by means of air, which is passed over pipes through which hot water circulates at a low pressure. A boiler is fixed in the cellars and pipes are carried from it into the Receiving Room, along the north and south walls of the laboratory,

into the Chemical and Physiological Laboratories, the library and the Superintendent's office and living rooms. These pipes are cased in, fresh air is admitted within the casing through perforated bricks, and is distributed into the rooms through short vertical shafts placed against the wall at intervals. The top of each shaft is provided with a valve which can be regulated as desired and through it the warm air enters the room. The aquarium is warmed by means of hot-water pipes lying in a trench covered with iron grating along the passages between the three rows of tanks (Plate I, *a*).

Ventilation is provided for by means of shafts in the walls dividing the central portion from the two end blocks, into which the foul air from the top of the rooms is conducted through grids. The up-draught in these shafts may be assisted by means of gas burners placed within them. Ventilation in the main laboratory is assisted by means of revolving ventilators (Plate IV, *e*) placed in the roof.

CORRESPONDENCE AND SHORT NOTES.

Communications addressed to the Honorary Secretary of the Association will, if suitable, in future numbers of the Journal be published under this heading.

OFFICIAL NOTICES.

The Council has appointed Mr. J. T. Cunningham, M.A., F.R.S.E., Fellow of University College, Oxford, to the post of Naturalist at the Plymouth Laboratory. There were four applications for the post. Mr. Cunningham has for several years acted as Superintendent of the Scottish Marine Station on the Firth of Forth, under the direction of Mr. John Murray, of the "Challenger" Expedition.

DESCRIPTION OF PLATES I, II, III, IV.

Plate I.—Ground Plan.

a. Sink in Receiving Room.
b b. Tables.
c. Slate-topped table.
d. Shelves.
e. Five table tanks, each 9 ft. 9 in. long, 2 ft. 3 in. wide, 1 ft. 9 in. deep.
f. Tank, 15 ft. 6 in. long, 9 ft. wide, 5 ft. deep.
g. Tank, 30 ft. 6 in. long, 9 ft. wide, 5 ft. deep.
h. Tank, 15 ft. long, 5 ft. wide, 5 ft. deep.
j. Six tanks, each 5 ft. long, 4 ft. wide, 4 ft. deep.
k. Tank, 15 ft. long, 4 ft. wide, 4 feet deep.
l. Two tanks, each 10 ft. long, 4 ft. wide, 4 ft. deep.
m. Pillars to support Dennett's arching.
n. Manhole into circulating reservoirs along north side.
o. Trench covered with grating containing hot-water pipes.
p. Culvert conveying salt water from circulating to main reservoirs.
r. Raised portion of reservoirs.

Plate II.—First Floor Plan.

a a. Two sinks in Physiological Laboratory.
b. Cupboard with air-tight glass doors.
c. Sink in Chemical Laboratory.
d. Slate-topped table.
e. Bench.
f. Blowpipe table.
g. Stink cupboard.
h. Shelves.
j. Slate-topped table in main Laboratory.
k. Twelve tanks, each 1 ft. 6 in. deep, 2 ft. 3 in. wide, 5 ft. long.
l l. Two sinks.
m. A "compartment."
n. Sink.
o. Bench.
p. Shelves.
r. Table with drawers and cupboards.

PLATE III.—PLAN OF CELLARS AND FOUNDATIONS.

a. Four-horse power gas-engine.
b. Two-horse power gas-engine.
c. Compressed-air receiver.
d. Duplicate pumps to throw 7500 gallons an hour.
e. Duplicate pumps to throw 2000 gallons an hour.
f. Arching, in plan.
g. Drains.
h. Foundation for pillars to support Dennett's arching.

PLATE IV.—SECOND FLOOR PLAN.

aaaa. Shelves in Library.
b. Washhand basins in Lavatory.
c. W.C.
d. Urinals.
eee. Revolving ventilators.

