L.M.B.C. REPORTS. No. IV.

THE FOURTH VOLUME OF REPORTS

UPON THE

FAUNA OF LIVERPOOL BAY

AND THE

NEIGHBOURING SEAS,

WRITTEN BY THE MEMBERS OF THE

LIVERPOOL MARINE BIOLOGY COMMITTEE,

AND OTHER NATURALISTS,

AND EDITED BY

W. A. HERDMAN, D.Sc., F.R.S.,

DERBY PROFESSOR OF NATURAL HISTORY IN UNIVERSITY COLLEGE, LIVERPOOL;
CHAIRMAN OF THE LIVERPOOL MARINE BIOLOGY COMMITTEE, AND
DIRECTOR OF THE PORT ERIN BIOLOGICAL STATION.

WITH FIFTY-THREE PLATES, AND OTHER ILLUSTRATIONS.

PRINTED FOR THE

LIVERPOOL MARINE BIOLOGY COMMITTEE,
UNIVERSITY COLLEGE, LIVERPOOL;

BY

THOMAS DOBB & CO.,
LIVERPOOL.

1895.

"The Scandinavians in our race still hear in every age the murmurs of their mother, the Ocean."—

Emerson.

Contents.

INTRODUCTION.

At the close of a third triennial period this Fourth Volume of Collected Reports upon the Fauna of Liverpool Bay and the Irish Sea is now ready to be issued. As in the case of the preceding volumes all the papers now bound together as Vol. IV. have been read at some period* during the last three years before the Liverpool Biological Society; and the L.M.B.C. have to thank the Council of that Society for the permission to print off extra sheets of those papers in the "Transactions" which deal with the Local Marine Fauna.

This present volume practically brings the account of the work of the Committee up to the end of the tenth year; the Committee was formed in 1885, the first volume of the "Fauna" was issued in 1886, Vol. II. in 1889, Vol. III. in 1892, and this fourth volume now appears in the Autumn of 1895. The previous volume closed the account of the work done in connection with the Biological Station on Puffin Island. The present one commences the record—which it is hoped may be a long one—of the investigations carried on at the Committee's new Station, at Port Erin, in the Isle of Man. This Biological Station was formally declared open for scientific work by His Excellency Spencer Walpole, LL.D., then Governor of the Island, on June 4th, 1892; and since then—as the reports in this volume show—the laboratory has been frequently used by students, and has proved to be quite as favourably situated and quite as well adapted for fostering the scientific investigation of the neighbouring sea as was anticipated by the Committee when they chose the spot

* In all cases the original dates of communication are affixed to the papers.

and planned the building. The increased size of the present volume may be taken as some measure of the increased, and always increasing, facilities for work afforded by the Port Erin Biological Station.

It ought to be noticed that although the primary objects of the Committee were originally faunistic and speciographic, yet observations on habits and life-histories, and bionomics in general, have not been neglected; and now some of our papers, such as Mr. Chadwick's on the Vascular Systems of the Starfishes, and Mr. Clubb's on the Cerata of Nudibranchs, are coming to deal with purely structural and morphological questions.

The other Reports in this volume deal, some of them—such as Mr. Gamble's on Turbellaria, Mr. Beaumont's on Nemertea, and Mr. Browne's on Medusæ—with fresh groups of animals which had not been adequately discussed in the previous volumes; while others, such as Mr. Thompson's and Mr. Walker's reports, are welcome revisions of these authors' own previous work on the Crustacea. Dr. Hanitsch has furnished us with a paper on the Classification and Nomenclature of British Sponges, which it may be said does not come strictly within the scope of the L.M.B.C. Reports. Still the subject matter is of such importance to anyone working systematically at our sponge fauna, and the treatment seems so well adapted to render the lists an indispensable working addition to Bowerbank's Monograph, that I had no hesitation in asking Dr. Hanitsch to allow the paper to be included in our series of reports upon the Fauna of Liverpool Bay.

There is no need to dwell upon the large number of species now recorded, and the additions that have been made by our explorations both to the British fauna and to science; such results, though very necessary, are no longer the sole, perhaps not even the chief objects which the

Committee have in view. I think all who are engaged in this work feel that it is growing steadily under their hands in every direction. Not only are there many animals and whole groups of animals in our sea still awaiting examination and record, but there are many points of view, the speciographic, distributional, anatomical, physiological, embryological, bionomical and others, from which even the best known forms would well repay further and more detailed investigation; and wider problems such as the association of animals together on particular sea-bottoms and at particular depths, and other questions of bionomics and of oceanography—some of them having important bearings upon Geology and upon Fishery questions—are now opening up before us and pressing for solution.

We are a small body, the Naturalists of Liverpool, our laboratory at Port Erin is a modest establishment with but scanty equipment, we have no State, County or Municipal subsidies, and our available funds (private subscriptions) are barely sufficient for the necessary expenses of steamers and apparatus in our explorations, and for the publication of our results; but fortunately there is no lack of work for us to do, work which is interesting in the doing, and work which, if we seek it earnestly and do it honestly, we cannot but believe will be of value to science, and may, through its connection with the fishing industries, be of direct benefit to mankind.

W. A. Herdman.

University College,
Liverpool; October, 1895.

"Geology and Zoology will gain much by inquiring how our marine animals are associated together."—

Edward Forbes.

[From Trans. Biol. Soc. L'pool. Vol. VII.]

SIXTH ANNUAL REPORT of the LIVERPOOL MARINE BIOLOGY COMMITTEE, and their BIOLOGICAL STATION at PORT ERIN.

By W. A. Herdman, D.Sc., F.R.S.

DERBY PROFESSOR OF NATURAL HISTORY IN UNIVERSITY COLLEGE, LIVERPOOL; CHAIRMAN OF THE LIVERPOOL MARINE BIOLOGY COMMITTEE, AND DIRECTOR OF THE PORT ERIN STATION.

[Read 9th December, 1892.]

Introduction.

As this, although a continuation of the series of Annual Reports dealing largely with the Biological Station on Puffin Island, is also in a sense the opening of a new record, it may help some of those whose sympathy we wish to enlist in the new locality where we have come to work if a brief explanation is given of the object of the Liverpool Marine Biology Committee and of the reason why they have a Station at the Isle of Man.

Biology is the science of living things, and deals with all plants and all animals including man. Used in its proper wide sense Biology includes not only Botany and Zoology, or Natural History, but also Embryology, Palæontology, Anatomy, Physiology and Anthropology. Marine Biology deals with the development, life-history, structure, actions, and relationships of the animals and plants which live in the sea, and also with any general theoretical questions upon which these animals and plants throw any light.

Some of the reasons why marine biology is a favourite subject of investigation, and is so often spoken of apart from other biological studies, are, that animals are much more numerous and more varied in the sea, and especially round the coasts, than upon land or in fresh waters, and represent a larger number of the more important groups;

moreover these marine forms have given rise in the past to the land and fresh water animals, and also to those of the deep sea—they are the parent community from which migrating swarms have been given off; it is amongst these marine animals round coasts that there has been the greatest over-crowding and the most severe struggle for existence, and it is there probably that, under the stress of competition, important new habits and structures have been evolved and modified. Many of the great biological discoveries and generalizations have been made from the study of marine animals, and many of the problems which still await solution, some of them theoretical questions of the greatest general interest, will probably have to be worked out in the abundant and varied material which presents itself to the marine biologist. Then again the sea is so large, and so comparatively unknown that there is much more chance of coming upon interesting new forms of life there than elsewhere. Finally it should not be forgotten that we are a maritime nation, that we most of us take kindly to the sea, and that we naturally regard it as a duty to thoroughly explore our coast lines, to examine the sea bottom lying off our shores and make known the conditions of existence and the various kinds of plants and animals living within the British Area. Probably these reasons sufficiently account for marine biology having flourished for the last century in this country and for the fact that there have always been amongst British Naturalists, enthusiastic investigators of the sea bottom by means of the dredge and the trawl.

I shall merely add that although Aristotle collected marine animals on the shores of Asia Minor more than 2000 years ago, and it is over a century since the Danish Naturalist O. F. Müller invented a dredge for scientific purposes, while our own Edward Forbes, most closely associated by birth, training, and in his after work with the Isle of Man, started his pioneer explorations round our coasts quite sixty years ago, yet there is still abundance of work left—an apparently inexhaustible field lies before the skilled observer. In all groups of marine animals investigations of all kinds, faunistic, anatomical, embryological, are urgently needed. Even in the collecting and naming of specimens from our most frequented hunting grounds much remains to be done. To take a recent instance as an example:—a couple of weeks ago when Mr. Thompson and I went for a day's dredging to Port Erin, as we were approaching land we took two last hauls of the small mud dredge close to the shore, the one within a few yards of the biological station the other just along the base of the breakwater, and the contents of the net when examined yielded numerous interesting Cumacea, Amphipoda and Copepoda, three of which latter (*Stenhelia denticulata*, *Laophonte spinosa* and *Ameira attenuata*) are new to science, while several others are rare and interesting forms.

So much for the general question of marine investigation: Biological Stations are a comparatively recent development which were unknown to the older naturalists. Any plan by which actual work on or close to the sea, so that the animals may be examined alive and in their natural surroundings, can be combined with the conveniences and exact methods of a laboratory is obviously a great advantage, and that is precisely what a biological station offers. It is a sea-side laboratory where the observer can conveniently apply the refinements of modern apparatus and re-agents to the work of the field-naturalist. Different Stations may specialize in various directions, but an institution like our Biological Station at Port Erin has I consider at least two important functions which it can perform :—(1) It can supply material and afford opportunities for their investigations to the Committee and to other specialists and so be a means of adding to knowledge, and (2) it will enable advanced science students and young graduates from our Colleges to become acquainted with marine animals in the living state, and in various stages of development, and will stimulate them to, and give them opportunities of commencing, research work.

The Liverpool Marine Biology Committee was instituted in 1885 for the purpose of investigating scientifically the Fauna and Flora of Liverpool Bay and the neighbouring parts of the Irish Sea, an area usually referred to for

Fig. 1. Map of the L.M.B.C. District. H, Hilbre Id., P, Puffin Id., E, Port Erin.

short as the L.M.B.C. district. The Committee established a small biological station on Puffin Island off the North coast of Anglesey, in 1887; and for the last five years this station has been kept up, and constant dredging and other exploring expeditions have been carried on, as the result of which three illustrated volumes of reports have already been published ("Fauna of Liverpool Bay," vols. I—III.). The Puffin Island establishment has been very useful to the Committee, and well worth the small annual expenditure required for its modest outfit. It has been used by some students of the local Colleges who wished to gain a general knowledge of the common marine animals and plants in a living state, and by a considerable number of specialists who went there to make observations, or who had the material for their investigations collected there and sent to them.

It has been felt however by the Committee for some time that a station which was more readily accessible from Liverpool, and with hotel or lodging accommodation on the spot, would enable their specialists to do more work, and be of more use to students and investigators generally. Also it was becoming evident that after five years work on the shores of the small island the greater number of

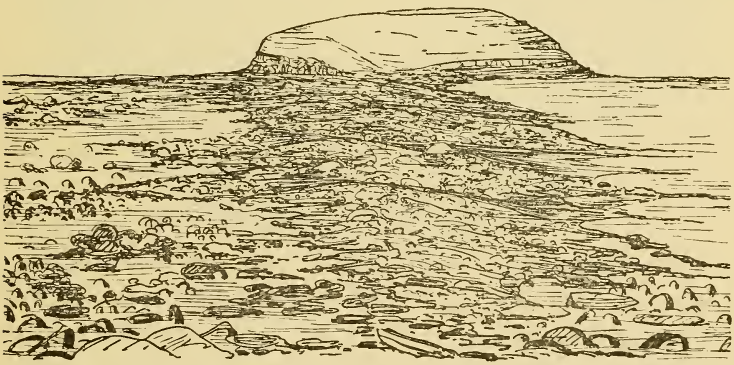


Fig. 2. Collecting ground at Puffin Island.

the plants and animals had been collected and examined, and that a change to a new locality with a rich fauna and a more extended and varied line of coast would yield increased material for faunistic work; and, consequently, in the last annual report (December, 1891) it was suggested that the time had arrived when the Biological Station then on Puffin Island might with advantage be transferred to some new and less inaccessible spot. Hoylake or West Kirby in Cheshire and Port Erin in the Isle of Man were both mentioned as suitable, and a free expression of opinion from local biologists was invited, with the result that it soon became evident to the Committee that our workers almost unanimously voted for the south end of the Isle of Man.

On communicating with the Isle of Man Natural History and Antiquarian Society through their energetic Secretary Mr. P. M. C. Kermode, of Ramsey, we were gratified to find that they welcomed our project, and passed the following resolution at their meeting on February 25th:— "On the strong recommendation of the General Committee, it was unanimously resolved that Professor Herdman be invited to establish a Marine Biological Laboratory in the island, and that this Society should afford all the assistance in its power to an undertaking which would be of so great an advantage to it and to the whole island, and would consider it an honour to co-operate with the L.M.B.C. in their excellent work" (see YN LIOAR MANNINAGH, vol. I., no. 11, p. 368.)

As it was felt to be highly desirable that the laboratory should be open and ready for work as early as possible in summer, Mr. Thompson and I went over on a mission to Port Erin and Port St. Mary early in March for the purpose of finding out what places were available at that end of the island. After examining various existing buildings at Port St. Mary, Perwick Bay, and other places, we fixed upon a most suitable site at Port Erin, and were fortunately able to arrange with the owner Mr. Thomas

Clague of the Bellevue Hotel, that a biological station of three rooms should be erected, of which the Committee would take a lease. The Committee desire to express their appreciation of the public spirit and enterprise which Mr. Clague has shown, the readiness with which he has met their views, and the trouble he has taken to see the whole work satisfactorily carried out.

Fig. 3. Stack Rock, Calf Sound, near Port Erin.

After returning to Liverpool I prepared detailed plans of the proposed biological station which, after being sanctioned by the executive of the Committee, were transmitted to the builder. The work was commenced on April 20th, and finished in every detail, including the internal fittings and varnishing of the woodwork, a couple of days before the opening on June 4th. A short description of the station and its surroundings may be appropriately placed on record here.

Port Erin and Neighbourhood.

Port Erin is at the S.W. end of the Isle of Man and occupies a fairly central position in the Irish Sea, being about 30 miles from Ireland, 33 from Scotland, 40 from Wales, and 45 or so from England. The bay faces nearly due West, and is in most winds a good natural harbour with sand at the end and bounded by precipitous cliffs both to North and South. From its position and the shape of the land, Port Erin has within a distance of a couple of miles in three directions—to Fleswick Bay, to the Calf Island, and to Port St. Mary—a long and varied coast line with a number of small bays, furnishing good collecting ground and shallow water dredging. Two of these bays, Port Erin and Port St. Mary, have harbours with sailing boats, and face in nearly opposite directions, so that in most winds one or other is sheltered and has a quiet sea.

The rich fauna around the Calf Island and off Spanish Head (see map, Pl. I.) is within easy reach; while at a distance of three to four miles from the biological station are depths of 20 to 30 fathoms, and at 14 miles 60 to 70 fathoms. Although Port Erin is a considerable distance from Liverpool, still it is reached by a regular service of swift steamers and convenient trains, so that there is no great uncertainty or delay in the journey. The 11.30 a.m. steamer from Liverpool to Douglas generally catches the 3.50 train in summer and the 5.30 in winter, arriving at Port Erin in each case an hour later.

The plan of Port Erin bay (Pl. II.) shows the position and surroundings of the Biological Station. (See also view, Pl. III.) It is on the beach at one corner of the bay, near where the sand and rocks meet, and at the foot of the cliff upon which the Bellevue Hotel stands. It is connected with the highroad by means of a broad zig-zag gravel walk and concrete steps, and is only about one third of a mile from the railway station. It is just at the bottom of the hotel grounds, and arrangements have been made with Mr. Clague by which those working at the Biological Station can live comfortably and economically at a fixed tariff at the hotel.

Fig. 4. Liverpool Marine Biological Station at Port Erin.

The sea comes to within a few yards of the windows of the Station, and the bay immediately in front is sheltered, pure sea water with a varied bottom suitable for small boat dredging and tow-netting; while the rocky coast, extending out towards Bradda Head, has many creeks and good shore pools containing an abundant stock of interesting animals belonging to various invertebrate groups.

The Biological Station is a substantially built, three roomed house, measuring a little over 30 feet by 20 feet, and standing on a solid stone and concrete platform, which raises it about 10 feet above high tide. It has windows looking out in three directions, north, south, and west. The front door (see Pl. IV.) leads into a short passage from which open to right and left two small rooms (6 and 7) which are used as the Director's room and library and the Secretary's office, and will also be available for the use of any members of the committee or any special investigators who from the nature of their work require a separate room where they can have privacy and can set up delicate apparatus or leave their specimens in safety. The secretary's office is also now being made light-tight, and fitted with screens to the window so that it can be used as a photographic dark room.

Opposite the entrance is the door into the main laboratory, which measures about 22 ft. by 20 ft., and has windows on both sides. In front of the windows run strong fixed work-tables which will accommodate half a dozen students with ease, ten at a pinch. So the greatest number who can work in the station at one time when crowded is a dozen, while half a dozen fill it comfortably. At the two ends of the main laboratory are fire-place, sink, tables, closed cupboard, and abundance of shelving; while along the centre of the room runs a strong table for small aquaria, and vessels containing animals. A door in one corner opens into a useful small yard between the house and the cliff, in which the concrete fresh water cistern supplying the laboratory sink is placed, and where dredges and other implements can be stored.

The Committee purposely did not arrange for any larger fixed aquaria or tanks in the laboratory as they desired to have the experience of a summer's work before deciding whether any such were necessary, and if so where they should be placed. It is now generally agreed that the station is so near to the sea, and pure water is so easily obtained when required, that it does not seem worth while to introduce pipes and a pump; while all the space in the laboratory is so useful that we can ill afford to occupy any of it with fixed tanks. There is, however, a small plot of ground alongside, on the western side of the steps leading to the beach, and just opposite the front door of the station, which might be used for the erection of a small aquarium and tank house. There is also, on the beach close to, a large rock pool placed in such a position between two reefs and the shore above that by the erection of three comparatively small concrete walls of no great height, and lying in a sheltered position, a pool having a length of about 40 feet and a breadth of from 12 to 18 feet and about 6 feet deep in the centre could readily be formed (see Pl. V.). Such a pool as this, into which the sea could be admitted or not as required at each tide through a sluice in one of the walls, would be of great service for keeping larger animals in, and might be made use of for spawning fish if the Lancashire Sea-Fisheries Committee decide to establish a small fish-hatchery alongside our biological station.

The Inauguration of the Station.

Towards the end of May when the building was nearly completed, it was decided by the Committee that it was due as well to their supporters in Liverpool as to the inhabitants of the Isle of Man, amongst whom they were going to work, that the institution should be formally inaugurated. His Excellency the Lieutenant-Governor was approached on the matter, and he kindly consented to open the biological station on Saturday, June 4th, while the Lord Bishop, the Manx Attorney General, and a number of members of the House of Keys and other representative men in the Island were good enough to promise to attend the ceremony and take part in the luncheon at the Bellevue Hotel which was to follow. A circular drawing attention to the completion of the station and giving an outline of the proposed arrangements at the opening was issued privately to naturalists and their friends in the neighbourhood, and as a response a party of over 30, consisting of members of the committee, a few other scientific men, and some of the subscribers to the funds, crossed over from Liverpool for the occasion.

The Liverpool Salvage Association, with their unfailing kindness, had been good enough to promise to lend their useful steamer the "Hyæna" for four or five days at that time, but as she was called off on duty at the last moment, they sent instead the steamer "Mallard" (under the command of Captain Batchelor of the Salvage Association), on the Friday afternoon, across to Port Erin, where she remained till Monday. Dredging trips in the neighbourhood took place on three of the days, and on the Saturday evening tow-netting with

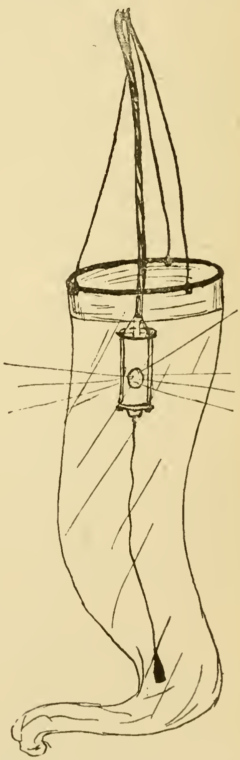


Fig. 5. Submarine electric light in tow-net.

submarine electric lights was carried on after dark in the bay.

Most of the Liverpool party arrived at Port Erin on the Friday afternoon for the purpose of completing the preparations for the opening, such as hanging diagrams and charts on the walls of the laboratory and unpacking the vessels and instruments. During the following forenoon all were busily engaged in collecting specimens. A party went out dredging towards the Calf Island in the "Mallard," others worked from a small boat in the bay, while others searched the shore pools in the immediate neighbourhood. The specimens were brought alive to the laboratory and arranged in the aquaria and dishes and under microscopes in order that the visitors in the afternoon might see the place as far as possible in working order and gain an intelligent idea of the objects and methods of marine biological investigation. The following account of the more public functions of the day, the opening ceremony and the luncheon, is extracted, with some abbreviation, from the daily papers.*

"His Excellency the Lieutenant-Governor, Spencer Walpole, Esq., LL.D., and the Lord Bishop of Sodor and Man, Dr. Straton, were met at the Port Erin Railway Station shortly before 1 o'clock by the following members of the L.M.B.C., Prof. Herdman (Director), Mr. I. C. Thompson (Hon. Sec.), Sir James Poole, Mr. J. Vicars (Mayor of Bootle), Mr. A. O. Walker, Mr. A. Leicester, Mr. R. J. Harvey Gibson, and a number of other naturalists including Mr. A. W. Moore, President, and Mr. P. M. C. Kermode, Secretary of the Isle of Man Natural History and Antiquarian Society. The Governor was accompanied by Miss Walpole; and Sir James Gell, Mr. J. S. Gell, Dr. Walters, and a number of other gentlemen and ladies from various parts of the island soon joined the party which then proceeded to the Bellevue Hotel, the road to which and down to the Biological Station on the shore was lined with flags and other decorations.

The little station at the foot of the cliff was soon reached, and on the

* See "Isle of Man Times," &c., for June 11th, Liverpool "Daily Post" and "Mercury" for June 6th, and "Nature" for June 16th, 1892.

permanent platform outside the laboratory there assembled a considerable company. In addition to his Excellency, the Bishop, Professor Herdman, and Mr. Thompson, the company included Sir James Poole (ex-Mayor of Liverpool), the Mayor of Bootle, Professor Weiss (Manchester), Professor Denny (Sheffield), Messrs. A. O. Walker (Colwyn Bay), P. F. Kendall (Manchester), Arnold Watson, R. Ascroft, N. Caine, R. J. Harvey Gibson, J. Lomas, A. Leicester (Liverpool), the Attorney-General of the Island (Sir James Gell), Mr. James Gell (High Bailiff, Castletown), the Rev. F. B. Walters (principal of King William's College), Dr. Clague (surgeon to his Excellency's household), the Revs. E. Ferrier, M.A., A. Newton, B. Brown, C. H. Leece, H. T. E. Barlow (principal of the Bishop Wilson Theological School, Bishop's Court), and A. Kermode (vicar of Onchan), Messrs. W. A. Stevenson, H.K., W. Quine, H.K., W. B. Stevenson, A. W. Moore, H.K., P. M. C. Kermode, (secretary of the Isle of Man Natural History and Antiquarian Society), F. Gaskell (Liverpool), A. R. Dwerryhouse, A. F. Dumergue, M. Lamart, W. S. Henderson, S. R. Christopher, Capt. Nowell, R. Garside, W. Shimmin, C. T. C. Callow, Capt. Batchelor, H. Williams, R. Craig, W. R. Wareing. J. Coventry, Dr. Hanitsch, Dr. Ellis, Professor Stevenson, G. H. Quayle, J. C. Crellin, H.K., H. Kelly, J. Clague, C. Squires, T. Clague, T. Costain, E. Allen, J. McArd, R. Moore, W. Davidson, Aylmer Ogden, &c., &c., and a number of ladies.