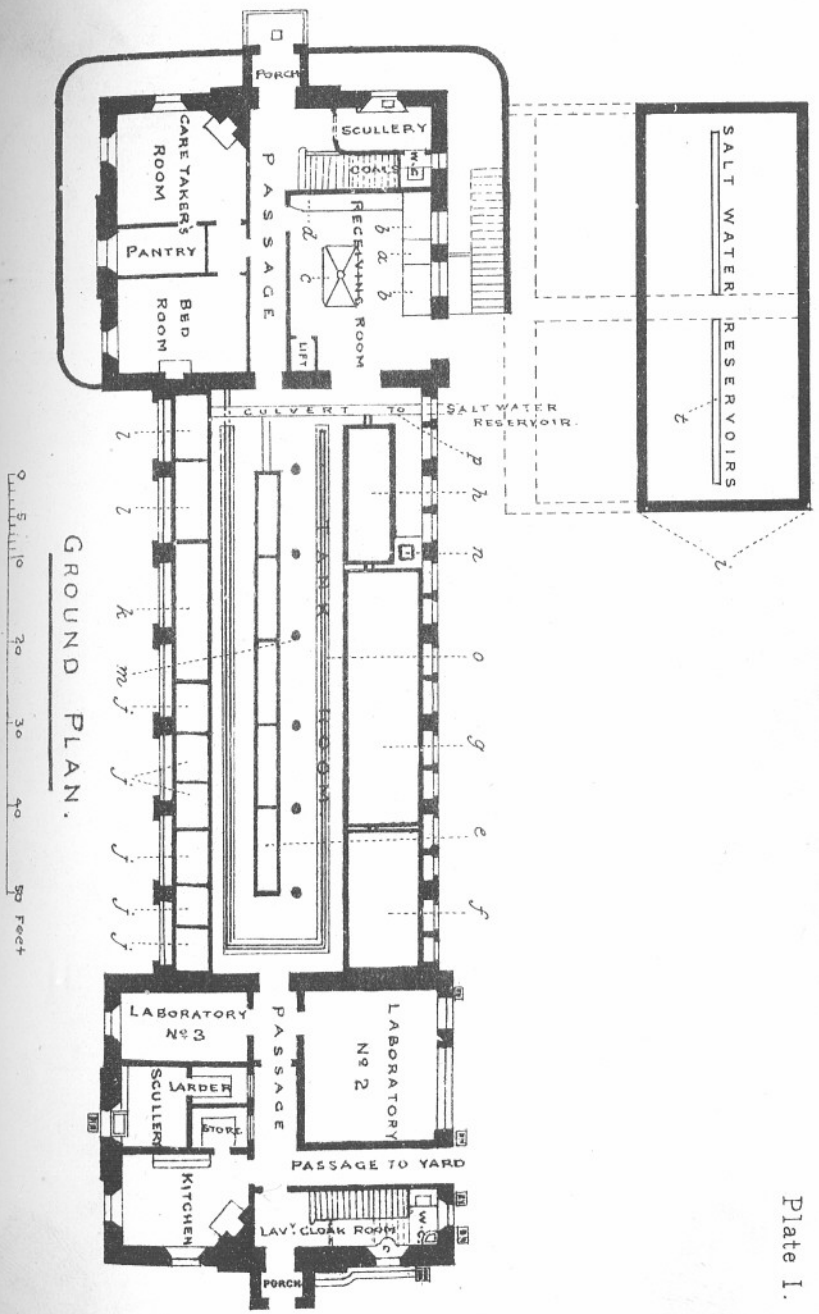
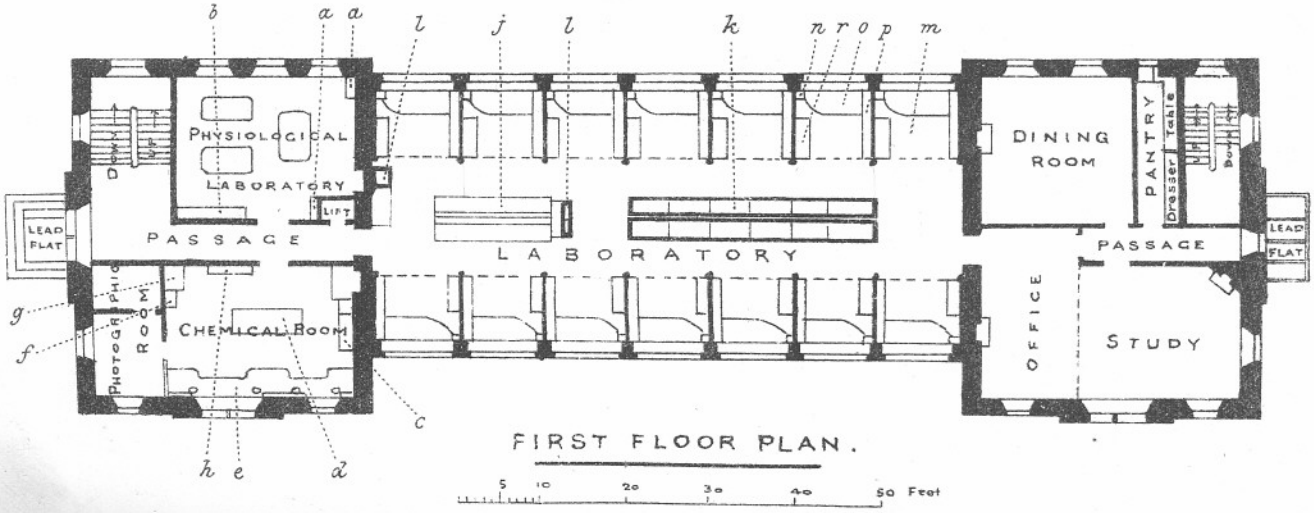
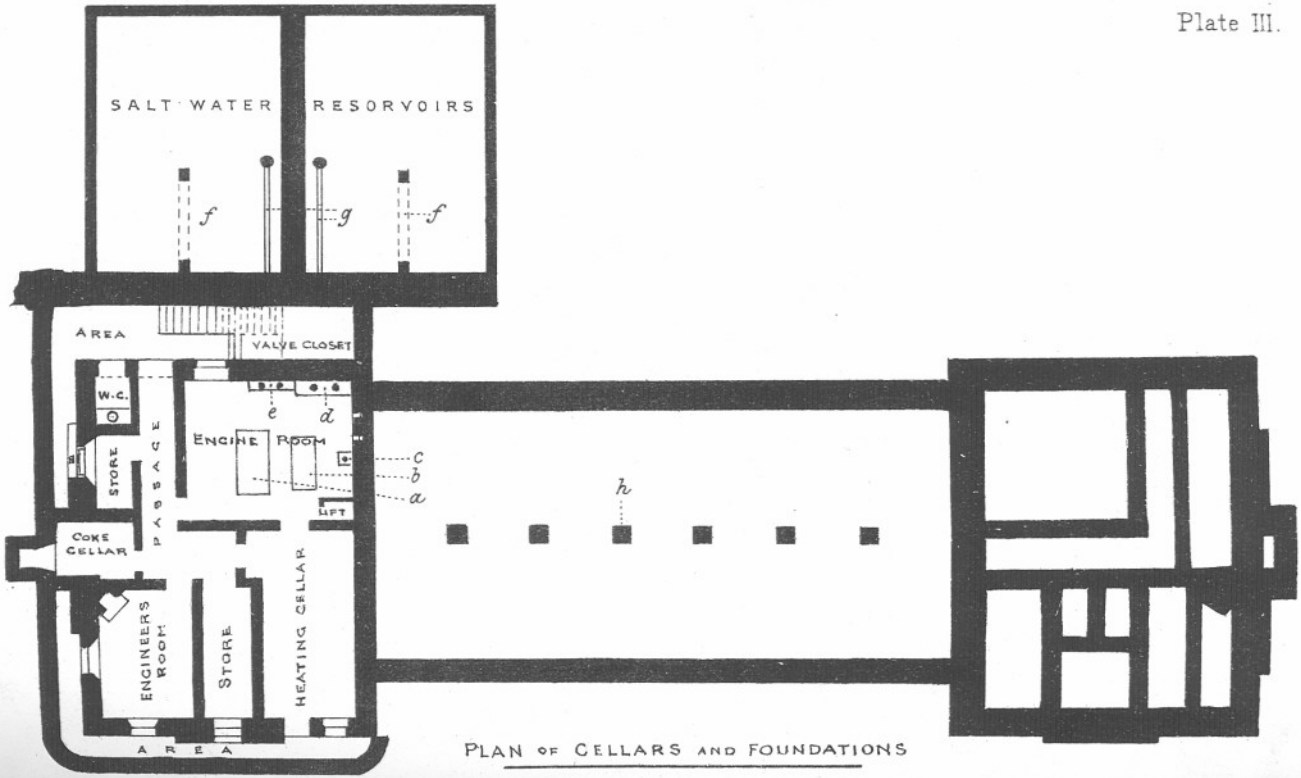