Professor Herdman then. on behalf of the L.M.B.C., addressed the Governor, and having made brief reference to the object of their biological investigations, asked him to accept the volumes already published on the "Fauna and Flora of Liverpool Bay," and having also presented His Excellency and the Bishop, each with a specially bound copy of the collected annual reports upon the former station at Puffin Island, requested the Governor to declare the station open for scientific work.

The GOVERNOR said :—Professor Herdman, my lord, ladies, and gentlemen, —I have, in the first instance, to express to you, sir, and to your Committee, my thanks for presenting me with these volumes, the contents of which I am sure I shall read with interest and advantage ; they will remind us, at any rate, that you, who have come here to-day, have done much to promote that cause of biological science to which this station is to be devoted. In your station at Puffin Island, on the coast of Anglesey, as I know from reading your reports, you have done much to illustrate this science. You have moved now from the Mona of Tacitus to the Mona of Cæsar—(hear, hear, and applause,)—and having exhausted, as I believe you have done, the fauna of the Menai Straits, you have come to this Island, where the population has for centuries had a deep stake in the harvest of the sea, and where I believe you will find that our fauna is enriched by those warm currents that find their way hither from the vast Atlantic Ocean. Some of you may possibly imagine that work of this character is only of minor importance—that it is not a great matter to make some addition to the long catalogue of our Algæ, or to add a new variety to our lists, of the Annelids; but then I may remind you that most of the great inventions and discoveries of the world have been almost accidentally found by men, like yourselves, labouring only in the cause of truth, and that every advance in our knowledge adds to the power of mankind, and raises him a little higher from the brute, a little nearer towards the angel. It is, then, both our duty and our interest to welcome—as on behalf of the people of this Island I do venture to welcome—you here who are working in the cause of truth, and I may say that whatever may be your own labours, or whatever revelations you may have in store for us, we may be at least certain that as a result of your discoveries truth will prevail; for it is as true now as it was in the days of Darius—if I may quote one of the noblest passages in the realm of literature, which has unfortunately been excluded from our Bibles—that truth is strongest. "As for the truth, it endureth and is always strong, it liveth and conquereth for evermore." (Hear, hear). I have great pleasure in declaring this biological station open. (Loud applause).

The Governor then opened the door of the building, and the party entered and made a minute inspection of the premises, and its biological treasures and apparatus, and after recording their names in the visitors' book, an adjournment was made to the Bellevue Hotel, for luncheon, which was served up in excellent style by Mr. Clague. Professor Herdman presided, and was supported right and left by his Excellency and the Bishop Mr. Thompson was the chairman *vis-a-vis*. The Menu was as follows :—

SYSTEMA EPULARUM.

"Infusio" (sive Jūs)—Cauda bovina.

Pisces—Gadus morrhua (Ostrea edulis).

Aves—Gallus bankivus, var. domest. (tost.—decoq.)

Mammalia—Bos taurus, var. monensis.

Ovis aries (Capparis spinosa)

Do., juv.

Crustacea—Homarus vulgaris (Lactuca scariola, var.)

Amorphozoa—Puddings, Custards.

Plantæ—Fruit-tarts.

Incertæ sedis—Jellies, Blancmange.

Varia—Desert, Nicotiana tabacum, Caffea Arabica.

The toast list was as follows:—"The Queen," proposed by the chairman, (Professor Herdman); "His Excellency the Lieutenant-Governor," proposed by the chairman, responded to by His Excellency; "The Lord Bishop of Sodor and Man," proposed by Sir James Poole, responded to by the Bishop; "The Legislature of the Isle of Man," proposed by Mr. A. O. Walker, J.P., responded to by Mr. W. A. Stevenson, H.K.; "The Isle of Man Natural

History and Antiquarian Society," proposed by the Mayor of Bootle, responded to by Mr. A. W. Moore, president, and Mr. P. M. C. Kermode, hon. secretary; "The Liverpool Marine-Biology Committee," proposed by the Lieutenant-Governor, responded to by Professor Herdman, chairman, and Mr. Thompson, hon. sec.; "The Manx Fisheries." proposed by Mr. R. L. Ascroft, of the Lancashire Sea-fisheries, responded to by Mr. R. Garside; "The Liverpool Salvage Association and other Visitors," proposed by Mr. R. J. Harvey Gibson, responded to by Captain Batchelor, and Professor Weiss.

In proposing the health of the Lieutenant-Governor, Professor Herdman pointed out that they welcomed and honoured his Excellency, not only as the representative of the Queen in the island, but also as a biologist, and alluded to Mr. Spencer Walpole's former connection with Huxley and Buckland, as one of H. M. Inspectors of Fisheries. He considered it a particularly happy conjunction of circumstances, that they should have happened to establish that marine biological station on a spot which had been rendered classic ground by the labours of that pioneer of British Marine Biology, Professor Edward Forbes, at a time when by rare good fortune the governor of the island is himself a biologist, (applause). It was exactly sixty years since Forbes, then a student at Edinburgh University, returned in summer to his home in the Isle of Man to commence his work on British Marine Biology (applause). He hoped the coincidence was a happy augury, and that as Edward Forbes had started marine investigation on this spot just 60 years ago, so that day Spencer Walpole had opened an institution which would do much to advance the study of marine biology in the Isle of Man.

His Excellency said :—Mr. Chairman, my lord, and gentlemen, I assure you, sir, I thank you very heartily for the much too flattering terms in which you have commended my name to this gathering, and I thank you all very heartily for the kindly way in which you have received it. I believe that it is a function of the Governor of the Isle of Man to be, in some respects, a "Jack of all trades," and I hope sometimes that it is not consequent upon that function that he should be "master of none." (Laughter). You have rightly reminded me that I have had in former days to deal with other subjects connected with your own, and I still continue to take a deep interest in them; but if I were at all disposed to be puffed up by the kindness of your greeting to day, perhaps I should find the best antidote to any feelings of pride in pondering over those specimens which we have lately been examining in your laboratory, for, I suppose that in the presence of biologists I may assume that they are the nearest living representatives of our own immediate ancestors (laughter), and I sometimes think that though we hear nowadays that we are living in the best of all possible times, yet a good deal is to be said in favour of that simple and primitive form of existence which those specimens remind us is still surviving in the sea. (Hear, hear, and laughter). I am quite sure in those days, for example, that the art of government was a good deal simpler, whilst the Socialists of that time had established a perfect Communism ; and though they had no ideas of property, they were free from all those difficulties to which property unfortunately gives rise. (Laughter and applause). They must, nevertheless, have succeeded in establishing a fixity of tenure. (Renewed laughter and applause). Perhaps, in view of the heated atmosphere of this room, it might also have been some satisfaction to reflect, that in those days there were not the ordeals of public luncheons, or, at any rate, if there were public luncheons, the fare was a good deal more frugal, and a good deal more wholesome than that which we have partaken of to-day. (Laughter and applause). In fact, Mr. Chairman, I have often thought myself that there was a great deal to be said for that view which Miss Kendall has so admirably expressed in "The Lay of the Trilobite." I should think that every biologist ought to be acquainted with that poem. One of the inferior members of the human family was walking across a mountain, I may remind you, when he came upon an ancient Trilobite, upon his rocky bed, and the Trilobite, if I may quote the lines, addressed him in some such words as these. He reminded him

"How all your faiths are ghosts and dreams, how in the silent sea
Your ancestors were monotremes, whatever these may be.
You've politics to make you fight, and utter exclamations ;
You've cannon, too, and dynamite, to civilise the nations.
The side that makes the loudest din is surest to be right ;
And Oh ! a pretty fix you're in, remarked the Trilobite."*

And if you recollect, the man, being somewhat of a philosopher, takes off his hat to the Trilobite and walks away, and as he goes away, utters some such words as these :—

"I wish our brains were not so good, I wish our skulls were thicker,
I wish that Evolution could have stopped a little quicker ;
For, Oh ! it was a happy plight, of liberty and ease,
To be a simple Trilobite in the Silurian seas." (Loud applause).

Sir James Poole gave "The health of the Bishop of Sodor and Man," and the Bishop, in reply, said in the course of an interesting speech, that the scientist and the theologian should go hand in hand (applause.) He welcomed the Biological Committee to the island, in the name of religion, and of the Church of England, and he hoped that ere long he would have the pleasure of welcoming the Members to Bishop's Court, as he now welcomed the cause they represented.

Mr. A. O. Walker, J.P., proposed "The Legislature of the Isle of Man," which was responded to by Mr. W. A. Stevenson, H.K.

* "Dreams to Sell," by May Kendall ; London, 1887, p. 8, slightly altered.

The Mayor of Bootle, (Mr. J. Vicars,) proposed "The Isle of Man Natural History and Antiquarian Society," Mr. A. W. Moore, President, and Mr. Kermode, Secretary, acknowledged the toast. The former expressed the hope that the investigations of the biologists might result in bringing back the herring, which had deserted the island.

His Excellency, in giving "Success to the Liverpool Marine Biology Committee," said : I have ventured once to-day, already, to say something as to the virtue of research for truth for truth's sake, but I do not know that such research need hinder you also from research into those practical objects with which the inhabitants of the Isle of Man and of the whole British Islands are so closely identified. Mr. Moore has alluded to the disappearance of the herring from these shores. I think that was an exaggerated form of words. I ate one of them for breakfast this morning. (Laughter). But there is no subject to which Marine Biologists could better devote themselves than to trace the causes which govern the migration of the herrings, considering how those migrations do govern the prosperity of the fishermen. (Hear, hear.) I need hardly remind you that there is no fish which produces so much wealth to the United Kingdom as the herring, while in this Island the herring assumes an absolutely national importance. We have towns in this Island built out of the profits of the herring fishery. We have large numbers of the population dependent on the herring fishery ; and so strong is the connection between the herring and the Island, that actually to this day, when we swear in a new judge, we always require him to administer justice as evenly as the backbone of the herring lies in the fish—(laughter)—a symbol which I may say parenthetically, was, I imagine, drawn by a fisherman and not by a scientist, because there is some little doubt about whether the backbone does lie evenly in the body of the herring. (Laughter and applause).

Now there is this that is remarkable about the herring. If you go to any portion of the United Kingdom, or this Island, you will always hear come plaints that the herring are disappearing, and if you examine any statistics connected with the herring fishery, you will find that taking ten years by ten years, the prodigious capture of the herring has gone on steadily increasing. (Laughter). Facts, therefore, are rather opposed to theory in this case, and in fact I know of nothing more instructive than to open the herring, or when you are munching the hard roe, to try and count the number of eggs. (laughter). I think for one when you have failed in that attempt, as you will fail, you will find a new proof that the old fiat is as true as when it was first pronounced, "let the waters bring forth abundantly the many creatures that have life." But if it is not true that the herring is decreasing, it is true that there are variations in the migration of the herring, which are seriously affecting the fishermen. (Hear, hear). If you ask the fishermen, you will gather the most fanciful reasons for these migrations. I recollect once being seriously told by a fisherman, who complained that the herring had disappeared from a portion of the coast, that we should find the reason for its disappearance in—I think it is the third verse of the fourth chapter of Hosea. (Laughter). I thought that man at any rate, in an age of doubt, had the capacity of belief. (Renewed laughter). But there is no subject to which I could better draw your practical attention than to expound to us the reasons for the migration of the herring, and to point out to the fishermen the conditions, whether of temperature, of weather, or of food with which they should be acquainted, and which should direct them where to go to reap that great harvest of the sea, which, depend upon it, is supplied us as bountifully now as ever. In directing this subject to your notice, I feel that I am leaving it in worthy hands, and that the researches that Professor Herdman and you have made in the past, afford confident assurance of what you may do in the future. (Applause). In coupling this toast with Professor Herdman's name, I hope you will allow me to congratulate him upon the notice which I read in the *Times* of yesterday, that the Royal Society has admitted him into that charmed circle which has so many attractions for men of science. (Loud applause). Without more words, for trains wait for no man, after a certain time, even in the Isle of Man (laughter) I give you the "Liverpool Marine Biology Committee," coupled with the names of Professor Herdman, and Mr. Thompson.

Professor Herdman, in reply to the toast, said : Your Excellency, my Lord Bishop, and Gentlemen,—As Chairman of the Liverpool Marine Biology Committee, whose success and continued prosperity you have so kindly toasted, I beg to thank your Excellency, and you all, gentlemen, for your kind words and your good wishes, and to tell you how grateful we are, as a Committee, for the honour you have done us, and for this inspiriting encouragement, and how we hope by our work in the future, to show that we have profited by your support to-day, and have been stirred up to fresh efforts by your appreciation of our work in the past (applause).

It is now just seven years since this committee was established. It originated in a meeting in March, 1885, held in University College, Liverpool, at which were present the representatives of the colleges, museums, and scientific societies of several neighbouring towns. I pointed out on that occasion how much good work might be done by a number of specialists working together at marine biology, and laid before the meeting the proposal that we should form ourselves into a committee for the purpose of investigating thoroughly the fauna and flora of the neighbouring seas. As the sea shores in the neighbourhood of Liverpool are unfortunately not so prolific of life and interesting to the naturalist, as your beautiful coast here, most of our work during the past six years, has had to be done from steamboats on dredging expeditions. Fortunately, we have had the sympathy and welcome support of some of the

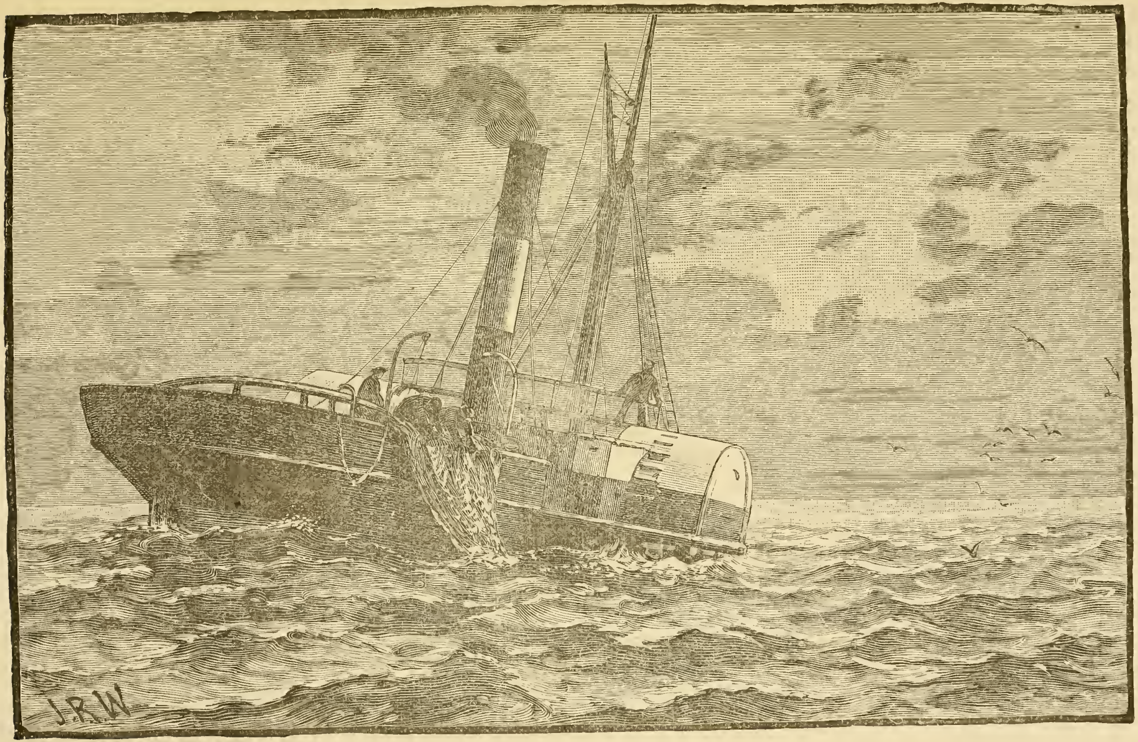


Fig. 6. Dredging from a steam tug in Liverpool Bay.

Liverpool Merchants and Ship-owners, who have kindly helped us by providing on various occasions, steam-tugs for our dredging trips. We have more than once been favoured in this way by our good friend Sir James Poole, whom we are delighted to have again with us to-day. (Applause).

We have also been aided most materially in our movement by the Liverpool Salvage Association, who have lent us in successive years at this time their useful and sturdy old gunboat the "Hyæna," whose graceful form you have seen more than once in Port Erin Bay (applause). I do not know whether you are all aware what a celebrated craft she is. Do you know that she was built for the Crimea, nearly forty years ago, along with a batch—perhaps one ought to call them a "litter,"—of other mammalia, the "Porcupine," the "Jackal," and others? Do you know that she was General Gordon's own gunboat during the war in China, when he pursued the rebels up the shallow rivers, and ran the "Hyæna" ashore on the mud banks in order to blow up their forts? And now, in her peaceful old age, she is lent by her present owners to certain enthusiastic biologists, who haul in dredges and other strange instruments over her low rounded stern, and send her electric lights in nets down to the bottom of the sea, for the purpose of capturing new and rare animals, and they succeed too, for is not one of their interesting new animals named *Jonesiella Hyænæ*, in honour of the old gunboat?

As a result of our successive expeditions in the Hyæna, and in other ways, our Committee has been enabled to achieve a very considerable measure of success. We have published a number of lengthy reports upon the various groups of animals in our district, and, lastly, we have established and kept up for five years, a small marine biology station on Puffin Island. The Puffin Island establishment has been of very great service to us, but during the last year or so we have, I think, all felt that the time had arrived when it would be an advantage to move our centre of operations to some less inaccessible spot in a new part of the area. Naturally our choice was determined by the rich marine fauna round this southern end of the Isle of Man, and that brings us down to the present time, and to the little laboratory which has been opened for work to-day. I must not conclude, however, without referring gratefully on the part of the committee to our host of the Bellevue, our landlord of the biological station, Mr. Clague, for his helpful assistance and energetic support. Remember it was only on March 6th, that Mr. Thompson and I came over here to inspect and to decide whether Port Erin, Port St. Mary, or Castletown would be best suited for our purposes. We were happily directed to Mr. Clague, and it is mainly due to his energetic action that the station has been so speedily completed (Applause). I thank you all, on behalf of the Committee, for your kind wishes, and for the support you are giving us in our work. (Applause).

Mr. I. C. Thompson said—The biological aspect of the work of the

Liverpool Marine Biology Committee has been so well put before us by Professor Herdman that I need only appear before you as that obnoxious individual, the practical man, and make a few remarks as to our proposed arrangements for workers at the laboratory rather in the way of the *argumentum ad pocketum.* Hitherto the work of the committee has been mainly supported by subscriptions and donations from our philanthropic friends interested in the work done, but not themselves actual workers, and we trust for an increased continuance of this most valued source of income. But we anticipate that the beautiful and very accessible Marine Laboratory to-day opened by his Excellency will attract a large number of working naturalists and students both belonging to the Isle of Man and from various parts of England who may frequently come for a few days or weeks at a time. It is proposed that all such should have the use of the station as workers for a payment of 10s. per week, and it is further proposed that all annual subscribers of one guinea and upwards shall have free access to the station and the use of a working table at any time provided it be unoccupied—a record of all work done being kept.

A month ago I visited the palatial marine station at Naples, and there saw English and foreign students at work. Now, there is no doubt a great advantage in studying the marine fauna of other districts, and a visit to Naples will repay any one ; but we happily know that Mona's Isle offers most unusual advantages for this work as was amply shown by Edward Forbes, and later by the work of our own committee, and I doubt if anywhere in the United Kingdom we can now find a richer hunting ground, or a laboratory with such beautiful surroundings as at the Port Erin Biological Station. I sincerely thank your Excellency, and you gentlemen, for the hearty way in which you have proposed and honoured this toast, and I trust that we may have many other happy reunions between our Manx and English naturalists. (Applause).

The toast of "the Manx Fisheries" was proposed by Mr. R. L. Ascroft, of the Lancashire Sea Fisheries Committee, and responded to by Mr. R. Garside who gave some interesting details in regard to the Isle of Man Fisheries and the Manx fishing fleet now working off the south coast of Ireland. "The Liverpool Salvage Association and other Visitors" was proposed by Mr. R. J. Harvey Gibson, and responded to by Captain Batchelor of the Salvage Association and by Professor Weiss of Owens College, Manchester.

The proceedings throughout were of a very inspiriting nature, and in the evening the party went on board the "Mallard" for a dredging expedition in the bay, when tow-netting, both surface and bottom was conducted by means of the electric light."

Dredging Expeditions.

On June 5th the whole day was spent in dredging and tow-netting from the "Mallard" (under the charge of Captain Batchelor of the Salvage Association) to the West and South of Port Erin, at the following localities:—

1. Three miles West of Fleswick, 20 fms., 6 hauls of the dredge; good varied ground, old shells, &c. Amongst the species obtained were:—*Halisarca dujardinii*, *Suberites domuncula*, *Clathria seriata*, *Aplysilla* (?) *sulphurea* (*green*), *Sarcodictyon catenata*, *Sertularella tenella*,* *Diphasia pinaster*,* *Cellaria fistulosa*, *Carinella linearis*, *Palmipes membranaceus*, *Porania pulvillus*, *Stichaster roseus*, *Balanus porcatus*, *Xantho rivulosa*, *Atelecyclus septemdentatus*, *Crania anomala*, *Pandora inæquivalvis*, *Pecten striatus*.

2. Fourteen miles West of Dalby, 60 fms., 2 hauls of dredge; bottom sticky blue clay-mud†: here were found, *Lagena hertwigiana*,* *Jaculella acuta*, *Hyperammina arborescens*, *Plumularia catharina*, *Brissus lyrifer*, *Panthalis œrstedi*,* (a representative of the rare family Acœtidæ. This addition to our local fauna has only been once before taken in British Seas, by Dr. Gwyn Jeffreys, 35 miles off the Skerries, Shetland, depth 75 fms.—as recorded by Prof. M'Intosh), thirty species of Polyzoa including *Beania mirabilis*, *Cellaria fistulosa*, *C. sinuosa*, and *Stomatopora granulata*.*

3. Eight miles West of Fleswick, 33 fms., 3 hauls of dredge; here were, *Sarcodictyon catenata*, *Aglaophenia myriophyllum*, *Diphasia pinaster*,* *Echinocyamus pusillus*,

* New to the district.

† The presence of this clay-mud in this deep depression of the Irish Sea may possibly—if it can be regarded as a glacial deposit—be considered confirmatory of the theory of glaciation of this neighbourhood held by the Glacialists' Association, according to which there was a great movement of ice through the North Channel, and downwards between Ireland and the Isle of Man to St. George's Channel, and so out to sea.

Malmgrenia castanea on *Spatangus purpureus*, *Membranipora trifolium*,* *Schizoporella simplex*,* *Melphidippa macra*, *Podocerus minutus*, *Cyproidea damnoniensis*, *Amphilochoides odontonyx*,* *Pseudocuma* sp. (probably new to science), *Balanus porcatus*, *Erythrops pygmæa*, *Atelecyclus septemdentatus*.

4. Six miles West of Port Erin, 24 fms., 2 hauls of dredge:—*Stichaster roseus*, *Amphidotus cordatus* and *A. flavescens*, *Thyone drummondii*, *Siphonostomum affinis*, Sars (which Mr. Hornell considers distinct from *S. diplochaitos*), *Crania anomala*, *Lilljeborgia pallida*, *Mæra semiserrata*, *Thia polita*, *Capulus hungaricus*, *Trochus millegranus*, *Lima hians*, *L. elliptica*, *Ascidia virginea*, *A. venosa*, *Styela grossularia*.

5. One mile West of Calf Island, 20 fms., 2 hauls of dredge:—*Schizoporella linearis*,* *Hippothoa flagellum*,* *Pecten pusio*, *P. tigrinus*, *P. varius*, *Tellina crassa*, *Solecurtus antiquatus*, *Odostomia scalaris*,* *Defrancia teres*.*

6. Off Kitterland, West end of Calf Sound, 17 fms., 1 haul of dredge; *Adamsia palliata*, *Lepton sulcatulum*,* *Cyclostrema cutlerianum*,* and *C. nitens*,* *Odostomia nitidissima*,* and *O. acicula*,* *Eulima bilineata*.*

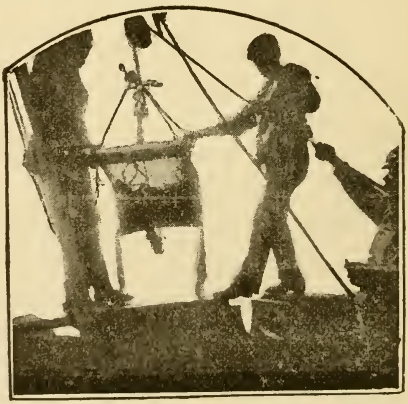


Fig. 7. Hauling in the dredge.

At each of these localities besides the ordinary large naturalists' dredge (see fig. 7), tow-nets were used, and also Mr. A. O. Walker's small dredge with a canvas bag for bringing up samples of the bottom, to be washed and sifted for small Crustacea, &c. Dr. Chaster reports to me that of the three species of Foraminifera new to the district obtained, along with many other species, from the mud at 60 fms., one, *Lagena hertwigiana*, is new to British seas.

The Zoophytes from these various hauls have been examined by Miss L. R. Thornely, who reports 38 species in all, including the following seven which are new to the district:—*Campanularia raridentata*, *Lafoëa fruticosa*, *Calycella fastigiata*, *Cuspidella grandis*, *C. costata*, *Halecium muricatum* and *Sertularella tenella*. The Polyzoa collected during this day represent 57 species, from which Miss Thornely reports three, *Hippothoa flagellum*, *Membranipora trifolium* and *Schizoporella simplex*, as being new to our district, and two, *Schizoporella linearis* and *Stomatopora granulata*, new to the Isle of Man lists.

On the following day (June 6th) on the way back to Liverpool dredging from the 'Mallard,' was conducted at the following places:—

1. Twenty miles South East from Port St. Mary, 26 fms.: good productive ground, large haul:—*Suberites domuncula*, *Spongelia fragilis*, *Lafoëa pygmæa** and *Plumularia frutescens*,* (altogether 25 species of Zoophytes, and 24 species of Polyzoa), *Cucumaria hyndmani*, *Antedon rosacea*, *Amphiura chiajii*, *Clavelina lepadiformis*, *Corella parallelogramma*.

2. Twenty-five miles South East from Port St. Mary, 23 fms., large haul:—*Cellaria fistulosa*, *Sertularia operculata*, *Antedon rosacea*, *Carinella linearis*, *Onuphis conchilega*, *Diastylis biplicata*, *Forbesella tessellata*, *Cynthia echinata*.

3. Twenty miles North West from Liverpool bar, 18 fms., poor haul.

4. Fifteen miles North West from the bar, 16 fms., poor haul.

On all these occasions besides the surface tow-nets, a bottom tow-net was attached a little way in front of the dredge, and appeared to work well; its contents were usually a good deal different from those of the surface nets.

Miss Thornely reports that the Zoophytes collected on June 6th, represent 25 species of which, one, *Plumularia frutescens*, is new to the district; while the Polyzoa represent 24 species. The detailed lists of all these collections are kept for future use, in connection with the reports on special groups, and at least one specimen of each species, is now being labelled and deposited in the "Local" Collection in the Zoological department of University College, Liverpool.

Fig. 8. A Dredging Party.
(J.V., T.C., W.A.H., W.J.S.)

After the formal Opening, work was carried on steadily at the Biological Station during the remainder of the summer till the end of September. Members of the Committee visited the station from time to time, and students of Science from London, Cambridge, Manchester, Liverpool, Aberystwyth and Edinburgh, were at work for longer or shorter periods. Mr. W. J. Waterhouse, B.Sc., acted as temporary curator for a short period; but it is the intention of the Committee, if they can obtain the services of a suitable young scientific man, to appoint early next spring, a resident Curator of the Station, who will in the absence of Members represent the Committee, will carry on observational and experimental work under the Director, collect and preserve specimens for the investigations of the specialists, and for the supply of laboratories and museums, and, so far as possible, help any of the workers, who require it, in collecting material and in their investigations. The Committee are aware that this appointment will be a considerable drain upon their slender resources, but they are convinced that the presence of a resident curator would be of such advantage to those working at the Station, that they feel it is their duty to make an effort to supply the necessary salary.

Fig. 9. A good Collecting Ground at low tide.

Station Record.

During the half-year, from the opening of the Station in June to the present month, the following naturalists have worked at the laboratory :—

DATE.	NAME.	WORK.
1892.		
June.	Mr. I. C. Thompson, F.L.S., Liverpool ...	Copepoda.
—	Mr. A. O. Walker, F.L.S., Colwyn Bay ..	Amphipoda.
—	Sir James Poole, Liverpool	General.
—	Mr. A. Leicester, Southport	Mollusca.
—	Mr. J. Vicars, Bootle, ...	General.
—	Prof. W. A. Herdman, F.R.S., U.C.L'pool...	Tunicata.
—	Mr. R. J. Harvey Gibson, F.L.S., U.C.L. ...	Algæ.
—	Dr. R. Hanitsch, Univ. Coll., Liverpool ...	Sponges.
—	Prof. E. F. Weiss, Owens Coll., M'chester ...	Algæ, &c.

—	Prof. Denny, Firth College, Sheffield	General.
—	Mr. Arnold T. Watson, Sheffield	Annelids.
—	Mr. R. L. Ascroft, Lytham	General.
	[A number of others forming the dredging party on the "Mallard" expedition of June 4th to 6th paid a passing visit to the Station.]	
—	Mr. W. J. Beaumont, Cambridge	Cœlenterata, &c.
—	Mr. W. J. Halls, Liverpool	Hydroida.
—	Mr. H. C. Chadwick, Manchester	Echinodermata.
—	Mr. I. C. Thompson, Liverpool	Copepoda.
—	Prof. W. A. Herdman, Univ. Coll., L'pool ...	Tunicata.
July.	Mr. W. J. Waterhouse, B.Sc., U.C.L'pool ...	General.
—	Mr. F. W. Gamble, B.Sc., O.C.M'chester ...	Turbellaria.
—	Mr. J. H. Salter, B.Sc., U.C., Aberystwyth ...	General.
—	Mr. W. J. Beaumont, Cambridge	Cœlenterata, &c.
—	Mr. J. Lomas, Liverpool...	Polyzoa.
—	Mr. Edw. T. Browne, B.A., U.C., London...	"Plankton."
—	Mr. W. H. Heathcote, Preston	Mollusca.
—	Mr. H. Sykes, Preston	Mollusca.
August.	Mr. B. Lal Chaudhuri, B.A., U. of Edin. ...	General.
—	Mr. W. J. Waterhouse, B.Sc., U.C., L'pool	General.
—	Mr. Rowe, Univ. Coll., Liverpool...	General.
—	Mr. J. A. Clubb, Univ. Coll., Liverpool ...	Nudibranchiata.
—	Dr. Ellis, Liverpool	General.
—	Mr. I. C. Thompson, F.L.S., Liverpool ...	Copepoda.
—	Mr. Edw. T. Browne, B.A., U.C., London...	General.
—	Mr. W. J. Beaumont, Cambridge	Cœlenterata, &c.
—	Mr. Rich. Assheton, Owens Coll., M'chester	Tow-nettings, Gnl.
September.	Mr. W. J. Halls, Liverpool	Hydroida.
—	Mr. Chopin, Manchester...	General.
—	Mr. W. J. Beaumont, Cambridge...	General.
—	Mr. B. L. Chaudhuri, Univ. of Edinburgh...	General.
—	Mr. Geo. Brook, F.L.S., Univ. of Edinburgh	General.
—	Mr. I. C. Thompson, Liverpool	Copepoda.
—	Prof. Herdman, Univ. Coll. Liverpool... ...	Tunicata.
—	Mr. A. O. Walker, Colwyn Bay	Amphipoda.
—	Mr. J. A. Clubb, Univ. Coll. Liverpool ...	Nudibranchiata.
—	Mr. P. M. C. Kermode, Ramsey	General.
October.	Mr. F. W. Gamble, Owens Coll. M'chester...	Turbellaria.
November.	Mr. I. C. Thompson, Liverpool	Copepoda.
—	Mr. P. F. J. Corbin, Univ. Coll. Liverpool...	Fishes
—	Prof. W. A. Herdman, Univ. Coll., L'pool ...	Tunicata.

This excellent list of those who have made use of the Station, and the fact that during the greater part of the summer the laboratory has been continuously occupied by workers, sufficiently justify the action of the Committee in moving the institution to such a favourable spot as Port Erin.

The Puffin Island Station.

In relinquishing the Puffin Island establishment, we are glad to think that it will be still kept up as a Biological Station. Dr. Philip White, and Prof. Reginald Phillips, and others connected with the University College of North Wales, at Bangor, have formed a Local Committee for the purpose of taking over our effects, and continuing our work; so we may congratulate ourselves that in moving to Port Erin, we have not only bettered our own position and established a new Biological Station, but we have also indirectly been the means of starting the Bangor Committee on similar work, and so have practically added one to the local centres of marine investigation.

Fig. 10. W.A.H. and R.H. on the rocks at Puffin Island.

Notes on Work done at Port Erin.

Mr. F. W. Gamble, B.Sc., Berkeley Fellow (in Zoology) of the Owens College, Manchester, worked at the laboratory during most of July, and also for a week at the beginning of October. He commenced there a systematic study of the Turbellarian Worms, collecting, preserving, and identifying the specimens. He succeeded in finding 23 marine species and 2 fresh water forms: with one exception (*Leptoplana tremellaris*) all these are new records for the district, the Turbellaria being a group which has not hitherto received adequate attention in our seas.

Mr. Gamble informs me that the most noteworthy forms in his list are:—*Stylostomum variabile*, *Cryptocelides loveni*, *Promesostoma lenticulatum* and *Plagiostoma sulphureum*; with the exception of *Stylostomum variabile*, these are all new to the British Fauna. Mr. Gamble's detailed report upon the Turbellaria of the L. M. B. C. district—which will be one of the first-fruits in the way of published scientific work from the new station—is now nearly finished. It will be laid before the Biological Society at the next meeting, and will be published in the forthcoming volume of Transactions.

Mr. W. J. Beaumont stayed for nearly four months at the Station, and besides working through a series of type animals of various invertebrate groups, he kept a number of live animals under observation, and verified for his own satisfaction points that had already been determined. In this way he reared and watched stage by stage the developing young of the small star-fish *Asterina gibbosa* which is very abundant in the "Coralline" pools at Port Erin; and at my suggestion he kept under observation for a long period living colonies of the Alcyonarian *Sarcodictyon catenata*, which is dredged not far outside the breakwater. The polypes of *Sarcodictyon* are very shy or sensitive, and have very rarely been seen in the expanded state. From Mr. Beaumont's observations there can be no doubt that it is the bright day-light that affects them. He found by visiting the laboratory at night that they were then frequently fully expanded, and also occasionally on dull mornings. Mr. Beaumont also made some observations on Lucernarians, which will form the subject of a short paper by himself, to be laid before the Biological Society at an early meeting. Mr. Beaumont reports to me that he collected two species of Lucernarians under stones on the shore, between the boat jetty and the breakwater on the south side of Port Erin harbour. The one species was *Lucernaria quadricornis*, Müller; the other he identifies as *Depastrum cyathiforme*, Sars, and of this two varieties, a light reddish brown and a dark purple, occur—both being adult.

Fig 11. The Laminarian Zone at low tide. Good Collecting Ground.

Mr. E. T. Browne, B.A., was at the Station for some weeks in July and August, and spent most of his time in studying the "plankton" or surface life. Amongst the animals he collected and identified were the following which had not been previously recorded:—*Tiara pileata* (= *Oceania episcopalis*, Forb.), *Aglaophenia tubulifera*, with Corbulæ, and *Anceus maxillaris* (found before but not recorded), male and female with eggs, inside *Sycandra compressa* on the rocks near the laboratory.

Mr. Chadwick was occupied in collecting and preserving material for his work upon the minute structure of Star-fishes, which will form the subject of a paper to be read before the Biological Society in spring.

The faunistic work of other investigators, and of some members of the Committee who were at the station, will be found referred to further on; while a few of the workers such as Mr. Chaudhuri, being students who were making use of the laboratory for their own purposes which did not include the prosecution of research, have of necessity left no record requiring publication.

Amongst some of the other noteworthy forms found at Port Erin or in the neighbourhood by workers at the station during the summer may be noted :—Foraminifera, *Astrorhiza limicola*, dredged off Port Erin, *Haliphysema tumanowiczii*, off Port St. Mary. The interesting Tubicolous Infusorian *Folliculina ampulla* is abundant in pools close to the Biological Station. Two species of Lucernarians are not uncommon, near breakwater on the south side of Port Erin bay; also *Adamsia palliata* with *Pagurus prideauxii*, and many other anemones. *Convoluta*, and various other Turbellaria, are found in shore pools close to the laboratory, and amongst sea-weeds in other parts of the bay, while various rarer forms have been dredged by Mr. Gamble, further out, *e.g.* off Bradda Head, and in Bay Fine. *Cephalothrix bioculata* is in the Coralline pools, and *Dinophilus tæniatus*, while a species of *Spadella* is found round the shore. *Antedon rosaceus*, the rosy feather star, is dredged close to Port Erin, it is usually infested with *Myzostomum*. Mr. Beaumont obtained 20 specimens of *Myzostomum* from one *Antedon*. *Porania pulvillus* and *Palmipes membranaceus* are not uncommon in the deeper water off Port Erin, and *Ocnus brunneus* has been taken. *Pleurobranchus membranaceus* is found in shore pools at Poolvaash near Port St. Mary. *Aplysia punctata* is common outside the breakwater and in Bay Fine, and also the interesting Ascidian *Corella parallelogramma*. *Doto pinnatifida* (two specimens on *Antennularia*, dredged Sept. 14th,) *Triopa claviger*, *Goniodoris castanea*, *Limapontia nigra*, *Runcina coronata*, and *Actæonia corrugata*, were all obtained ; and also the following other Mollusca, *Pandora inæquivalvis*, *Lima* *loscombii*, *Capulus hungaricus*, *Scaphander lignarius*, *Otina otis*, *Bulla hydatis*, and *Melampus bidentatus*, mostly from Bay Fine.

Molgula citrina and *Ascidia depressa* are under stones near Port St. Mary, and many species of compound Ascidians, especially Botryllids, such as *Botryllus morio*, *B. aurolineatus*, *B. violaceus*, and *Botrylloides albicans*, are common both at Port Erin and Port St. Mary.

Protective Colouring.

The common shore prawn, *Virbius varians*, found at Port Erin, and probably all round the coast, is a most marked case of protective colouring. Specimens taken from a "zostera prairie" are of the same bright green colour as the "Sea grass," to the blades of which they adhere closely, (see Pl. VI. fig. 3). Their eggs also are green. Specimens, however, which are found amongst the red sea-weeds, such as half rotten masses of *Delesseria* and *Rhodymenia* (see fig. 2), are either completely red, or red with a slight mottling of white or grey. Specimens found on a sandy bottom, or on small gravel, are mottled black, grey and white. These are all cases of simple, but very complete, protective colouration.

The specimens of *Virbius*, however, which occur upon the dark brown sea-weed *Halidrys siliquosa* present a more complicated case, as they actually mimic the chambered capsules of the Alga, both in form and colour, and also in position. The Crustacean is here of a dark brown colour, and has the habit of clinging to the stem in such a position that the body extends straight outwards in a stiff attitude (see Pl. VI. fig. 1); and the plant may be shaken to some extent without affecting the pose of the Crustacean, and its resemblance to the capsules.

These are clear cases of the Crustaceans having become adapted to suit their surroundings through the action of natural selection, but there seem to be the four following alternatives as to the present position of affairs :—

1. There may be the 4 above noted (and possibly others) colours of individuals as 4 distinct varieties, which produce young of their own colours, keep to their own special habitat, and do not inter-breed. This I think unlikely.

2. There may be no permanent varieties, but the young when they first settle down upon the sand or sea-weeds may, whatever their colour may be, have great adaptability, so that under the influence of their environment they soon assume a protective colouration. This would be a case of "direct action of the environment," partly perhaps due to food.

3. This adaptability—or marked susceptibility to the influence of environment—may possibly be retained throughout adult life, so that conceivably a green *Virbius* might migrate from the *Zostera* bed to a clump of *Halidrys*, and then change from a green to a dark brown colour.

4. Lastly, the young of all 4 colours may present great variation in tint, and then under the action of natural selection those which are not specially fitted to their surroundings in each case will be eliminated.

I am inclined myself to regard the last as the most probable explanation, but we have arranged to start some experiments and observational broods at the Biological Station which it may be hoped will throw some light upon these and other similar cases.

Other Faunistic Work.

Looking at the additions to the "Fauna" during the year:—Mr. A. O. Walker records amongst Amphipoda, in addition to those noted above, *Harpinia neglecta*, Sars, (noted before as *H. plumosa*), Colwyn Bay and Port Erin, *Dexamine thea*, Boeck, from Port Erin harbour (common), *Hoplonyx similis*, Sars (new to Britain), *Megamphopus cornutus*, Norman, and a new species of *Podocerus*, from Laxey Bay, for which the following name and diagnosis are proposed by Mr. Walker :—

" *Podocerus herdmani*, n. sp.

" Allied to *P. falcatus* and *P. minutus*, G. O. Sars, but differing in the 'hand' of the second gnathopod of the male, as shown in annexed figures 12 and 13.

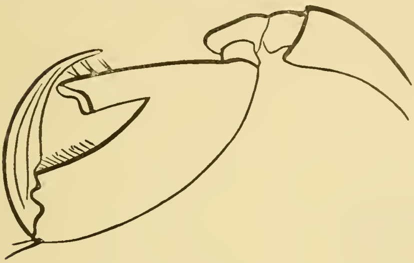


Fig. 12. *Podocerus minutus* (after G. O. Sars.)

Fig. 13. *Podocerus herdmani*, n. sp.

The large tooth which in these species springs from the base of the hind margin, in this species is much shorter and rises from nearly the centre. There is also a prominent tooth near the centre of the hind margin of the 'finger' which is very characteristic. The female resembles *P. minutus*. Length 3 mm."

In regard to *Megamphopus cornutus*, Mr. Walker reports to me " Canon A. M. Norman, *in lit.* Dec. 6/92 gives *Protomedeia longimana*, Boeck 1870, and *Podoceropsis intermedia*, Stebbing 1878, as synonyms of *Megamphopus cornutus*, Norman, 1868. At the same time he sent me his type specimen, also one from Farland Point, Cumbrae, and one from G. O. Sars labelled *Protomedeia longimana*, from the Lofoten Islands. Of these the last has the 'horn' on the 1st epimere by far the longest as it reaches to the end of the 3rd (apparent 1st) joint of the lower antenna. Next comes the type from the Shetlands in which it barely reaches the proximal end of that joint. In the Cumbrae specimen—also a male, but not so large as the others—it cannot be seen at all, nor can it in my specimens (still smaller) from the Isle of Man. The second gnathopod is also much more highly developed in length, spines on palm of hand &c., in the Lofoten and Shetland specimens than the others. It is probable that the above differences may be only a question of age, but it is not impossible that the latitude may have an influence in reducing the size and development of the species. Upon a comparison of my specimens of *Podoceropsis sophiæ*, Boeck and *P. intermedia* Mr. Stebbing agrees with me that the two species are obviously distinct."

Fig. 14. A.O.W. washing sand for Amphipods.

Immediately after the publication of Mr. Walker's "Revised Report upon the Podophthalmata" in July, 1892, several additional species were found, so an "Addenda" slip has now been printed and issued to all purchasers of Vol. III. of the "Fauna." This slip contains records of the following species:—*Inachus dorynchus*, *Stenorhynchus longirostris*, *Ebalia cranchii*, *Pinnotheres veterum*, *Pirimela denticulata*, *Spiropagurus hyndmanni* and *Nephrops norvegicus*. Since then in dredging from Bradda Head to the Port Erin breakwater, in November, we got a Schizopod (*Gastrosaccus sanctus*) new to the district, the only former British locality being Jersey, and a *Microdeutopus* which is probably new.

Mr. A. Leicester who took charge of the Mollusca during our expeditions, and has also worked through a good deal of material which he had collected at Puffin Island last year, reports to me that he has fifteen species of Lamellibranchs and Gastropods to add to our records: of these 8 are from Bay Fine and the immediate neighbourhood of Port Erin, and 7 from Puffin Island. Among the more noteworthy of these, collected and identified by Mr. Leicester and Dr. Chaster of Southport, are *Solecurtus antiquatus*, *Bulla utriculus*, *Cyclostrema cutlerianum*, and *C. nitens*, *Odostomia warreni* and *Defrancia teres* from off Port Erin; and *Mya binghami*, *Homalogyra rota*, *Odostomia nivosa*, and *O. turrita* from Puffin Island. Mr. W. H. Heathcote, of Preston, who spent some time at the Biological Station in July, was chiefly engaged in dredging for Mollusca about Bay Fine (see Pl. I.). He succeeded in getting a number of the rarer forms amongst which may be recorded *Defrancia leufroyi*, and *Fusus antiquus*, var. *despectus*. Mr. Heathcote also reports to me *Utriculus hyalinus*, Turt., cast up at Southport, new to the district.

During September Mr. A. Chopin, of Manchester, carried on some dredging from Port St. Mary and Port Erin, and was able to add at least two species new to our records, viz. the sponge *Reniera rosea*, Bowerb. (from Fleswick Bay and Perwick Bay), and the crab *Pirimela denticulata*, Leach, (off Spanish Head, 15 fms.). *Reniera rosea* was recorded by Bowerbank from Tenby and Sark. Dr. Hanitsch informs me that this species seems to have a larger amount of "spongin" than most other Renierid sponges, and approaches therefore the Chalinidæ. The only other sponge new to the district reported by Dr. Hanitsch is the Desmacidonid *Halichondria (Amphilectus) expansa*, B., dredged on September 24th off Clay Head. It had previously been obtained only at Skye, by Dr. A. M. Norman. The specimens of *Spongelia fragilis* which we dredged off Clay Head and Garwick are noteworthy for being the largest yet found in our district.