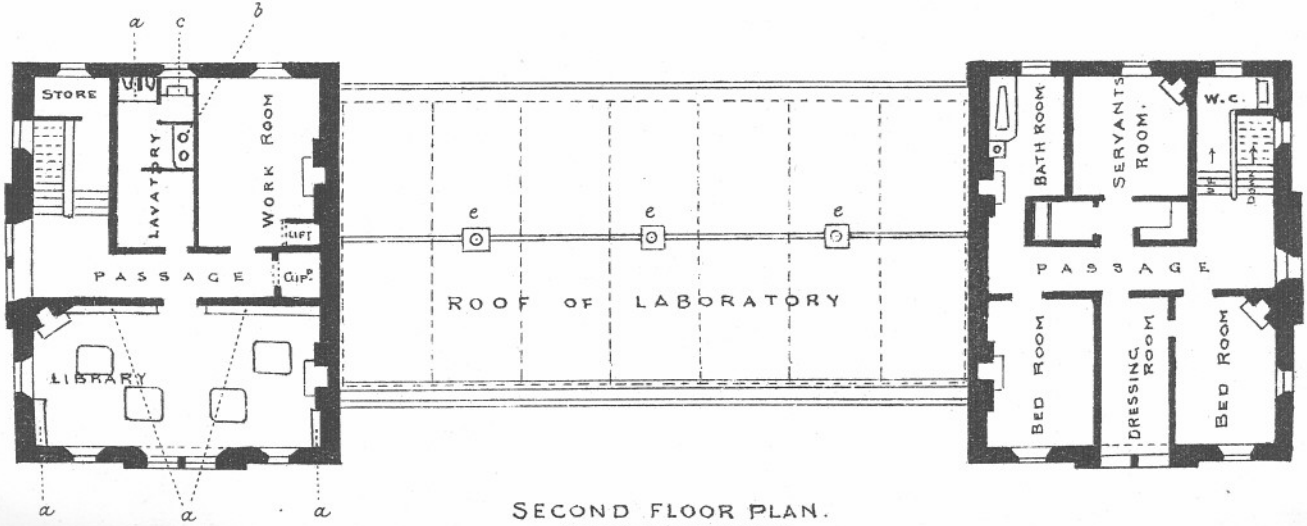
Plate I.