Mr. I. C. Thompson has been engaged for some time on a "Revision" of the L. M. B. C. Copepoda, which will incorporate the work of his previous reports with all the recent "finds" in this group—"finds" which during this last season have been astonishing in their number and quality. I have suggested to Mr. Thompson to give in this 'Revision,' (which will be laid shortly before a meeting of the Biological Society) a simple outline figure, with details of the diagnostic points, of every species of L.M. B. C. Copepoda, an addition which while entailing a great deal of extra labour on the author, will I am sure increase greatly the usefulness and value of his paper.

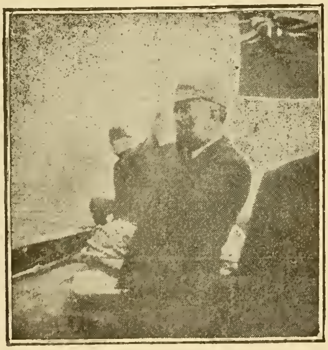


Fig. 15. I.C.T. picking out Copepoda.

Mr. Thompson reports to me as follows :—" Over 20 species of Copepoda new to the district have been added to our record during the last year, viz.—*Mesophria pallida*, *Euchæta prestandræ*, *Cyclopina magna* (n.sp.), *Ectinosoma curticorne*, *Notopterophorus papilio*, *Laophonte horrida*, *Laophonte spinosa* (n.sp.), *Normanella dubia*, *Dactylopus tenuiremis*, *D. flavus*, and *D. minutus*, *Thalestris rufo-violescens*, *T. peltata*, *Porcellidium tenuicauda*, *Anchorella uncinata*, *Ameira attenuata* (n.sp.), *Stenhelia denticulata* (n.sp.), *Monstrilla rigida*, *Lichomolgus agilis*, *Cylindropsyllus lævis*, *Tetragoniceps bradyi*, and *Paramesochra dubia;* six of these, viz., *Euchæta prestandræ*, *Monstrilla rigida*, *Cyclopina magna*, *Ameira attenuata*, *Stenhelia denticulata*, and *Laophonte* *spinosa*, are additions to the British Fauna, and the four last are new to science. The chief causes for so large an addition to our Copepodan fauna are, first the more special attention we now pay to the minute examination of mud and other dredged materials, which have yielded the majority of the above-named species—Port Erin bay and particularly the muddy bottom just inside the breakwater having proved to be specially rich ground ; and, secondly, the establishment of Professor Herdman's "Fishery Laboratory" at University College, where large numbers of fish are constantly being examined, and, where under the keen scrutiny of Mr. Corbin a large number of fish parasites have been found in situ on the gills of the fishes. Many of these yet await examination, and there is evidently still much to be achieved by a careful examination of the mouths and gills of our common fishes. The branchial sacs of Ascidians collected by Prof. Herdman, have yielded many kinds of parasitic Copepoda, one of these, *Notopterophorus papilio*, a remarkably interesting animal, being new to the district."

A new Copepod, *Lichomolgus agilis*, has been very recently found and described by Mr. T. Scott, of the Scottish Fishery Board, as frequenting Cockle shells. This Copepod we have also found here, in all the cockles examined, and it is probably a common form which has been hitherto overlooked on account of its peculiar habitat.

The Hydroid Zoophytes and Polyzoa collected during the year have, as in previous seasons, been examined by Miss L. R. Thornely, with whom I have gone over a good deal of the material, including any doubtful or difficult specimens. One of the most interesting points is that Miss Thornely has been able to establish that the *Lafoea pygmæa*, Ald., of Hinck's "Zoophytes" is really, as Alder seems to have indicated in his drawings, a species of

Calycella. It has in our specimens from rock pools at Port Erin, obtained on Sept. 25th., a distinct operculum, and the name of the species must consequently become *Calycella pygmæa.* In these same pools the following other Zoophytes have been found lately:—*Clava multicornis, Coryne van-benedeni, Campanularia fragilis,* Opercularella lacerata, Sertularia operculata, Plumularia similis;* and 9 species of Polyzoa.

On November 13th., a dredging off Bradda Head yielded 11 species of Zoophytes, and 7 species of Polyzoa, none very specially rare. It ought, perhaps, to be stated that all these lists of collections of Zoophytes and Polyzoa from various localities now being determined by Miss Thornely, are kept for record in the MS. tables of geographical distribution within our district, which will be published in some future report, when they seem sufficiently complete. A number of Zoophytes, Polyzoa, and other invertebrata have been sent to the Laboratory lately by Captain Eccles and the other bailiffs in connection with the investigations now going on into the food, &c., of fishes. One such gathering dredged from near Eastham, in October, contained 21 species of Zoophytes and 11 of Polyzoa. One of the Zoophytes was *Bougainvillea ramosa*, which had not previously been reported from our district. Another gathering, from the Rock Channel, contained 18 species of Zoophytes and 15 of Polyzoa. A third set, trawled in Morecambe Bay, consisted of 9 species of Zoophytes and 3 of Polyzoa, amongst which were *Eudendrium annulatum*, and *Bowerbankia caudata.*

British Association Committee.

At the British Association meeting in Edinburgh, early in August, a committee was formed, with a small grant, for the purpose of exploring further the southern part of the

Irish Sea. "This committee consists of Professor Haddon, Mr. W. E. Hoyle, Mr. Geo. Brook, Mr. A. O. Walker, Mr. I. C. Thompson (Secretary) and Professor Herdman (Chairman)," and the grant will be expended in providing a series of short dredging expeditions to the more unknown parts of the area. The first of these British Association Committee expeditions was organized at the end of September when the steam trawler "Lady Loch" of Douglas was hired for September 24th. The wind was so strong and the sea so heavy that it was quite impossible to do any work off the southern and western sides of the island, so we steamed up the eastern side and spent the day in dredging in the neighbourhood of Laxey at the following localities:

Fig. 16. Emptying the lredge on deck.

1. Off Clay Head, 20 fms., several hauls; varied bottom. *Polymastia robusta*, *Suberites domuncula*, *Amphilectus incrustans*, *Spongelia fragilis* (large specimens), and a

Desmacidonid sponge (the *Halichondria expansa* of Bowerbank) which is new to the district, and probably belongs to the genus *Amphilectus*, ten species of Zoophytes and fourteen species of Polyzoa, *Pinnotheres veterum*, *Lima hians*, *Psammobia tellinella*, *Ascidia mentula*, &c.

2. Off Garwick Head, 4—12 fms., "Melobesia" bottom. Several hauls. *Aglaophenia pluma* and seven other species of Zoophytes, *Amathia lendigera*, *Ebalia cranchii*, *Podocerus herdmani*, n. sp.

3. Laxey Bay, 8 fms., "Zostera" bed.
Campanularia angulata, *Clytia johnstoni*, *Antennularia antennina* and *Sertularia polyzonias*, *Cerapus difformis*, *Membranipora spinifera** and six other species of Polyzoa, Compound Ascidians, *Pectunculus glycimeris* (large, alive).

The Ascidians dredged in this expedition yielded a number of parasitic Copepoda amongst which were *Botachus cylindratus*, *Notopterophorus papilio*, *Doropygus pulex* and *D. poricauda*, *Notodelphis allmani* and *Ascidicola rosea*.

On this occasion a specimen of the somewhat uncommon fish Müller's Top-knot (*Zeugopterus punctatus*) was obtained at Port Erin. It had been caught by a net close to the shore, and was kindly brought to the laboratory by Mr. John Costain.

Publications, &c.

Since the last annual report, the third volume of the "Fauna of Liverpool Bay" has been published (July, 1892). It contains papers on the marine Algæ, Porifera, Annelids, Crustacea, Mollusca, Tunicata, and other groups, and is illustrated by twenty-three plates and a chart. As is stated in the introduction to the volume, the additional species recorded in the various papers now brings the number of marine animals and plants known to inhabit the L.M.B.C. district up to 1685. To this has still to be added the 105 new forms found during this last summer and referred to in the present report.

A melancholy interest attaches to one of the papers in Vol. III. of "The Fauna," viz., The Report upon the Testaceous Mollusca. It was the last piece of work of the late Mr. F. Archer who was a member of the Committee from the beginning, and has always taken an active interest in the work. In addition to all more personal feeling of loss, his ready sympathy, kindly criticism, and sturdy common sense will be greatly missed at the Biological meetings and on the collecting expeditions. Mr. Archer's place on the committee has been filled up by the election, on June 3rd, of Mr. John Vicars. With Surgeon-Colonel S. Archer's sanction I took charge of his brother's note books for the purpose of having his work on the Mollusca published. Fortunately Mr. Brockton Tomlin of Chester was kind enough to undertake the responsible work of putting the notes and records in proper form for the printer. It is a matter of great satisfaction to the Committee that one so eminently qualified both as a conchologist and also from his knowledge of Mr. F. Archer's collections and notes and methods was found willing to undertake this work and carry it out without delay.

The Mollusca of the future L.M.B.C. expeditions will be worked up and reported upon by Mr. Alfred Leicester, Priory Gardens, Birkdale, who will gladly receive and acknowledge records of specimens from other conchologists in the district.

We have suffered another loss in the death, quite recently, of Mr. T. J. Moore the last President of the Biological Society. Mr. Moore's poor health for the last few years has prevented him from taking any active part in our expeditions, but he attended as far as possible the meetings, and we have always had his sympathy and advice in our investigations. Unfortunately his long expected report upon our local marine fishes was never completed. In the first two volumes of the "Fauna" we have two papers from his pen, one on the American Clam (*Venus mercenaria*) in Vol. I., and a report upon the L.M.B.C. Seals and Cetaceans in Vol. II.

It is proposed that the vacancy caused by Mr. Moore's death should be filled up by the election of His Excellency Spencer Walpole, LL.D., Lieutenant-Governor of the Isle of Man, who has kindly consented to serve on the Committee.

It is an encouraging and hopeful feature of our first season's work at Port Erin to notice the number of new recruits who are joining our School of Marine Biology. In addition to those noted above as having done some special work at the biological station, Dr. G. W. Chaster, of Southport, is helping Mr. Leicester with Mollusca and is also working at the Foraminifera of the district, and Mr. P. J. F. Corbin is collecting records and specimens of the fishes and is paying special attention to their parasites. The Committee hope that not only may they continue to draw together the young biologists of Liverpool and the neighbourhood, but that Manxmen interested in Natural History may now be induced to work as students at the Port Erin laboratory, and so fit themselves for investigating seriously the abundant marine fauna and flora of their Island.

All faunistic work—the distribution and relations of species, their variations, their habits, and "habitats," the nature of their distinguishing characteristics and the bearing of these upon the natural surroundings and mode of life—all these, always matters of great interest to those who appreciate nature, have now become of special importance in the philosophy of Biology since Darwin showed how much centres around the problem of the "Origin of Species." Now that we are beginning to understand how little a species or variety is, and yet at the same time how much of world-wide importance the differentiation of these sets of individuals implies, the work of the "field naturalist"—if inspired by the true scientific spirit and regulated by due caution—acquires a new meaning and a real value. The Biologist cannot afford to despise any line of enquiry. All accurate observations have their use, and may at any time prove of great importance by illustrating some theoretical question and taking their place in the elucidation of the system of nature which we see around us and of which we form a part.

In conclusion I may state that the Committee are now trying in various ways to add to the facilities for work at the Biological Station in view of the coming Spring and Summer. A few useful books of reference and monographs on British animals are being collected to form a small working library, extra dredges, tow-nets, and other collecting apparatus, small aquaria and vessels, and supplies of various kinds, are now being laid in, so that the conditions for work in the laboratory may be reasonably expected to be much more favourable in the future than they were last summer. Then it may be pointed out—perhaps after our association with Puffin Island it is necessary to emphasize this—that at Port Erin there is the comfortable Bellevue Hotel, and other hotels, and lodgings of all kinds, at which students can live; and finally the Biological Station is open to lady-students as well as to men, and the neighbourhood is one which, taken along with the presence of the laboratory, and dredging facilities, offers many advantages to, and would probably supply the diverse wants of, parties of students or vacation expeditions of scientific Societies.

In view of the books of reference and the apparatus we are now buying, and of the further additions to the stock which are contemplated, as well as the maintenance of a permanent Curator, our Hon. Treasurer asks me to state that our expenses in the coming year will probably be considerably heavier than they have been in the past, and that he trusts that there will be some substantial additions to the subscription list.

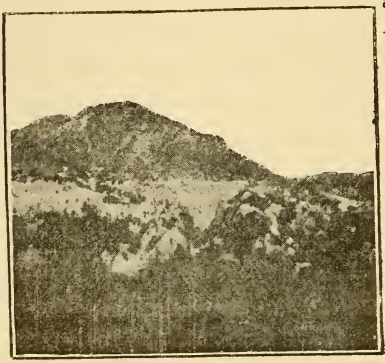


Fig. 17. Rocks showing white band caused by myriads of adhering *Balanus*.

I append to this report:—(A.) the Regulations drawn up by the Committee in regard to the Station, and with which they expect workers to comply, and (B.) the Hon. Treasurer's Balance Sheet and list of Subscribers.

List of the Plates.

APPENDIX A.

LIVERPOOL MARINE BIOLOGICAL STATION AT PORT ERIN.

REGULATIONS.

I.—This Biological Station is under the control of the Liverpool Marine Biology Committee, the executive of which consists of the Hon. Director, Prof. Herdman, and the Hon. Sec. and Treas., Mr. I. C. Thompson.

II.—In the absence of the Director, and of all other Members of the Committee, the station is under the temporary control of the Curator, who will keep the keys, and will decide, in the event of any difficulty, which tables are to be occupied by particular workers, and how the boats, and dredges, microscopes, &c., are to be employed.

III.—The Curator will be ready at all reasonable hours, and within reasonable limits, to assist workers at the station, and to do his best to provide them with material for their investigations.

IV.—Visitors will, on application to any Member of the L. M. B. C., or to the Curator, be admitted at reasonable hours to see the station, so long as it is found not to interfere with the Scientific Work.

V.—Those who are entitled to work in the station, when there is room, and after formal application to the Director, are :—(1) Annual Subscribers of one guinea or upwards to the funds (each guinea subscribed entitling to the use of a table for four weeks), and (2) others who pay the Treasurer 10s. per week for the accommodation and privileges. Workers at the station are recommended to board at the Bellevue Hotel.

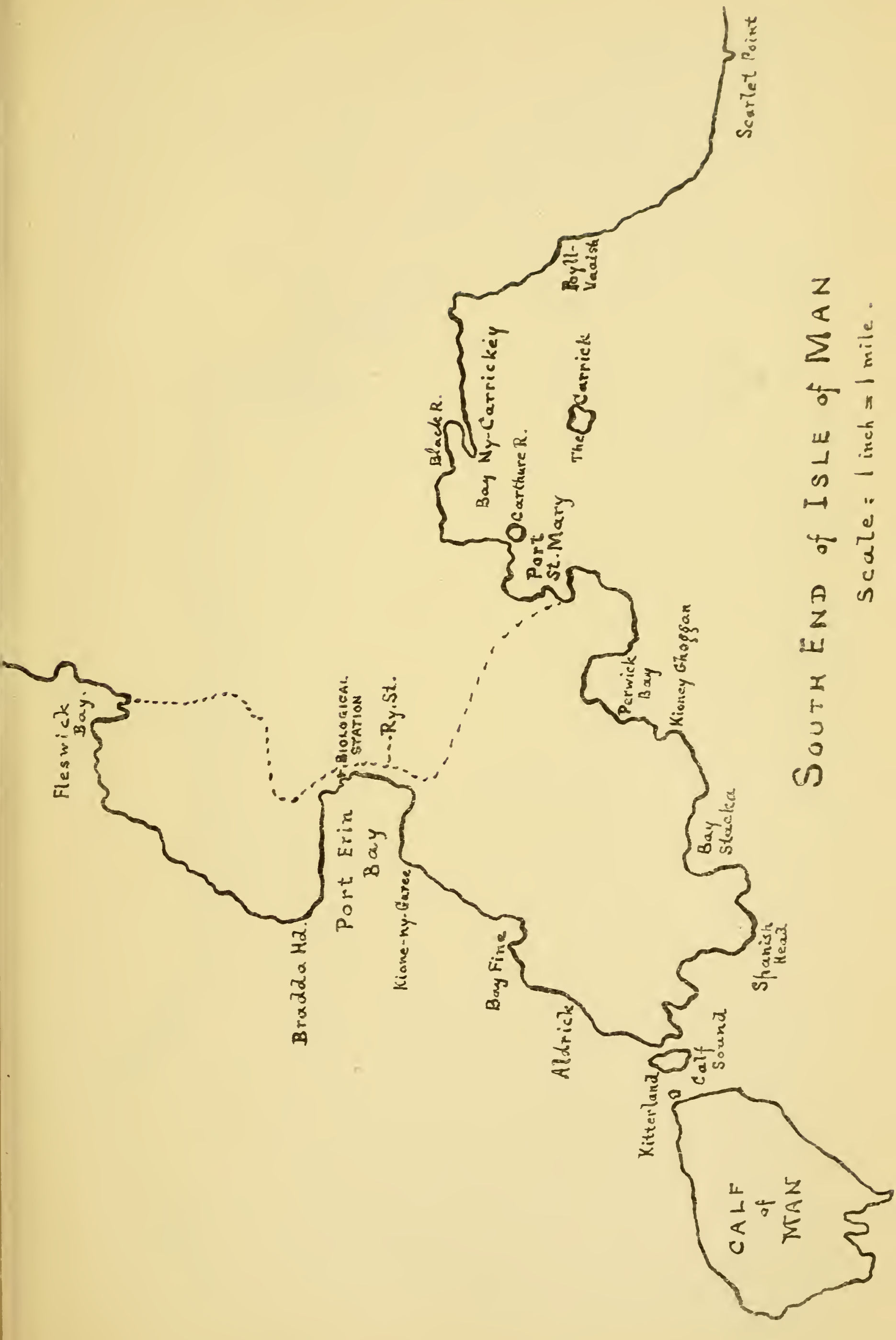
VI.—Each worker is entitled to a work-place opposite a window in the Laboratory; and to make use of the microscopes, reagents and other apparatus, and of the boats, dredges, tow-nets, &c., so far as is compatible with the claims of other workers, and of the routine duties of the Curator.

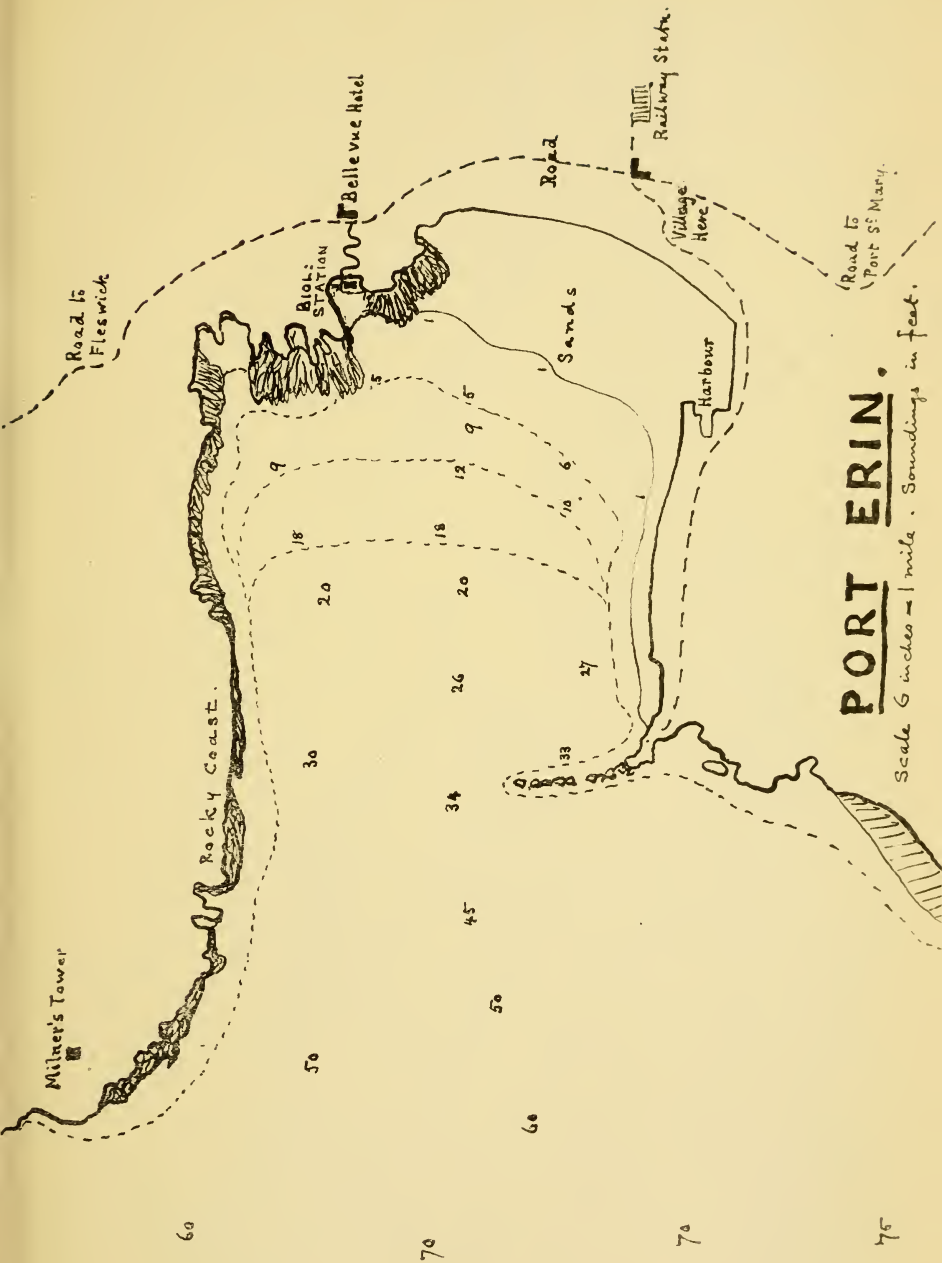
VII.—Each worker will be allowed to use one pint of methylated spirit per week, free. Any further amount required must be paid for. All dishes, jars, bottles, and tubes may be used, but must not be taken away from the Laboratory. If any workers desire to make, preserve, and take away, collections of marine animals and plants, they must make special arrangements with the Director in regard to bottles and spirit.

VIII.—Workers desiring to employ larger sailing boats than those belonging to the station, can do so, at their own expense, by applying to Mr. Clague, of the Bellevue Hotel.

IX.—All workers at the station are expected to lay a a paper on some of their results, or at the least a short report upon their work, before the Biological Society of Liverpool, during the current or the following session.

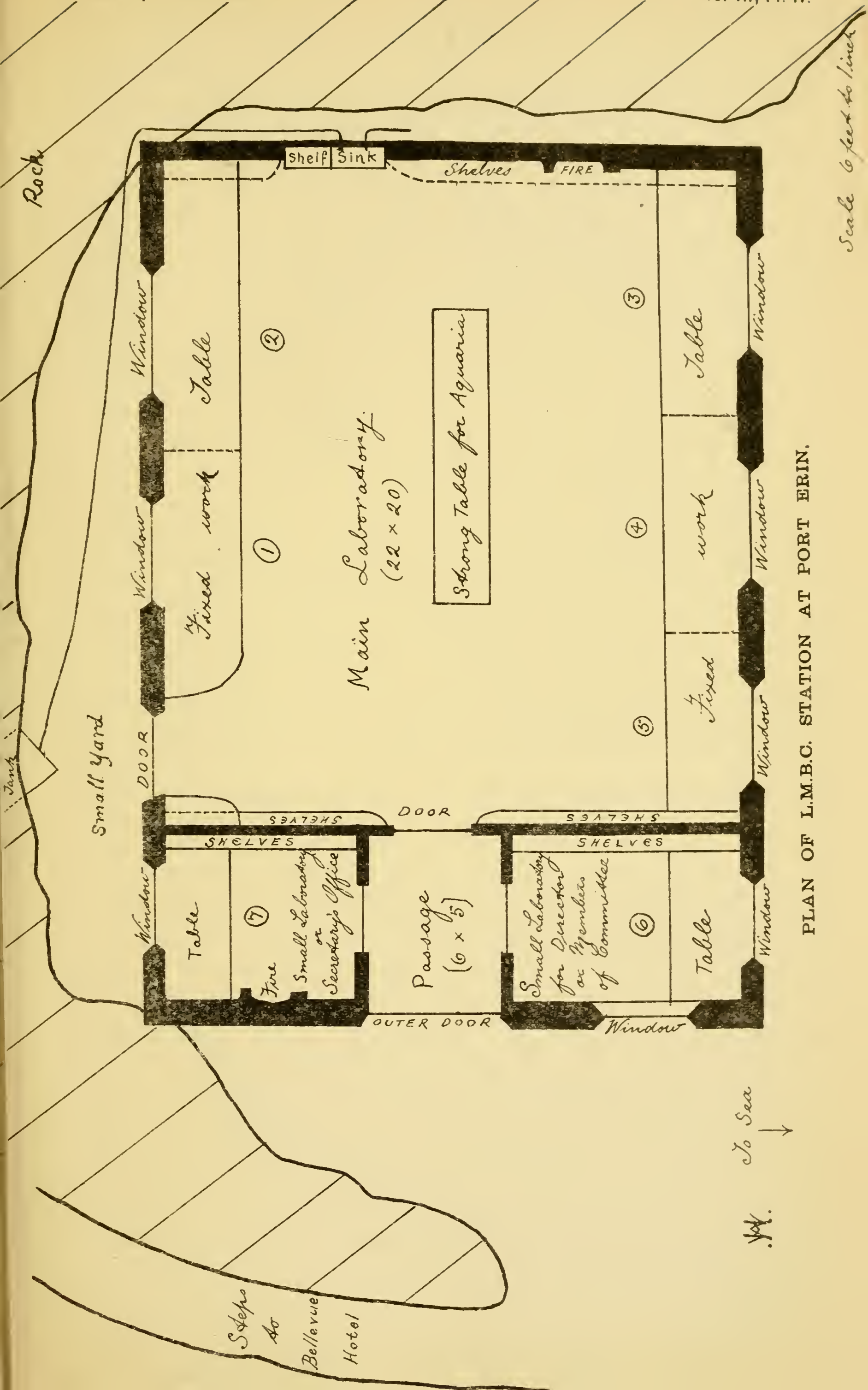
X.—All Subscriptions, payments and other communications relating to finance, should be sent to the Hon. Treasurer, Mr. I. C. Thompson, F.L.S., 19, Waverley Road, Liverpool. Applications for permission to work at the Station, or for preserved animals, or communications in regard to the scientific work, should be made to Professor Herdman, University College, Liverpool.


Fleswick Bay
Bradda Hd.
Port Erin Bay
BIOLOGICAL STATION
Ry. St.
Kione-ny-Garee
Bay Fine
Aldrick
Kitterland
Calf Sound
CALF of MAN
Spanish Head
Bay Stacka
Kioney Ghoggan
Perwick Bay
Port St. Mary
Carthure R.
Bay Ny-Carrickey
Black R.
The Carrick
Poyll-Vaaish
Scarlet Point
SOUTH END of ISLE of MAN
Scale: 1 inch = 1 mile.

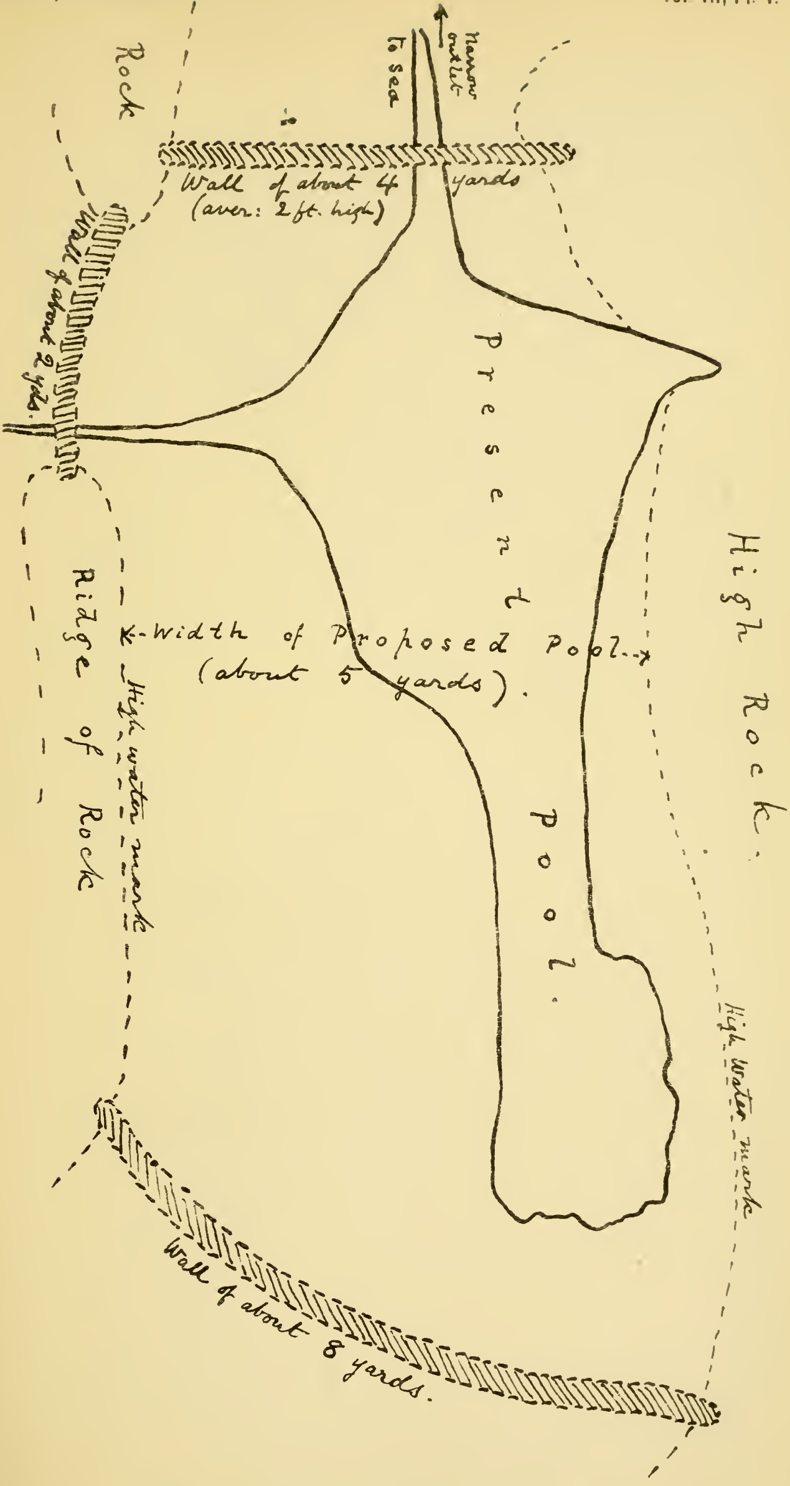

Road to Fleswick
Milner's Tower
Rocky Coast
Biol: Station
Bellevue Hotel
Road
Railway Statn.
Village Here
Sands
Harbour
Road to Port St. Mary
PORT ERIN.
Scale 6 inches = 1 mile. Soundings in feet.

LIVERPOOL, MARINE BIOLOGICAL STATION AT PORT ERIN.

LIVERPOOL, MARINE BIOLOGICAL STATION AT PORT ERIN.



PLAN OF L.M.B.C. STATION AT PORT ERIN.



LARGE POOL AT PORT ERIN.

Fig. 1.

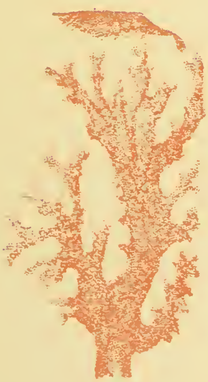


Fig. 2.

Fig. 3.

W. A. H., pinx.

VIRBIUS VARIANS.

Appendix B.

SUBSCRIPTIONS and DONATIONS.

	Subscriptions. £	s.	d.	Donations. £	s.	d.
Archer, Francis, B.A., (the late), 21, Mulgrave street	1	1	0		—	
Banks, Prof. W. Mitchell, 28, Rodney-st.	2	2	0		—	
Barlow, Rev. T. S., Bishop's Court, I. of Man	0	10	6		—	
Beaumont, W. J., Cambridge	2	2	0		—	
Bickersteth, Dr., 2, Rodney-street... ...	2	2	0		—	
Brook, George, British Museum (Nat. Hist.) London	1	1	0		—	
Brown, Prof. J. Campbell, University College, Liverpool	1	1	0		—	
Browne, Edward T., B.A., 14, Uxbridge road, Shepherd's Bush, London ...	1	1	0		—	
Burton, Major, Fryars, Beaumaris... ...	2	2	0		—	
Caine, Nath., 10, Orange-court, Castle-street	1	1	0		—	
Caton, Dr., 31, Rodney-street		—		1	1	0
Chadwick, H. C., 2, Market-place, Chorlton-cum-Hardy, Manchester	0	10	0		—	
Chaudhuri, B., 94, Polwarth Gardens, Edinburgh	1	1	0		—	
Clague, Dr., Castletown, Isle of Man ...	1	1	0		—	
Clague, Thomas, Bellevue Hotel, Port Erin	1	1	0		—	
Comber, Thomas, Leighton, Parkgate ...	1	1	0		—	
Coventry, Joseph, 34, Linnet Lane ...	1	1	0		—	
Craig, Robert, 34, Castle-street	1	1	0		—	
Crellin, John C., J.P., Ballachurry, Andreas, Isle of Man	1	1	0		—	

Davidson, Dr., 2, Gambier-terrace... ...	1	1	0	—
Denny, Prof., Firth College, Sheffield ...	1	1	0	—
Derby, Earl of, Knowsley	5	0	0	—
Drysdale, Dr., (the late), 36A, Rodney-street	1	1	0	—
Dumergue, A. F., 79, Salisbury road, Wavertree	1	1	0	
Gair, H. W., Smithdown-road, Wavertree...	2	2	0	
Gamble, Col. David, C.B., Windlehurst St. Helens	2	0	0	—
Gaskell, Frank, Woolton Wood, ...	1	1	0	—
Gaskell, Holbrook, J.P., Woolton Wood,	1	1	0	—
Gell, James S., High Bailiff of Castletown...	1	1	0	—
Gibson, R. J. Harvey, 41, Sydenham-avenue	1	1	0	—
Gifford, J., Whitehouse terrace, Edinburgh	1	0	0	—
Glynn, Dr., 62, Rodney-street	1	1	0	—
Halls, W. J , 35, Lord-street	1	1	0	—
Henderson, W. G., Liverpool Union Bank	1	1	0	—
Herdman, Prof., University College. L'pool.	2	2	0	—
Holder, Thos., 1, Clarendon-buildings Tithebarn-street	1	1	0	—
Holland, Walter, Mossley Hill-road ...	2	2	0	—
Holt, George, J.P. Sudley, Mossley Hill ...	1	0	0	—
Heathcote, W. H., 54, Frenchwood-street, Preston	0	10	6	—
Howes, Prof. G. B., Royal College of Science, South Kensington, London...	1	1	0	—
Isle of Man Natural History and Antiquarian Society	1	1	0	—
Johnstone, Rev. Geo., M.A., 41, Bentley-rd.	0	5	0	—
Jones, Chas. W., Field House, Wavertree	5	0	0	—
Jones, J. Birdsall, 10, St. George's-crescent	1	1	0	—
Kermode, P. M. C., Hill-side, Ramsey ...	1	1	0	—
Leicester, Alfred, Priory Gardens, Weld-rd., Birkdale	1	1	0	—
Lomas, J., Amery-grove, Birkenhead ...	0	10	6	—
Macfie, Robert, Airds	1	0	0	—

Marshall, Prof. A. Milnes, Owens College Manchester	1	1	0	—		
Meade-King, H. W., Sandfield Park, West Derby	1	0	0	—		
Meade-King, R. R., 4, Oldhall-street ...	0	10	0	—		
Melly, W. R., 90, Chatham-street... ...	1	0	0	—		
Miall, Prof., Yorkshire College, Leeds ...	1	1	0	—		
Monks, F. W., Brooklands, Warrington ...	1	1	0	—		
Muspratt, E. K., Seaforth Hall	5	0	0	—		
Mylchreest, J., White House, Kirk Michael. Isle of Man	1	1	0	—		
Newton, Rev. A. S., Grammar School Ramsey, Isle of Man	1	1	0	—		
Poole, Sir James, Tower Buildings ...	2	2	0	—		
Rathbone, R. R., Glan-y-Menai, Anglesey	2	2	0	—		
Rathbone, S. G., Croxteth-drive, Sefton-park	2	2	0	—		
Rathbone, Mrs. Theo., Backwood, Neston	1	1	0	—		
Rathbone, Miss May, Backwood, Neston ...	1	1	0	—		
Rathbone, W., M.P., Greenbank, Allerton	2	2	0	—		
Roberts, Isaac, F.R.S., Tunbridge-wells ...	1	1	0	2	2	0
Shepheard, T., Kingsley Lodge, Chester ...	1	1	0	—		
Simpson, J. Hope, Annandale, Aigburth-drive	2	2	0	—		
Stevenson, W. A., Ballakreighan, Castletown, Isle of Man	1	1	0	—		
Stevenson, W. B., Balladoole, Castletown, Isle of Man	1	1	0	—		
Stewart, W. J., City Magistrates Office ...	1	1	0	—		
Sykes, W., Preston...	0	10	0	—		
Tate, A. Norman, (the late), 9, Hackin's-hey	1	1	0	—		
Thompson, Isaac C., 19, Waverley-road Sefton-park	2	2	0	—		
Thornely, James, Baycliff, Woolton ...	1	1	0	—		
Thornely, The Misses, Baycliff, Woolton ...	1	0	0	—		
Toll, J. M., 340, Walton Breck-road ...	1	1	0	—		
Tomlin, B., 59, Liverpool-road, Chester ...	0	5	0	—		
Talbot, Rev. T. U., 4, Osborne terrace, Douglas, Isle of Man	1	1	0	—		

Vicars, John, 8, St. Alban's-square, Bootle	2	2	0	—
Walker, Alfred O., Nant-y-glyn, Colwyn Bay	3	3	0	—
Walker, Horace, South Lodge, Princes-park	1	1	0	—
Walpole Spencer, LL.D., His Excellency The Governor, Isle of Man	2	2	0	—
Walters, Rev. Frank, B.A., King William College, Isle of Man	1	1	0	—
Wareing, W. R., Charlesbye, Ormskirk ...	1	1	0	—
Watson, A. T., Tapton-crescent, Sheffield	1	1	0	—
Weiss, Prof. F. E., Owen's College, Manchester	1	1	0	—
Westminster, Duke of, Eaton Hall ...	5	0	0	—
Wiglesworth, Dr., Rainhill...	1	0	0	—
	119	14	6	3 3 0

Fig. 18. Rocks covered with seaweeds and animals.

THE LIVERPOOL MARINE BIOLOGY COMMITTEE,

Dr. IN ACCOUNT WITH ISAAC C. THOMPSON, HON. TREASURER. **Cr.**

Dr.

1892	£	s.	d.
To Balance due Treasurer, 1891	3	0	6
,, Expenses of Dredging Expeditions	17	14	6
,, Half-year's Rent of Port Erin Biological Station	5	0	0
,, Microscopes, Apparatus, and Furniture at Port Erin Biological Station	21	4	3
,, Books on Marine Biology	3	5	9
,, Postages, Carriage of Apparatus, &c.	5	12	7
,, Printing and Stationery	26	4	1
,, Sundries	0	11	0
,, Salary to Temporary Curator	7	0	0
	£89	12	8
By Balance due Treasurer	2	4	8

Cr.

1892		£	s.	d.
By Subscriptions and Donations	£120 16 6			
Of which £75 11 0 is repaid to Endowment Fund	75 11 0			
,, Dividend, British Workman's Public House Co., Ltd., Shares		4	10	0
,, Sale of Reports		17	12	6
,, Sale of Fittings, Boats, &c., at Puffin Island Station		20	0	0
,, Balance due Treasurer		2	4	8
		£89	12	8
Endowment Fund Investment.—				
Brit. Workman's Public House Co.'s Shares		105	11	0
Funds pending Investment		75	0	0
		£180	11	0

ISAAC C. THOMPSON,
HON. TREASURER.

LIVERPOOL, *December* 31*st*, 1892.

Audited and found correct,
ALFRED LEICESTER.

[WORK FROM THE PORT ERIN BIOLOGICAL STATION.]

REPORT on the TURBELLARIA of the L.M.B.C. DISTRICT.

By F. W. Gamble, B.Sc.,

BERKELEY FELLOW OF THE OWENS COLLEGE, MANCHESTER.

With Plates XII to XIV.

[Read January 13th, 1893.]

The following Report is a summary of observations made during July and part of October, 1892, at the Port Erin Biological Station belonging to the Liverpool Marine Biology Committee. Owing to the limited time at my disposal much yet remains to be done before an accurate idea of the Turbellaria of the District can be formed. My researches at Port Erin and at the Marine Biological Association's Laboratory at Plymouth, seem to point to the conclusion that we are only beginning to ascertain the richness of this portion of the British Fauna. As a general result 28 species representing 23 genera have been found at Port Erin. Five of these are new to Britain.

The Turbellaria (like the Protozoa, Nematodes and some smaller groups) have, for various reasons been little studied in this country. It is chiefly to the following workers that the knowledge we possess of the marine species, is due.

Sir John Dalyell recorded a few species from the Firth of Forth; Dr. Johnson worked Berwick Bay; Mr. Wm. Thompson of Dublin worked the east coast of Ireland. In 1861 Prof. Ed. Claparède paid a visit to Skye, where he found many new forms. Prof. M'Intosh has noticed some species in his "Marine Invertebrates and Fishes of St. Andrews." These records, however, do not by any means give us a complete account of the Turbellarian fauna of the several districts. With the brilliant exception of Claparède's paper, the observations are frequently too fragmentary to allow us to accurately determine the species that are mentioned. A very valuable addition, therefore, to our knowledge is the description of 34 marine forms obtained by Professor von Graff during a two months stay at the "Ark" Millport, N.B. This list incorporated in his "Monograph" of the group (1882) furnishes a basis of comparison with other part of our coasts. For the last ten years, however, little work has been done on British Marine Turbellaria.

We may next consider how and where marine Turbellaria are to be found. Dividing the group for our present purposes into the flat leaf-like *Polyclads* 1 cm. or so long, and the small, usually cylindrical *Rhabdocœls* rarely more than 2 mm. in length, the following methods have proved successful. The Polyclads are to be found by extremely careful search on the under surface of weed-covered stones between tide-marks. Almost all forms are coloured in such a way as to remain unobserved unless the keenest vigilance be exercised. Infra-littoral species occur among shells, polyzoa and hydroids dredged at various depths up to 20 fms. The Rhabdocœles being minute cannot be directly observed on the shore. It is necessary to collect sea-weeds, stones covered with diatoms, ascidians, &c., the sand at the base of corallines, and to place these separately in vessels containing sea-water. The Turbellaria will presently emerge and can be found by searching the sides of the vessel with a hand-lens. Dredge-material treated in like fashion will yield numerous forms constituting a fauna fairly distinct from the littoral one. For Polyclads I have found the coast near Port St. Mary to be the best. For Rhabdocœles, the Calf Sound and tide-pools round Port Erin have proved most productive.

Pelagic Turbellaria are rare, but occasionally occur in tow-nettings. Such are certain Rhabdocœles and larval Polyclads.

TURBELLARIA.

I.—TRICLADIDA.

1. *Planaria alpina*, Dana (Pl. XII, figs. 1 and 2.)

This fresh-water species is about $\frac{1}{4}''$ in length, body grey, produced anteriorly into a pair of tentacles, a single pair of eyes are present. I have found it in cold springs near Silverdale (Lancashire) and in the sheltered gorges near Port Erin. This last fact taken in connection with Wm. Thompson's discovery of *alpina* on the East coast of Ireland (which however needs confirmation) have an important bearing on the geographical distribution of this Turbellarian. *Planaria alpina* is a distinctly alpine creature and where occurring at lower levels, does so in water of a constantly low temperature. Dana first found it in the Graubüntner Alps. It has since been found near Chur and in the Davos mountains at heights of 6—7000 feet and in water at a temperature of 2°C which is frozen from November to May. v. Kennel (in a most interesting paper, (Zoologische Jahrbücher, III, p. 447), to which I am greatly indebted) has found it in the Maine Valley at Würzburg at the outflow of a spring (temperature 10°C). The effect of a higher temperature than this is readily seen when attempts are made to keep these animals indoors. As soon as the water rises above 12°C they die very rapidly.

With these facts in mind v. Kennel has attempted their explanation. The difficulty is this, how did *Planaria alpina* get from Switzerland to Würzburg, England, the Isle of Man and Ireland? The tendency to explain this and similar cases by saying that *alpina* is a "Relicktform" of the ice-age, has induced von Kennel to oppose this easy method of solving the problem and to try whether recent migration of an active or passive nature may not sufficiently account for the facts. In the first plfice it is clear that (assuming recent migration) although active wandering may account for the occurrence of *Planaria alpina* in the Alps and in southern Germany, it cannot apply to England since, by hypothesis, England was separated by sea from the Continent. The only water-way from the Graubündtner Alps to the Maine Valley is the Rhine. Now although the water in the upper part of this river would be of a sufficiently low temperature to allow of *alpina* living in it, lower down the temperature is too high. If however, gradually from time to time, chiefly in the winter, migration had gone on extending further and further down the Rhine, suitable places might have been secured in the Maine Valley where the species might still be found. Such occurrences would scarcely have escaped the notice of the Germans, and as I said above, this reasoning cannot explain the presence of this form in countries separated by arms of the sea.

Next then, let us consider a passive migration. This is possible for fresh-water animals in two ways. (1) Winter eggs or eggs with resistant membranes might be carried by the wind to distant regions and (2) eggs or young may transferred by fish or birds, &c. *Planaria alpina* lays its eggs in capsules possessing chitinous walls. These capsules are attached to leaves or stones, and might be carried by the agencies I have mentioned. If either method were used we might expect to find this creature more generally distributed than is the case. It must however be remembered that it is only in certain places that the conditions are sufficiently favourable for existence. von Kennel gives an interesting example of this.