FIRST FLOOR PLAN.



PLAN OF CELLARS AND FOUNDATIONS



SECOND FLOOR PLAN.

0 5 10 20 30 40 50 FEET

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, Lord DALHOUSIE, 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 will have cost little short of £11,000 when completed. The number of naturalists who can be employed by the Association on special investigations, and definitely retained for the purpose of carrying on researches throughout the year, must depend on the funds subscribed by private individuals and public bodies for this purpose. The first charges on the revenue of the Association are those for the working of the sea-water circulation in the tanks, the payment of servants and fishermen, and the salary of the Resident Superintendent. The gentleman holding this post receives £200 a year and a residence; also it is intended to appoint immediately a naturalist, who will devote himself especially to the study of food fishes, at a salary of £250 a year. THESE ARE THE ONLY SALARIED OFFICERS OF THE ASSOCIATION: the entire work of conducting its affairs has been done hitherto by voluntary service. It is confidently expected that valuable researches will be carried on at the Plymouth Laboratory by naturalists who will come there as volunteers, and will even pay a small rent for the use of a working-table in the Laboratory and other appliances. It will be part of the business of the Superintendent and Naturalist to organise and direct these voluntary researches as far as possible, so as to obtain definite and practical results.

The Association has actually received, or has in promise, altogether about £15,000, of which £5000 has been granted by the Treasury. The annual revenue which can be at present counted on is about £950, of which £500 a year for five years is granted by the Treasury, whilst £180 is in the uncertain form of Annual 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 £4000.

It is obvious that the MARINE BIOLOGICAL ASSOCIATION urgently needs additional funds in order to purchase such accessories as a steam launch and boats, and in order to increase the permanent staff engaged at Plymouth. 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.

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NOTICE.

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

Persons desirous of joining the M. B. A. can do so on application to the Hon. Secretary. Members pay One Guinea annually, or a Composition Fee of Fifteen Guineas for Life Membership. Founders pay £100. Governors (Life-Members of Council) £500. 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.

For a statement of the objects and organization of the Association, see page 3 of the wrapper.

Members of the Association are requested to pay the Subscription for the year 1887-88 *to the Honorary Treasurer,* Frank Crisp, Esq., 6, *Old Jewry, London, E.C.*