In a small pool near Würzburg, dry every summer, he finds Daphnids and Asplanchna. In another close by, Cypris, Culicidæ, and fly-larvæ, and these are never associated with Daphnids. When the conditions are favourable, development proceeds at a rapid rate. Thus in 1883 the summer was very dry in south Germany; no rain had fallen for weeks. One night a heavy thunderstorm broke and two days afterwards, v. Kennel found in rain-pools not only Infusoria, Ostracods, Mesostomid Turbellaria with winter-eggs, but also Branchipus with ripe eggs. The next day all was dry as before. How far passive migration has occurred in the case of *P. alpina* it is difficult to ascertain. At Würzburg, neither fish nor birds visit the spring where it is found. But this does not hold for other localities where I have seen it. If we keep in mind that it is at the point where springs reach the surface that this form chiefly occurs, it is not difficult to accept v. Kennel's supposition (before the eggs were known) that the real habitat of this animal is in the interior of mountains and in subterranean water and we are driven to the conclusion that the animal must have ranged over western Europe before the glacial epoch, acquiring its present distribution owing to the separation of England, Ireland and Isle of Man from the Continent and one another. Now however that the egg-capsules have been discovered, it appears more probable that a passive agency has been the main factor in a post-glacial process.

2. *Polycelis cornuta*, O. Schmidt (Pl. XII, fig. 5.)

This species occurs commonly in fresh-water in the neighbourhood of Port Erin, but in warmer water than *Planaria alpina*.

II.—RHABDOCŒLIDA.

A. ACŒLA:—This group is of considerable interest owing to the very simple organisation of its members. They have no alimentary canal or digestive cavity. The food (chiefly Entomostraca) is secured by the pharynx and passed on to the parenchyma which is the assimilating-tissue. An otolith is constantly present.

Family—APHANOSTOMIDÆ.

3. *Aphanostoma diversicolor*, Oe. (Pl. XII, figs. 6 and 7.)

This species occurred in tide-pools close to the Port Erin Biological Station. It is distinguished by the colouration of the anterior end. The central part is violet, due to parenchymatous contractile pigment-cells; the peripheral portion and the extreme tip is coloured yellow owing to yellow vacuoles in the parenchyma. This form is recorded from Millport and Plymouth.

4. *Convoluta paradoxa*, Oe. (Pl. XII, fig. 3.)

During July, swarms of this species in different stages of development occurred among drift sea-weed (especially *Ceramia*) in Port Erin Bay. Tide-pools also yielded specimens but not so abundantly. The most interesting point of its structure is the presence of brown bodies usually known as yellow-cells or symbiotic algæ, which live in its tissue and largely determine its structure.

It has been known for ten years (owing to the work of Geddes and others) that another species of *Convoluta* (*C. schultzii*) contained chlorophyll, but whether the chlorophyll is autochromic, that is a product of the animal's activity; or exochromic, and due to symbiotic unicellular algæ, is a question which can scarcely be considered as thoroughly settled.

Geddes' attention was first drawn to these *Convoluta* when he saw what he took to be filamentous green sea-weed lying in an inch or so of water in sandy tide-pools at Roscoff. The sea-weed upon examination proved to be a multitude of *Convoluta schultzii* which were basking in the sunlight in a most conspicuous way. Suspecting that this was a purposeful action, Geddes experimented and ascertained that the green bodies evolved oxygen and formed starch, while a most disagreeable odour (resembling that of trimethylamine) was exhaled, which probably rendered the animals free from attack and thus enabled them to enjoy the direct sunlight.

The green bodies consist of cells containing one or more chloroplasts, one or more pyrenoids, and rod-like masses of starch. In the present species (*C. paradoxa*) similar bodies but brown in colour are present. The physiological action of the brown bodies has not been tested. That of the green cells of *C. roscoffensis* has furnished the basis for recent work by Haberlandt* and his conclusion, if correct, in all probability will be found to apply to *C. paradoxa*. His hypothesis is to this effect. The green bodies are physiologically algæ, that is, are descended from algæ, "which at the present time owing to profound adaptation in and with the *Convoluta*, have lost their independent algal character and now constitute an integral histological element, the assimilating tissue of the *Convoluta*."†

Littoral species of animals adopt various devices in order to resist the attacks of the waves. *Convoluta paradoxa* adopts a method which, as Professor Herdman tells me, is paralleled in the Nudibranch *Ancula cristata*.‡ The "tail" or pointed hinder extremity of the body is provided with sticky adhesive papillæ which enable *C. paradoxa* to

* v. Graff, "Acœla," 1891.

† See Lankester "Nature," vol. XLIV., 1891, p. 465.

‡ See Trans. Biol. Soc., Vol. IV., p. 135.

remain firmly attached to its favourite weeds (species of *Ceramium*, &c.). These papillæ are elevations of the epidermis. The force of adhesion exercised by them, may be roughly estimated by using a powerful syringe. Repeated action of an in-going or out-going stream do not affect the Convoluta. It merely sways slightly in the direction of the current without in the least loosening its hold on the substratum. This device is general among littoral Turbellaria; some forms indeed (*Planaria dioica*, Claparède) are provided with adhesive papillæ over their entire surface.

Eggs of *Convoluta paradoxa* were found in orange clumps (30—40 in a clump) during July. Each egg measured ·07 mm. in diameter, and owed its colour to the contained food-yolk. The adult (physiologically a female) becomes a tense bag of eggs which ruptures at the slightest touch. Young *Convolutæ* swim with great ease and rapidity, resembling in colour, form, and movement, the Copepoda associated with them. They contain very few (4—8) zooxanthellæ and are consequently of a much lighter colour than the adults.

Convoluta paradoxa has been recorded from Firth of Forth, Berwick Bay, Guernsey, St. Andrews, Skye, Weymouth, Millport and Plymouth, and is generally distributed in northern and southern European seas.

5. *Convoluta flavibacillum*, Jensen (Pl. XII, fig. 4.)

Occurred in tide-pools in front of the Port Erin Station during July. It is distinguished from the preceding species by its larger, more robust form, and the absence of zooxanthellæ.

B. Rhabdocœla:—Family Mesostomidæ.

6. *Promesostoma marmoratum*, Schlz (Pl. XII, figs. 8, 9.)

This active littoral species appears to the naked eye as a fine whitish thread 1—1.5 mm. long. The body truncate and furnished with adhesive papillæ posteriorly, tapers gradually forwards from the hinder fourth of its length. Reticular black pigment was present only between the eyes. The character which especially distinguishes this species is the copulatory organ (fig. 9). This consists of a fine chitinous tube coiled in the manner of a bishop's crozier. This tube is enclosed in an outer muscular one which transmits the spermatozoa, the inner chitinous duct containing the secretion of the accessory or granule-gland.

The form of the copulatory-organ among Turbellaria has been much used for the discrimination and determination of species in this group. It is therefore interesting to find in different individuals of *Promesostoma marmoratum*, an amount of variation of this organ, which, unless intermediate forms occurred, would certainly rank them as different species. Thus only one loose turn of the spiral may be present, and the form of the apex may vary considerably from that seen in fig. 9. This fact appears to be correlated in some way with the wide geographical distribution of the species, which ranges from the west coast of Greenland to the Mediterranean and Black Sea. This species has occurred at Skye, Millport, and Plymouth. At Port Erin it occurs in tide-pools.

7. *Promesostoma ovoideum*, Schm. (Pl. XII figs. 10, 12.)

A pale specimen of this species (wanting the usual black reticular pigment) occurred among shell-dèbris dredged outside Port Erin Breakwater, October, 1892, and is new to the British fauna. After leaving Port Erin I found it under similar conditions at Plymouth.

8. *Promesostoma lenticulatum*, Schm. (Pl. XII, figs. 11, 13.)

This species, hitherto only seen by Schmidt who found it at the Faroe Islands, occurred among *Corallina* in a tide-pool near the Port Erin Station.

Schmidt's description did not include the genital organs, and since these afford the most distinctive features, the systematic position of this species has long been doubtful. Length .65 mm. Body truncate and slightly convex in front with rounded projecting angles. Colour bright red, due to the contents of the gut. The eyes are very striking owing to the comparatively large size of the lens. The pharynx is sub-central. The copulatory organ has the form of the tool known as a "rose-bit" or "countersink." For further description of this and other species included in this paper, see my memoir on "British Marine Turbellaria," in the forthcoming number of the "Quarterly Journal of Microscopical Science."

9. *Byrsophlebs intermedia*, v. Graff (Pl. XII, figs. 17, 18.)

Length ·5 mm. Body flattened, yellowish-white, rounded in front, bluntly pointed behind. The feature which distinguishes this species from the closely allied *B. graffi*, Jensen, is the elongate form of the penis, the basal part of which is composed of the granule-vesicle strengthened by spiral muscles. The distal part is enclosed in a funnel-shaped copulatory-organ ending in a rounded aperture, from the margin of which a chitinous spur is given off.

This species occurred along with *Provortex balticus* and other forms in a coralline tide-pool near the Biological Station, Port Erin.

10. *Proxenetes flabellifer*, Jens. (Pl. XII, figs. 14, 15, 16.)

This species has the form of a fine white thread the advancing end of which is kept in continual, sensitive motion above the substratum. The hinder end is provided with well-developed adhesive papillæ which are speedily used at the slightest provocation. The rhabdites are present in large numbers in this genus, forming a pair of extensive and well-marked tracts converging between the eyes to the anterior end. The copulatory-organ is retort-shaped, and consists of a number of chitinous pieces, separating the duct of the vesicula seminalis from the passages constituting the outlets for the granule-gland. The sperm, conveyed down the main duct, issues through the passages‡ ‡ ‡, the granule-secretion on the other hand by the duct marked ‡ ‡, outside the retort. The chitinous strips forming the neck, are bound together by the piece marked D. The spermatheca, placed in front of the genital pore, receives at its blind end the chitinized ducts of an accessory-gland, while its distal portion bears a series of five triangular chitinous teeth hinged at their bases to its inner wall.

This species occurred in tide-pools round Port Erin and also commonly among weeds from "the Clets" a group of rocks in the Calf Sound. It has been recorded from Millport and Plymouth.

Family—PROBOSCIDÆ.

11. *Pseudorhynchus bifidus*, M'Int. (Pl. XIV, figs. 33, 34.)

Length 1 mm. Body produced in front into a conical non-ciliated "proboscis"; posteriorly it widens and ends in a bifid hinder extremity. Colour whitish-yellow with rounded brown spots over the surface. This form is interesting as it shows the way in which the proboscis characteristic of this Family has been elaborated. In *Pseudorhynchus* the proboscis is simply the slightly modified anterior extremity, furnished with numerous short retractor muscles. It is probable that by a specialization of these together with the addition of a mass of muscles known as the "muscle-cone" and a pharyngeal sheath, the typical proboscis has been formed as we see it in *e.g. Acrorhynchus*.

The copulatory-organ is a long funnel-shaped chitinous structure, round the outer face of which a spiral ridge occurs, produced at regular intervals into spinous processes. The use of this organ has not been definitely ascertained. It appears possible that it may have some use as an offensive weapon. It this connection another member of this family, *Gyrator hermaphroditus*, (found in fresh-and sea-water in this country) is suggestive. The so-called copulatory-organ is here converted into a stylet enclosed in a sheath and provided with protractor and retractor muscles. According to Hallez, it plays no part in copulation but enables the animal to seize the Entomostraca upon which it feeds. On approaching one of these, *Gyrator* bends the hinder end of the body (containing the stylet) downwards and forwards and stabs its prey repeatedly, which is then taken up by the pharynx.

Pseudorhynchus bifidus occurred among drift-weed in Port Erin Bay. It is also recorded from St. Andrews where it was first discovered by Prof. M'Intosh; and from Millport.

12. *Acrorhynchus caledonicus*, Clap. (Pl. XIII, figs. 19, 20.)

Length 1 mm. Body elongate, cylindrical, slightly tapering anteriorly. Colour white with grey blotches, the pharynx pure white. The dermal musculature, as in most representatives of this family, is very strong, and enables the animal to bear compression under a cover-slip without rupture. A mature animal treated in this way displays the complicated reproductive organs with almost diagrammatic clearness. The granule-and sperm-vesicles are bound together in a common penial muscular sheath which leads into a copulatory organ armed with small knobbed chitinous spines.

This form is frequently obtained among sea-weeds between tide-marks at Port Erin, and also occurs at Skye, Millport, and Plymouth.

13. *Macrorhynchus naegelii*, Kölliker. (Pl. XIII, fig. 21.)

In form, colour and size this species closely resembles the foregoing. It may be readily distinguished, however, by the presence of a special chitinous investment round the lower portion of the granule-vesicle. This is a short funnel-shaped tube, the wide mouth of which is usually provided with a curved spur.

The great bulk of the genital organs in this and other species of Proboscidæ, leads, during the development of the individual, to the loss of the alimentary canal as a definite coherent structure. Consequently, examination of adults shews that the body is almost exclusively filled with the reproductive apparatus, the gut being merely represented by isolated cells.

This species occurs at Port Erin, Millport, and Plymouth.

14. *Macrorhynchus helgolandicus*, Met. (Pl. XIII, fig. 22.)

During my visit to the Port Erin Station, during October of last year I found a number of immature examples of this form which is distinguished from all other species of *Macrorhynchus* by the possession of a special "poison-dart" in addition to complicated male and female copulatory organs. This had led v. Graff to place this species in a special division "Venenosi" as opposed the remaining Macrorhynchus-species included as "Typici."

M. helgolandicus has also occurred at Millport and Plymouth.

15. *Hyporhynchus armatus*, Jens. (Pl. XIII, figs. 23, 24.)

Length 1 mm. Body very elongate, thread-like and of a white colour. Although usually associated with other Turbellaria of a similar colour and appearance, this species is distinguished (as they are in turn) by peculiarities of locomotion which are sufficient to enable one to identify it even with the naked eye. The proboscis (as in the sub-family Hyporhynchinæ) opens on the ventral surface, behind the anterior extremity, and is much reduced in size as compared with that of the Acrorhynchinæ. The copulatory-organ consists of two spirally-coiled chitinous tubes fused throughout the greater portion of their lengths. Of these the finer duct transmits the granule-secretion, the wider one enables the spermatozoa to reach the exterior. The spiral takes two complete turns and ends in a terminal straight portion where the two ducts separate from one another.

This species was dredged in 15 fms. just outside Port Erin Breakwater. It has also occurred at Plymouth.

Family—VORTICIDÆ.

16. *Provortex balticus*, Schultze (Pl. XIII, figs. 27, 28.)

Length ·5—·75 mm. Body cylindrical, truncated, in the angles produced into blunt processes. The posterior extremity forms a long, finely-pointed "tail." The colour is due to irregular brown pigment which appears to be deposited as fine vacuoles in the cells of the parenchyma. The pharynx which opens through the mouth just below the anterior end, is provided with a distinct "seam" to to the margin, furnishing a surface of insertion for the strong pharyngeal retractor muscles.

The copulatory organ is cylindrical. Its aperture constitutes a slit, one margin of which is bent upon the main-duct and ends in a free process of variable shape. The uterus discovered by von Graff, lies in front of the penis and contains a single yellow cocoon at a time. A long fine duct leads to the genital aperture.

This extremely active, tiny animal occurs plentifully in tide-pools near the Port Erin Station. It is also recorded from Millport and Plymouth.

C. ALLŒOCOELA: Family—PLAGIOSTOMIDÆ.

17. *Plagiostoma sulphureum*, v. Gr. (Pl. XIII, figs. 29, 30.)

Length 2 mm. Body elongate, cylindrical, slightly narrowed and rounded at both extremities. Colour bright yellow, due to the rhabdites which lie in the epidermis. The mouth and the very small pharynx lie just behind the brain. The intestine occupies the central part of the length of the body. Opening into the pharynx is a large number of pyriform, finely granular cells, apparently glandular. Behind these a mass of cells occurs from which the ova develope from before backwards. A pair of vitellaria lie at the sides of the body, uniting in front. The follicular testes, few in number, are sub-central. The penis consists of a large proximal vesicula seminalis and a terminal muscular tube enclosed in a sheath. The spermatozoa, which afford the safest mark by which this species may be recognised, have a broad central portion, a finely-tapering tail and a cap-like anterior end. These are lateral expansions of the fine, sinuous central thread.

It is interesting to find this species, hitherto only recorded from Trieste, in a coralline tide-pool near the Port Erin Biological Station.

18. *Plagiostoma vittatum*, Frey & Leuck. (Pl. XIII, fig. 26.)

Length 1—2 mm. Body rounded in front, tapering gradually posteriorly. The colour is usually in the form of three transverse bands of purple reticular pigment; one across the head, another across the centre of the body, and a third across the tail. This is the typical form, but varieties are almost as abundant as the type. Thus von Graff at a single haul among Ulva, at Millport, obtained nine colour varieties.

The cocoons of this species occur in the autumn. They are brown, stalked vesicles, which according to van Beneden are attached to the abdominal appendages of the lobster, but I have found them on the surface of weed-covered stones between tide-marks.

This species is not uncommon in tide-pools at Port Erin, and is abundant at Millport and Plymouth. Young specimens occur in tow-nettings taken near shore.

19. *Vorticeros auriculatum*, O.F. Müller (Pl. XIII. fig. 25.)

Length 1·5—2 mm. Body elongate. The angles of the anterior margin are produced, in the expanded condition, into a pair of slender tentacles, almost $^1/_5$ the length of the body. They may, however, completely disappear during contraction. The colour is due to violet, reticular, parenchymatous pigment which occupies the dorsal surface (except the margins) and is continued as a narrow band over the upper surface of the tentacles. The anatomy resembles in detail that characteristic of *Plagiostoma*.

This elegant form occurs in tide-pools at Port Erin. It has been taken by v. Graff at Millport, and myself at Plymouth.

20. *Allostoma pallidum*, P.J. v. Ben. (Pl. XIII, figs. 31, 32.)

A few immature examples of this species occurred at Port Erin. The anterior sixth is marked off from the rest of the body by a circular ciliated groove. The epidermis contains large numbers of "mucus-rods," which have been considered as intermediate between the amorphous secretion of a subepidermal gland, and the sharply-defined rhabdites. All three are homologous, but differ in the degree of consistency.

The common genital pore is almost terminal at the hinder end. The penis is muscular. It receives the vasa deferentia and granule-gland in its upper proximal portion. The oviducts (according to v. Graff), unite before opening to the exterior. This species has been recorded from Millport.

21. *Cylindrostoma quadrioculatum*, Leuck. (Pl. XIV. figs. 35 and 36.)

Length ·5—·75 mm. Body colourless, rounded in front, produced posteriorly into a long pointed "tail," beset with adhesive papillæ. The pharnyx and its large cylindrical sheath are long and muscular. The mouth is placed just in front of the brain. The latter is quadrate, and bears two pairs of eyes: an anterior small pair, the lenses of which are directed backwards and outwards, and a larger posterior pair, whose lenses face forwards and outwards. The sides of the body are occupied by a large gland, which produces food-yolk throughout its anterior portion, ova in the posterior. Hence it is called the germ-yolk-gland. The genital aperture is combined with the mouth, and through it the muscular penis containing both male secretions opens to the exterior. A large spermatheca lies at the hinder end of the body.

Cylindrostoma quadrioculatum occurs in tide-pools at the base of the littoral zone, near Port Erin. It is also recorded from Millport, Skye, and Plymouth.

22. *Cylindrostoma inerme*, (Hallez.)

This species resembles the former in many points, but is distinguishable from it by the following characters. The form of the body is stouter, the tail shorter. The bright yellow colour is due to small groups of pigment granules in the epidermis. The genital organs in general correspond closely to those of the foregoing species, but a spermatheca is absent. This form occurs among drift seaweed in Port Erin Bay and is also found at Plymouth.

Family—MONOTIDÆ.

23. *Monotus lineatus*, O. F. Müller, (Pl. XIV. fig. 39.)

Length 2—2·5 mm. Body elongated, flattened, tapering anteriorly, armed with strong adhesive-cells posteriorly.

The colour is white, frequently marked with brown pigment. The epidermis contains numerous flagella. The anterior end is used in an extremely sensitive way. Immediately upon encountering any obstacle it is sharply retracted, and the hinder extremity at the same moment grasps the substratum by its shield-shaped adhesive surface. This is done so rapidly that it becomes difficult to surprise the animal and capture it by means of a pipette.

A short distance from the anterior end an otolith is constantly present in members of this family, and in front of it is a median transverse band of pigment usually spoken of as the "eye." The pharynx is inserted near the centre of the body, and is extremely contractile. The germaria, two in number, are placed at the sides of the base of the pharynx. The penis is characteristic of the species. It is merely a soft papilla receiving the contents of the muscular vesicula seminalis, and transmitting them to the exterior through the male pore, which is placed behind the female pore, a short distance from the posterior end. *Monotus lineatus* occurs not uncommonly among *Corallina* in tide-pools about Port Erin and on the "Clets." It is recorded from Millport, Skye, St Andrews, and Plymouth.

24. *Monotus fuscus*, Oersted. (Pl. XIV, figs. 37 and 38.)

This species resembles the former in many external and internal anatomical features. The colour however is rather different. The anterior end is whitish, the rest of the body brown. Von Graff and Jensen record individuals with purple pigment.

The changes of colour undergone by young *Monotus* in reaching the adult condition are the following, as v. Graff has already noticed. Very young specimens (1 mm. or so,) are white, with a few carmine granules. Next, these granules increase in number, giving a reddish tint to the individual. Lastly, the red colour of the granule gives way to brown which appears when the specimens reach 1·75—2 mm. in length.

Monotus fuscus ranges through the littoral zone to its higher portions where the rocks and weeds are exposed to the drying effects of the atmosphere. Turbellaria are however so constituted (being without any outer protective membrane) that dryness means death to them. It is interesting therefore to find *M. fuscus* adopting a singular device in order to gain a moist environment during the ebb-tide. Prof. Hallez, of Lille, in 1879, recorded that after scraping *Balani* off the rocks at Wimereux, and placing them in a basin of sea-water, this form presently emerged. They had concealed themselves among the thoracic appendages of the *Balani*, and thus continued to keep their surface in contact with a moist medium. Hallez hence called it *Monocelis balani*. Prof. v. Graff has found that at low water *M. fuscus* occurs between the gills of Chiton and Patella, and he supposes that it leaves this situation when the tide returns. *Balanus balanoides* at Port Erin yielded several specimens. The copulatory organ has the form of a tubular chitinous duct, attached by muscles to the mouth of the vesicula seminalis.

Monotus fuscus occurs between tide-marks at Port Erin, Millport, and Plymouth.

III. POLYCLADIDA.

A. Acotylea: Family—Leptoplanidæ.

24. *Leptoplana tremellaris*, O. F. Müll. (Pl. XIV, fig. 40.)

Length 20—25 mm. Body delicate, slightly expanded in front, the anterior margin being almost semi-circular. Swimming is effected by repeated violent vertical strokes of the expanded margins. The colour is variable. White, light-brown, and mottled dark-brown specimens occur. On the ventral surface the central, plaited pharynx is readily seen lying in its sheath. Behind it comes the male genital pore, towards which the conspicuous V—shaped area, caused by the vasa deferentia, converges: behind this again, the female pore. Behind these two apertures is a muscular depression, the sucker, which is probably of considerable use to the animal since it ensures a firm hold on the substratum. From the dorsal surface the sacculated main-gut and its numerous lateral branches may usually be seen. In front, four groups of eyes are generally readily distinguishable although occasionally the two groups on each side unite, so that their double nature is not obvious. The anterior group consists of eyes which, in genera closely allied to *Leptoplana*, surround the bases of a pair of tentacles, hence the term *tentacular group*. The tentacles persist in a rudimentary condition in *L. Alcinoi*, Lang. The posterior group contains rather larger, more markedly reniform eye-specks. From other species of *Leptoplana* which resemble *tremellaris* in appearance, this species may be distinguished by the presence of the sucker and by the simple, non-muscular, female genital canal.

This species occurs at Hilbre Island, Puffin Island, Port Erin, and Port St. Mary, on the under surface of weed-covered stones between tide-marks. It also descends to about 20 fms. Young specimens are more or less pelagic and differ from the adult in their shape which is almost that of a spherical triangle.

Other localities for *L. tremellaris* on the British coast are the following:—Firth of Forth, St. Andrews, east coast of Ireland, Aberystwyth and Plymouth.

B. COTYLEA: Family—EURYLEPTIDÆ.

25. *Cycloporus papillosus*, Lang. (Pl. XIV, figs. 41, 44.)

Length 10—15 mm. Body fairly consistent, oval, slightly narrowed in front, where it is continued into a pair of short stumpy tentacles. The dorsal surface is typically produced into a number of small, usually brightly coloured papillæ which are quite superficial elevations and do not involve the underlying alimentary canal. They are absent in the variety *laevigatus*, and are replaced by pigment-spots. The colour is very variable and the meaning of this variability is discussed below. Peripheral clumps of pigment occur on the margin. Eyes are present on and round the bases of the tentacles, and a pair of larger groups are also present over the brain, (cephalic groups). The mouth lies behind the brain and leads into a bell-shaped pharynx which appears as a light area on the dorsal surface. The long main-gut is median and gives off 6—7 pairs of lateral branches. The male and female genital aperture lie behind the mouth in the order named. The sucker is subcentrally placed on the ventral surface of this animal.

The conditions under which *Cycloporus* is found appear to point very forcibly to the conclusion that the colouring is associated and probably correlated with that of the substratum. *Cycloporus* is found often in pairs of similarly coloured individuals, on the surface of sponges and compound ascidians both in the littoral and deeper zones. The general colour is frequently but not always that of the particular ascidian (*Leptoclinum durum*, &c.) The main-gut which is median with lateral branches, appears to simulate lines separating off the cœnobia, while the peripheral pigment-spots resemble in detail the coloured and expanded ends of the vessels of the ascidian test. This is not all. The sucker with which the *Cycloporus* is provided, enables it to adhere so strongly to the substratum of which it appears to form an integral part, that it is often necessary to use a knife to detach the specimens. Professor Lang has observed numerous examples at Naples and these appear to be adapted each to its particular and self-coloured surroundings.

While these facts, the striking nature of which can only be realised on the shore, appear to point to detailed adaptation in the form, texture, colour, and immobility of the Polyclad to the Ascidian, there are one or two opposing facts which must not be omitted in attempting to arrive at a just conclusion. *Cycloporus* is sometimes found on substrata, with which it has no perceptible resemblance and secondly 3—5 black spots are generally present in var. *laevigatus* which have no analogue in the ascidian. This only helps to shew how very fragmentary and incomplete is our knowledge of the true life-relations of these animals. A theory, thoroughly consistent with the facts cannot be framed until far more observations than we at present possess, are made in different localities and at different times of the year.

Certain colour-varieties of *Cycloporus papillosus* closely resemble *Stylostomum variabile*, and it may be useful to point out the features by which the former can be always recognized. The presence of a median gut-branch over the pharyngeal region is diagnostic. Such a branch only exists *in front* of that region in *Stylostomum*. Again, examination of living or still better, of well-preserved specimens of *Cycloporus*, shews that the mouth-opening is distinct from the male and female genital apertures. In *Stylostomum* on the other hand, the male and oral apertures are united and open just behind the brain.

Cycloporus papillosus has been observed by Prof. Herdman at Puffin Island, and was dredged by Mr. H.

C. Chadwick, in 12 fms., off Bradda Head, Port Erin. The variety *laevigatus* has been taken by Mr. W. J. Beaumont and myself, between tide-marks, both at Port Erin and Port St. Mary. I have also taken it at Plymouth.

26. *Oligocladus sanguinolentus*, Quatr. (Pl. XIV, fig. 42, 45.)

Length 6—7 mm. Body elongated, oval, broadly rounded behind, slightly narrowed in front. A pair of long, conical marginal tentacles are present, and between them the anterior extremity projects slightly. Ground-colour white, against which the deep carmine-coloured intestine is distinctly visible. The mouth is far forward, in front of the brain. The strong muscular cylindrical pharynx, is enclosed in a sheath which gives off a posterior coecum extending behind the mid-ventral sucker. 4—5 pairs of secondary branches arise from the straight main-gut. The first pair enclose the pharynx and unite in front of it. From this junction a short median offset represents the unpaired branch which in other Polyclads arises directly from the main-gut. A terminal gut-branch enters each tentacle. Eyes are present round the bases of the tentacles and also as a couple of small sharply-defined groups over the brain. The male genital aperture lies just behind the brain. The female pore surrounded by the radiating masses of the "shell-gland," is placed half-way between the male pore and the mouth.

This species, hitherto only recorded by Köhler, from Guernsey,* was dredged on several occasions among shell-dèbris outside Port Erin Breakwater. I have also found it under similar conditions at Plymouth.

Eurylepta cornuta which probably occurs, though I have not met with it, in the L.M.B.C. district, differs from this species by its large size (sometimes an inch long), scarlet colour, and elongate group of eyes over the white pharynx.

*Annals & Mag. Nat. Hist., XVIII, 1886.

27. *Stylostomum variabile*, Lang (Pl. XIV, figs. 43, 46.)

Length 5—8 mm. Body oval, rounded posteriorly, narrowed anteriorly. The angles of the truncated front-margin are slightly produced into rudimentary tentacles. The body is usually colourless, and is more or less transparent according as the genital organs are less or more developed. Immature examples display the branches of the brightly-coloured intestine very clearly. The mouth combined with the male genital pore, is just behind the brain. The muscular pharynx gives rise to the white anterior area seen upon the dorsal surface. Small groups of eyes are present over the brain, and at the base of the tentacles. In front of the sucker lies the female pore, surrounded by the massive "shell-gland." The uterus is placed at the sides of the main-gut.

This species was dredged on shelly ground, outside Port Erin Harbour. It also is found at Plymouth, and has been recorded by Dalyell from the Firth of Forth.

In concluding this Report I wish to express my hearty thanks to Prof. Herdman for the use of the L.M.B.C. Station, at Port Erin, and to my friend Mr. W. J. Beaumont, for his ever ready assistance in the capture of these Turbellaria.

Explanation of Plates, XII—XIV.

List of Abbreviations :—

AU eyes, BR brain, CH copulatory organ, D intestine, DP dorsal papillæ, EJ ejaculatory duct G and PE penis, GA genital atrium, GD poison glands, GER germaria, GO genital aperture, KC chitinous granule-duct, KD granule-gland, ME penial sheath, MO mouth, MR retractor muscle, OD oviduct, OT otolith, PH pharynx, PR proboscis, PS penis-sheath, RS receptaculum seminis, T testis, TE tentacle, S stylet, SB and VS vesicula seminalis, SK sucker, SP spermatozoa, ST chitinous investment of ejaculatory duct, SP spur of copulatory organ, TR investment around vesicula, UT uterus, VD vas deferens, VG vesicula granulorum, X muscular pit.

Plate XII.

Fig. 1. *Planaria alpina*, Dana. Drawn from the living animal. Natural length ·75—1·5 cm. (× 2).

Fig. 2. *Planaria alpina*, Dana. The genital atrium and organs in connection with it.

Fig. 3. *Convoluta paradoxa*, Oe. From the living animal, seen from the ventral surface. Natural length 2 mm. (× 20).

Fig, 4. *Convoluta flavibacillum*, Jensen. (Partly after v. Graff), (× 15).

Fig. 5. *Polycelis cornuta*, O. Schmidt. Anterior part of body (× 15).

Fig. 6. Violet pigment-corpuscles from *Aphanostoma diversicolor*, Oe.

Fig. 7. *Aphanostoma diversicolor*, Œrsted (× 30).

Fig. 8. *Promesostoma marmoratum*, Schultze (× 25).

Fig. 9. The copulatory organ of *P. marmoratum*.

Fig. 10. *Promesostoma ovoideum*, O. Schmidt (× 40).

Fig. 11. *Promesostoma lenticulatum*, O. Schmidt (× 40).

Fig. 12. Copulatory organ of *P. ovoideum*.

Fig. 13. Copulatory organ of *P. lenticulatum*.

Fig. 14. *Proxenetes flabellifer*, Jensen. Natural length 1·75 mm. (× 20).

Fig. 15. Chitinous teeth from the duct of the spermatheca of *P. flabellifer*.

Fig. 16. Copulatory organ of *P. flabellifer*, (after v. Graff).

Fig. 17. *Byrsophlebs intermedia*, v. Graff. Natural length 1 mm. (× 20).

Fig. 18. Copulatory organ of *B. intermedia.*

Plate XIII.

Fig. 19. *Acrorhynchus caledonicus*, Claparède. Drawn from the living animal. Natural length 1·5—2 mm. (× 20).

Fig. 20. Copulatory organ of *A. caledonicus.*

Fig. 21. Granule-vesicle of *Macrorhynchus naegelii*, Köll.

Fig. 22. Male genital organs of *Macrorhynchus helgolandicus*, Metschnikoff, (after v. Graff).

Fig. 23. *Hyporhynchus armatus*, Jensen. Natural length 1·5 mm. (× 25).

Fig. 24. Copulatory organ of *H. armatus.*

Fig. 25. *Vorticeros auriculatum*, O.F.M. Tentacles not quite fully extended. Drawn from life (× 25).

Fig. 26. *Plagiostoma vittatum*, Frey and Leuckart (× 25).

Fig. 27. *Provortex balticus*, Schultze. From the living animal (× 60).

Fig. 28. Chitinous copulatory organ of *P. balticus.*

Fig. 29. *Plagiostoma sulphureum*, v. Graff. From the living animal. Natural length 2 mm. (× 25).

Fig. 30. Ripe spermatozoon of *P. sulphureum.*

Fig. 31. *Allostoma pallidum*, van Beneden. Natural length 1·5—2·5 mm. (× 25).

Fig. 32. The genital organs of *A. pallidum*, (after v. Graff).

Plate XIV.

Fig. 33. *Pseudorhynchus bifidus*, M'Intosh. Drawn from life, showing the anterior conical proboscis. Natural length 1·5 mm. (× 25).

Fig. 34. Corkscrew-shaped copulatory organ of *P. bifidus*, (after v. Graff).

Fig. 35. *Cylindrostoma quadrioculatum*, Leuckart.

Fig. 36. Head of *C. quadrioculatum*,

Fig. 37. *Monotus fuscus*, Œrsted. (The figure also represents *M. lineatus*.) From the living animal.

Fig. 38. Copulatory organ of *M. fuscus*.

Fig. 39. Copulatory organ of *M. lineatus*.

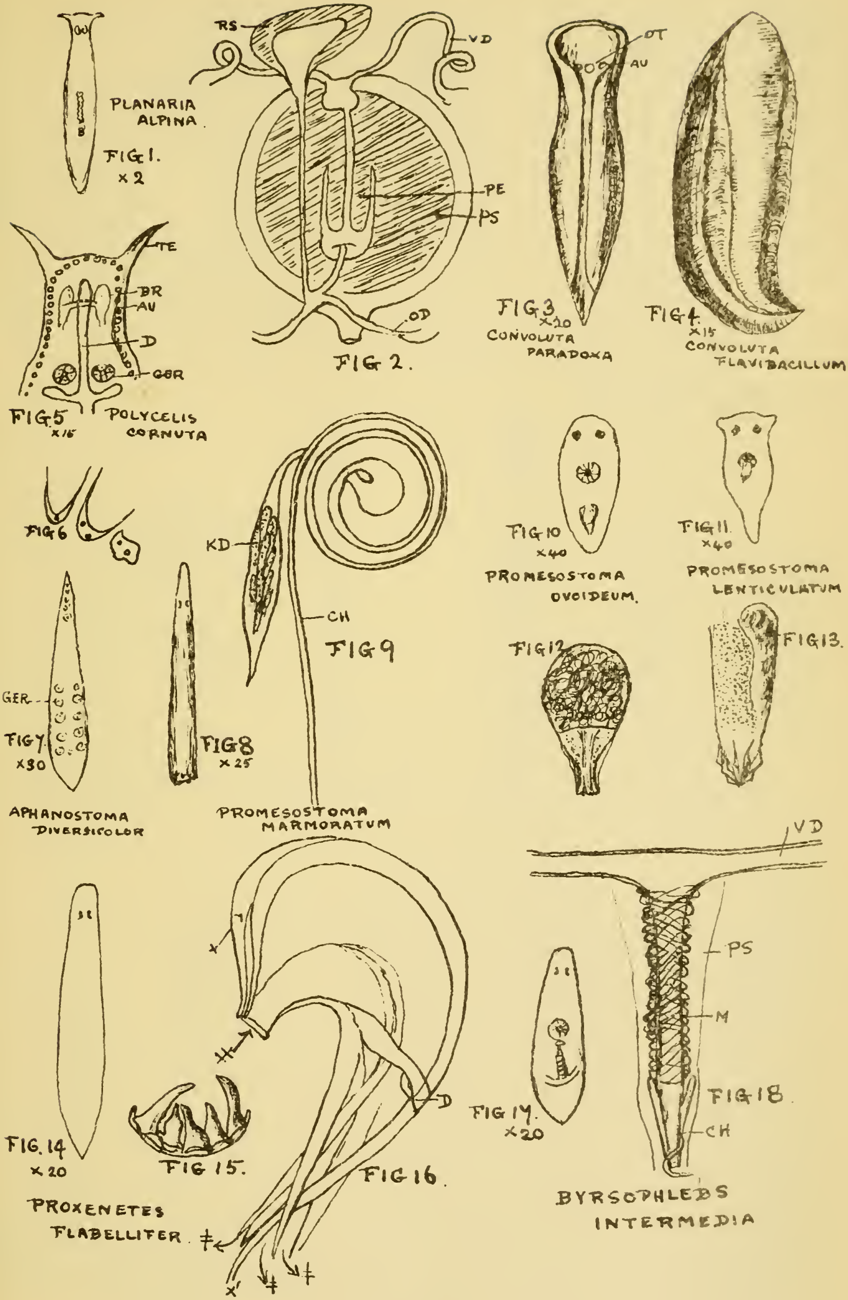
Fig. 40. *Leptoplana tremellaris*, O.F.M. From the living compressed animal, ventral surface. Natural length 18 mm. (× 2).

Fig. 41. *Cycloporus papillosus*, Lang. (× 8).

Fig. 42. *Oligocladus sanguinolentus*, Lang. Length 1·1 cm. (×4).

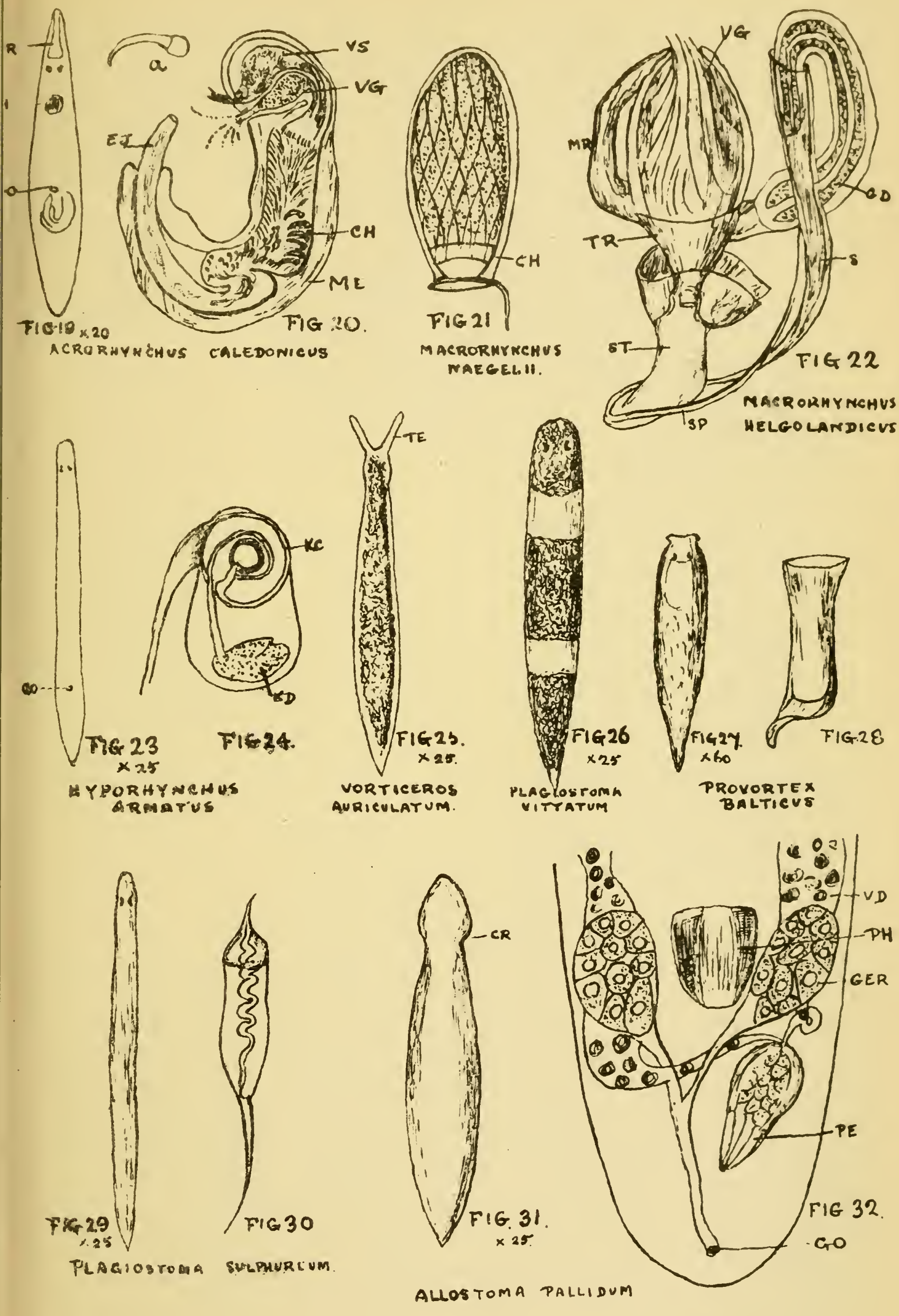
Fig. 43. *Stylostomum variabile*, Lang. An immature specimen (× 5).

Figs. 44—46. Diagrams to illustrate the relation positions of mouth and genital aperatures, and other points which distinguish the genera *Cycloporus*, *Oligocladus* and *Stylostomum*, (after Lang).



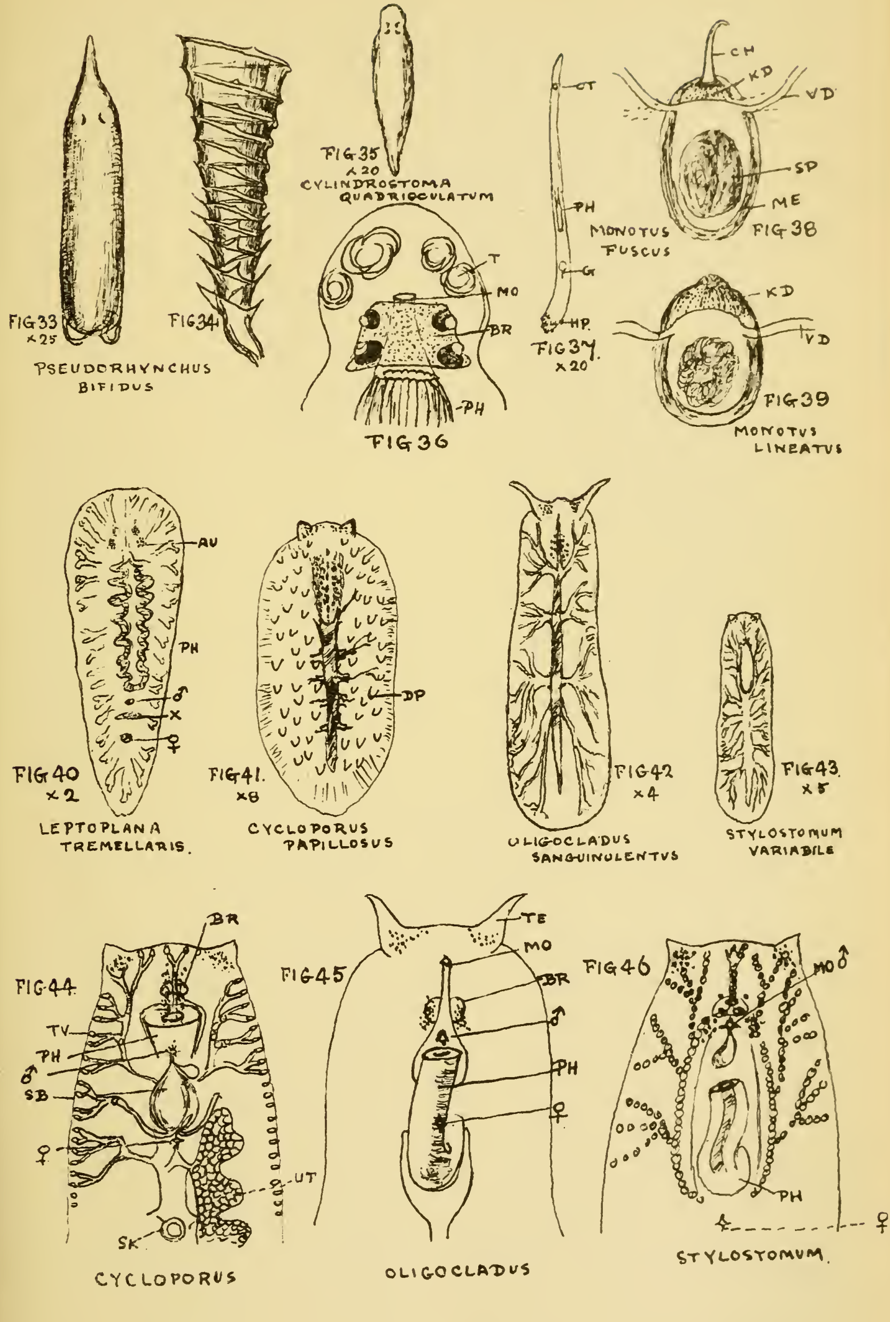
F. W. G., del.

L.M.B.C. TURBELLARIA



F. W. G., del.

L.M.B.C. TURBELLARIA.



F. W. G., del.

L.M.B.C. TURBELLARIA.

[WORK FROM THE PORT ERIN BIOLOGICAL STATION.]

REVISED REPORT on the COPEPODA of LIVERPOOL BAY.

By Isaac C. Thompson, F.L.S., F.R.M.S.

With Plates XV to XXXV.

[Read February 10th, 1893.]

Three previous Reports have been issued upon the Copepoda of the L.M.B.C. District, the last being in the year 1889. Since that time so many species new to the district have been found that it was thought advisable to draw up a complete Report of all the species recorded in the district up to the present time.

Previous to the work of the L.M.B.C., commenced in 1885, very little in this group had been done, six species only of marine Copepoda having been recorded in our area. The present Report deals with 136 species of which 18 are new to British seas, 11 of them being new to science. Those new to British seas are as follows :—

Labidocera acutum, Dana, *Euchæta marina*, Prestandrea, *Giardella callianassæ*, Canu, *Monstrilla danæ*, Claparède, *Monstrilla rigida*, Thompson, *Sabelliphilus sarsii*, Claparède, and *Artotrogus orbicularis*, Boeck. Those new to science are :—

Herdmania stylifera, *Cyclops marinus*, *Hersiliodes puffini*, *Jonesiella hyænæ*, *Ameira attenuata*, *Stenhelia denticulata*, *Stenhelia hirsuta*, *Monstrilla longicornis*, *Laophonte spinosa*, *Cletodes monensis*, and *Lichomolgus maximus*.

The total number 136 species are divided amongst the various families as follows: Calanidæ 13 species, Pontellidæ 4, Misophridæ 3, Cyclopidæ 7, Notodelphidæ 7, Harpacticidæ 72, Monstrillidæ 4, Sapphirinidæ 11, Artotrogidæ 6, Chondrocanthidæ 1, Caligidæ 6, Lernæidæ 1, and Lernæopodidæ 1 species.

It will be noticed that the above enumeration includes both the free swimming and semi-parasitic and wholly parasitic species, any exact line of division being impracticable as many of the semi-parasitic species are free swimmers at night being also occasionally taken by townet during the day. This is especially the case with members of the family Caligidæ.

During the many expeditions in the "Hyæna," "Spindrift," "Mallard" and other vessels, townets at the surface and at various depths have been systematically employed; and washings from dredged material have often yielded good results. The establishment of the Marine Biological Station upon Puffin Island early on in our work, under the directorship of Professor Herdman, F.R.S., proved of the greatest service as regards the investigation of Copepoda, for besides affording the opportunity of frequent personal visits, the resident curator during the greater part of the time forwarded regularly townettings, dredged mud, &c., for examination taken at various hours day and night and throughout the entire year. After five years work at Puffin Island, the removal of the L.M.B.C. Station to Port Erin at the south-west corner of the Isle of Man in the summer of last year has proved a complete success. The accessibility of the new station and its more completely equipped laboratory have facilitated the ready examination of living specimens immediately on landing from the boats, a circumstance of great value when dealing with minute forms of life like the Copepoda subject to rapid decomposition.

The muddy bottom of Port Erin Bay inside the breakwater has proved an exceedingly rich hunting ground for Copepoda, several of the new species having been taken there as well as several rare ones not taken in any other part of the district. Indeed it seems probable that it is from dredged material in such localities that we must look chiefly for additions to our microscopical fauna, the free swimming forms of our district being more completely tabulated.

Experience further leads me to the opinion that small isolated tracts, probably local depressions in a muddy or sandy bottom are particularly rich in Copepoda, apparently similar material taken from near such local centres having at the same time proved most unprolific or nearly altogether destitute of life. The rock pools at Hilbre Island as well as those of Puffin Island have proved valuable hunting grounds worked with a fine hand townet.

The parasitic species in the Report found in the branchial sacs of Ascidians have all been sent to me by Prof. Herdman. To him also and to his "Fisheries Laboratory" Assistant Mr. P. J. F. Corbin I am indebted for a large number though hitherto not a great variety, of fish parasites. The recent establishment of this Fisheries Laboratory gives promise of much valuable opportunity for the study of this important and rather neglected branch of our Copepodan fauna. Many of the other fish parasites here recorded were collected by our lamented colleague Mr. Frank Archer, B.A., while staying at Bull Bay, Anglesey.

A new form of *Lichomolgus, L. agilis*, has been recently described by Mr. Thomas Scott, F.L.S., of the Scottish Fishery Board, from specimens inhabiting the inside of Cockle shells. This species I have found in the water of all the fresh cockles examined and it is probably very common, although previously overlooked. I had, however, taken it two years ago in a night townetting off Puffin Island, and put it aside as a new form, but deferred any description in the hope of finding more specimens. Still more recently I have found in the shells of the *Pecten maximus* a large *Lichomolgus* herein described as *Lichomolgus maximus*. It is probable that the examination of other mollusca obtained when dredging may lead to the discovery of further new species of parasitic Copepoda. A closely allied species to the two last mentioned, *Sabelliphilus sarsii*, Claparède, was sent to me by Mr. Chadwick, adherent to the tentacles of a species of *Sabella* collected on the Beaumaris shore. I have since found it attached to the same host around Puffin Island and think it probable that although apparently hitherto unrecorded elsewhere in British waters, it only requires looking for.

As a preservative fluid for Copepoda I have always found a mixture composed of equal parts of Alcohol, Water and Glycerine with 1 per cent. of Carbolic Acid most useful. Specimens may be transferred direct to it from sea water and can be so preserved for any desired period of time, to be mounted direct without further preparation in either Glycerine Jelly or Farrants Medium. I can confirm the value of Canon Norman's "excellent device" for capturing Copepoda and other small Crustacea while alive from freshly dredged material as given by Mr. A. O. Walker, F.L.S. (Report on the Higher Crustacea of Liverpool Bay taken in 1889) Fauna of Liverpool Bay, Report III, p. 239, 1892, many rare Copepoda having come to me through this means. Recently I have employed a still more exhaustive method with the greatest advantage, particularly when as is often the case material or dredged mud or sand requires to be kept a considerable time before it can be examined, viz., the dredged material is washed through a coarse sieve into a finely meshed silk bag into which a running stream of water from a tap is allowed to fall. By careful kneading with the hands all the soluble or very finely suspended particles are washed away through the texture of the bag. The clean residue is then placed in a large flat dish of water and stirred round, when the fine floating organic portion, often very rich in Foraminifera, Diatomacea, Ostracoda, Amphipoda, and Copepoda can be strained off and placed in preservative fluid for examination.

As a ready means of detecting and naming species must be of value to the sea side naturalist, I have in the plates (XV to XXXV) given small outline sketches of the forms treated of in this Report together with reference to special points of distinction so far as space allowed. They are mostly taken direct from the animal under the microscope, a few being taken in part from the drawings of Claus, Brady, &c. In the cases of genera including several species, the distinctive points only of some are given.

The importance to man of the distribution of Copepoda in our lakes, seas and oceans is twofold—firstly from a sanitary point of view, as purifying agents, and secondly economically as affecting our food supply of fishes. Neither can indeed be easily overrated. As the chief and ever active scavengers of our seas, seizing upon impurities and decomposing matter which might else become a scourge too terrible to contemplate, these minute crustaceans by means of their internal laboratories, convert decay and refuse into their own organizations which in turn become the chief food of fishes. As might naturally be expected, Copepoda are most plentiful near to land, thither probably attracting shoals of fishes, in their turn the valuable food of man. Our direct material indebtedness to Copepoda can thus be easily traced.

In this work as in other matters biological, I have constantly availed myself of the always ready help of my friend and instructor Professor Herdman, F.R.S. In much of the earlier collecting and sorting out of specimens I enjoyed the co-operation of Mr. W. S. McMillan, F.L.S., and I am indebted to our colleague Mr. A. O. Walker, F.L.S., of Colwyn Bay and to others for material and specimens collected. Lastly my sincere thanks are due to my friend Dr. G. S. Brady, F.R.S., of Sunderland, for frequent help in the examination and confirmation of specimens and whose distinguished work on British Copepoda has formed the chief basis for my classification.

Since completing the manuscript of this Revision the very beautiful and comprehensive work of Dr. Giesbrecht, of Naples, "Pelagische Copepoden," (Fauna und Flora des Golfes Von Neapel, 1892) has appeared, and in a few instances I have adapted the nomenclature in accordance with the results of his important researches. In the following enumeration of species all the measurements given are taken from the rostrum or anterior portion of the cephalothorax to the termination of the caudal segments, and do not include anterior or caudal setæ.

Map of L.M.B.C. District.

COPEPODA.

Family I.—Calanidæ.

Calanus finmarchicus, Gunner. (Pl. XV, fig. 1.)

Length 2.80 mm. A thoroughly pelagic species, common throughout the year but rarely or never taken except in the open sea. When found at considerable depths it is usually of a dark red colour and contains a quantity of oil. It constitutes the chief food of the Greenland whale.

Metridia armata, Boeck. (Pl. XV, fig. 2.)

Length 1.80 mm. Single specimens have been rarely found and only in the open sea at a considerable distance from land. The broad leafy terminations (*a*) of the swimming feet easily distinguish it.

Pseudocalanus elongatus, Baird. (Pl. XV, fig. 3.)

Length 1.30 mm. Very common throughout the district and seldom absent in any townet gathering. The females are often found with three or four large ova.

Pseudocalanus armatus, Boeck. (Pl. XV, fig. 4.)

Length 1.75 mm. A pair of this rare species was taken by surface townet in Port Erin Bay, in 1889, during an illumination of the surface of the sea by electric light from the "Hyæna." Its only other occurrence in the district was in the "Mallard" cruise of 1892 when a single specimen was found among some dredged material taken at a depth of 20 fathoms outside Port Erin. I was at first in doubt whether those specimens were *Ætidius armatus*, Brady, and after careful examination of them with Brady's description of the latter, I am disposed to query whether the two species are not synonymous. The lateral spines of the posterior end of the cephalothorax readily distinguish it from *P. elongatus*.

Paracalanus parvus, Claus. (Pl. XV, fig. 5.)

Length 1.30 mm. One specimen only of this rare form was taken by townet off Puffin Island.

Acartia clausii, Giesbrecht. (Pl. XV, fig. 6.)

Length 1.45 mm. Common in the open sea.

Giesbrecht separates *A. clausii* from *A. longiremis*, the slight points of difference being chiefly in the 5th feet, the spinal termination of the female 5th foot of *A. clausii* (*b*) being much shorter and stronger than that of *A. longiremis*. It is probable that we may have both species but those I have dissected for examination all belong to the former.

Acartia discaudatus, Giesbrecht. (Pl. XV, fig. 6.)

Length 1.20 mm. Taken frequently off the mouth of the Dee and about the Anglesea coast. It may be readily distinguished from *A. clausii* by the caudal segments (*c*) which are about as broad as long.

Temora longicornis, Müller. (Pl. XV, fig. 7.)

Length 1.75 mm. Perhaps the most common British surface species, although rarely or never taken outside British waters. The caudal segments (*b*) form a sufficiently distinguishing feature.

Eurytemora clausii, Hoek. (Pl. XV, fig. 8.)

Length 1.40 mm. Generally met with in brackish water estuaries or pools and in salt marshes. Abundant in pools behind Leasowe embankment.

Eurytemora affinis, Poppe. (Pl. XVI, fig. 1.)

Length 1.75 mm. A large number of this species were taken by townet off the sandbanks at the mouth of the Mersey in 1886. It was not subsequently recorded in the district until 1891, when the filter beds of the Bootle Corporation baths were found to be swarming with it. Mr. Ascroft has since sent me specimens found in tidal pools at Lytham. The males I have found are conspicuous by the number of spermatophores attached to them.

Isias clavipes, Boeck. (Pl. XVI, fig. 2.)

Length 1.60 mm. Frequently taken by townet in the open sea but never abundantly.

In a former paper "Second Report on the Copepoda of Liverpool Bay," Proc. Biol. Soc., L'pool, Vol. II, I pointed out the existence of a pair of curved spines trifid at apex, one on each side of the tubercular genital prolongations on the first abdominal somite of the female. Brady's drawing and description of the fifth foot of the male are not quite correct. He says the inner branch "of the right side is provided with swimming setæ and is two jointed," and he so figures it. This accidental error led M. Canu in "Les Copepodes libres Marins du Boulonnais," (Bulletin Scientifique de la France, Paris, 1888) to suppose that a male specimen he examined differing in the fifth feet from Brady's drawing could not be *I. clavipes* and he accordingly named it *I. bonnieri*. On examining my specimens of *I. clavipes* I found they agreed with Canu's *I. bonnieri*, and on the matter being referred to Dr. Brady he at once saw that Canu's drawing is correct for *I. clavipes*. *I. bonnieri* must therefore be withdrawn.

Centropages hamatus, Lilljeborg. (Pl. XVI, fig. 3.)

Length 1.30 mm. Common in the open and seldom absent from the townets. It is rather surprising that so far as I am aware the allied species *C. typicus* has never been found in the L.M.B.C. district.

Parapontella brevicornis, Lubbock. (Pl. XVI, fig. 4.)

Length 1.30 mm. Occasionally taken in surface townet also rarely in tidal pools. The two lateral abdominal spines (*c*) easily distinguish this species.

Family II.—Pontellidæ.

Labidocera wollastoni, Lubbock.

Length 2.50 mm. During the autumn months we have taken this somewhat rare species plentifully in surface townets off Puffin Island and in the open sea. Males and females seem equally plentiful. The fifth feet (*b*, *c*, *d*) readily distinguish it.

Labidocera acutum, Dana. (Pl. XVI, fig. 6.)

Length 2.50 mm. One specimen, a male, of this rare exotic species was found in dredged material taken off Puffin Island in 10 fathoms when in company with Dr. Brady.

Anomalocera patersoni, Templeton. (Pl. XVI, fig. 7.)

Length 3.75 mm. This large striking Copepod has been frequently taken in the district, but generally when it has occurred, as on two dredging expeditions round about the Isle of Man, it has been in such profusion for a few days as to almost fill the townets and to be clearly visible on the surface from the steamer's deck. When living it is of a deep green colour interspersed with blue and red but so far I have been unsuccessful in preserving its natural colour. What becomes of these tremendous shoals at other times remains a mystery. Dr. J. Murray considers it unlikely that an animal so coloured could be a deep water species, and we have never taken it at any great depth, nor does it appear to be of wide geographical distribution. Male and females were equally plentiful.

Euchaeta marina, Prestandrea. (Pl. XVI, fig. 8.)

Length 3.0 mm. A single specimen of this well known southern species, never I believe before recorded in British seas was found adherent to the branchial sac of an Ascidian dredged by Prof. Herdman in Garwick Bay, Isle of Man. The presence of this animal so essentially a free swimmer, in such a situation is most unaccountable. Its transversely notched rostrum with two sharp teeth readily distinguishes it from any other known species.

Family III.—Misophriidæ.

Misophria pallida, Boeck. (Pl. XXI, fig. 1.)

Length 0.75 mm. An exceedingly rare species, one specimen only having been recorded in the district, dredged in 10 fathoms off Puffin Island in July, 1891. Curiously enough, Boeck and Brady each also found only one specimen. The inner branch of posterior antenna (*b*) in my specimen is itself two branched, the smaller one being one jointed with terminal setæ.

Cervinia bradyi, Norman. (Pl. XXVII, fig. 7.)

Length 1.30 mm. The beautiful stags horn character of the posterior antennæ clearly distinguishes this striking Copepod from any other known species.

The anterior antennæ (*b*) of all of my specimens have a remarkable two jointed branch springing from the base of the third joint, the basal joint being about equal to the third joint of main the branch, and the terminal being very small, both terminated with long plumose setæ. Norman did not observe any fifth feet. They are certainly very small but distinctly present and consist (*a*) of a short basal joint and a longer second joint having one lateral seta and terminated by one long and one short seta. All the specimens taken were (like Norman's) of one sex and were dredged on only one occasion in mud at 39 fathoms about 12 miles out from Port Erin.

Herdmania, n. gen.

First pair of antennæ, (Pl. XXVIII, fig. 11) nine-jointed; second pair (fig. 4) two branched, the primary branch composed of two long joints, the secondary branch of one long joint and three small terminal joints. Mandibles (fig. 5) small, armed with short sharp teeth and palp composed of two one jointed branches.

Maxillæ (fig. 6) with well developed palp, bearing four appendages, the apical one three jointed. First pair of foot jaws (fig. 7) four jointed, the second foot jaw is not yet determined. The first pair of swimming feet (fig. 8) has its inner branches two jointed, the outer branches three jointed. The second, third and fourth pairs have both branches three jointed. The fifth feet are two jointed in the female, and three jointed in the male.

Herdmania stylifera, n. sp. (Pl. XXVIII, figs. 1—12.)

Length 0.60 mm. Body ovate, rounded anteriorly with a small rounded rostrum. Anterior antennæ of female (fig. 2) nine jointed, the first joint being the largest and produced into a beaky spine at the apex of the inner side. The second and third joints are about equal in length, and both rather smaller than the first. The fourth joint is about one quarter the length of the third; the fifth is about as long as the sixth and seventh together. The eighth is long and narrow, and the ninth is a very small apical prominence. Some of the setæ which thickly clothe the antennæ are plumose. The first joint of the male antennæ (fig. 3) is about the same length as that of the female its beaky spine being recurved downwards, the fourth and following joints forming a vesiculiform swelling, the apical joints being narrow and curved. Posterior antennæ (fig. 4) two branched, the inner branch composed of two joints; the outer branch is considerably shorter and composed of four joints, the basal joint of which is about equal to that of the inner branch, the three terminal segments being very short. Mandibles (fig. 5) have four sharp teeth, and a two branched palp with numerous short setæ. Maxilla (fig. 6) has a large lobe and four branches, the apical of which is composed of three very small joints. First foot jaw (fig. 7) is four jointed and is covered with spines and setæ.

Diligent search of the only two specimens found and careful dissection of one failed to reveal the presence of posterior foot jaws, so if present any description of these appendages must await the capture of more specimens. Inner branch of first pair of swimming feet (fig. 8) two jointed, the inner side of apical joint being produced into a long digit-shaped spine with rounded end. The outer branch of first pair and both branches of second, third, and fourth feet and of the fifth feet of male are all three jointed, the inner terminations of the first and second joints of the inner branches of the second and fourth feet (fig. 10) forming strong beak like spines. The fifth feet of the female (fig. 11) are two jointed, the second being more than twice the length of the first and bearing three lateral and three apical spinous setæ. The fifth feet of the male (fig. 12) are alike and both three jointed. Abdomen six jointed with sharply pointed lateral terminations to the second, third and fourth segments. Caudal stylets very long and narrow, swollen at the upper end and gradually widening to the base, with outer lateral setæ one on each near the end and having several terminal setæ.

Two specimens only, a male and female of this remarkably elegant but minute species were taken by the mud dredge at 39 fathoms in the Irish Sea about twelve miles out from Port Erin. I feel a peculiar pleasure in connecting the name of the genus with that of my friend Prof. Herdman.

Family IV.—Cyclopidæ.

Oithona spinifrons, Boeck. (Pl. XVII, fig. 1.)

Length 1 mm. Generally present in townet gatherings throughout the year. It is easily recognized by its delicate whip like antennæ clothed with long setæ.

Cyclopina littoralis, Brady. (Pl. XVII, fig. 2.)

Length 0.75 mm. Frequently found amongst sea-weeds between tide marks about Puffin Island. Though seldom taken in any abundance, I recollect on one occasion finding hundreds in one night's townetting off Puffin Island in May, 1889. The many jointed anterior antennæ serve to distinguish this from the next species.

Cyclopina gracilis, Claus. (Pl. XVII, fig. 3.)

Length 0.45 mm. Less common than the last species, but occurring occasionally in townettings taken near land. Anterior antennæ, eleven jointed.

Cyclops marinus, n. sp. (Pl. XXIX, fig. 1—8.)

Length 1.20 mm. Body ovate (fig. 1) with long abdomen. Anterior antennæ (fig. 2.) 12 jointed, the first joint being the longest, and the eighth almost as long but narrower, the third and sixth joints being very short. Posterior antennæ (fig. 3) four jointed, the joints being of nearly equal length. Mandibles (fig. 4) have six long sharp teeth at apex. Palp reduced to a small tubercle from which spring four spinous setæ. Maxillæ (fig. 5) without palp, having two large teeth at apex and a number of lateral small ones. Anterior foot jaw (fig. 6) four jointed, with numerous spinous setæ, some of them plumose. Posterior foot jaw (fig. 7) three jointed, the upper one dividing into three branches terminated with spinous setæ.

First four pair of swimming feet (fig. 8) all three jointed, the inner joint of all except the fourth pair having a curved spine at the apex. Fifth feet (fig. 9) two jointed, the second joint being more than double the size of the first and having seven strong setæ. Abdomen four jointed, the first joint being nearly as long as the second and third together. Caudal segment about three times as long as broad, each bearing five terminal setæ and one short lateral seta.

Two specimens only, both females were dredged in 20 fathoms about 20 miles out from Southport pier, during the "Mavis" expedition.

Through scarceness of specimens and absence of males I regret the necessarily imperfect description of this very important addition to our fauna of a marine species of Cyclops, assuming as seems probable that *Cyclops ewarti*, Brady, found by Mr. T. Scott, F.L.S., about five miles above Queen's Ferry, Firth of Forth, 1887, may have found its way thither from a fresh water source.

Thorellia brunnea, Boeck. (Pl. XVII, fig. 4.)

Length 1.30 mm. Solitary specimens are occasionally taken in the open sea and in dredged material.

Hersilioides puffini, Thompson. (Pl. XVII, fig. 5.)

Length 0.80 mm. A few specimens were taken by townet off Puffin Island a few years ago when weekly gatherings of material were sent to me from there for examination, but it has not occurred since in the district.

Giardella callianassæ, Canu. (Pl. XVII, fig. 6.)

Length 0.75 mm. A single specimen was taken by townet in Liverpool Bay during the "Despatch" expedition, 1886. This species was described by M. Canu in "Bulletin Scientifique" series III, 1888, p. 410.

Family Notodelphyidæ.

Notodelphys allmani, Thorell. (Pl. XVII, fig. 7.)

Length 4.0 mm. A few specimens were found by Prof Herdman in the branchial sacs of the Ascidian *Ciona intestinalis* dredged off the south end of the Isle of Man.

Doropygus pulex, Thorell. (Pl. XVII, fig. 8.)

Length 1.30 mm. Found by Prof. Herdman in company with the preceding species, and also in the branchial sac of *Ascidiella scabra*, dredged in Groudle Bay, Isle of Man; also in the branchial sac of *Ascidia plebeia*, dredged from the "Hyæna," off the Calf of Man, in twenty fathoms. The male (*b*) is smaller than the female (*a*).

Doropygus poricauda, Brady. (Pl. XVIII, fig. 1.)

Length 2.50 mm. One specimen of this species was amongst several of the last preceding taken from the branchial sac of *Ascidia plebeia*.

Doropygus gibber, Thorell. (Pl. XVIII, fig. 2.)

Length 3.20 mm. Found in the branchial sac of *Ascidia plebeia* dredged from the "Hyæna" in 1890.

Botachus cylindratus, Thorell. (Pl. XVIII, fig. 3.)

Length 1.75 mm. Found by Professor Herdman in the branchial sacs of *Ascidia mentula* and *Ascidia plebeia*, from the Isle of Man.

Thorell and so far as I know all subsequent observers have failed to find the male of this species. In each of the several ascidians in which the females were found were a few minute specimens which generally correspond to the males of other species and are evidently the male of *Botachus cylindratus*. (Fig. 3. *a*.) Prof Herdman tells me that they were in appearance like minute commas attached to the inner folds of the branchial sac of the Ascidian, and from their minute size and very tenacious hold might easily be overlooked.

Ascidicola rosea, Thorell. (Pl. XVIII, fig. 4.)

Length 3.75 mm. Several specimens of this species have been found in the branchial sacs of Ascidians dredged off the Isle of Man.

Notopterophorus papilio, Hesse. (Pl. XVIII, figs. 5, 6.)

A few specimens of each, male and female of this most remarkable and beautiful Copepod were found in Ascidians dredged in Garwick Bay, Isle of Man by Prof. Herdman. The female is described by Brady (Copepoda of British Islands, Ray Society, Vol. I, p. 142) from Hesse's first memoir in which no mention is made of the male. It was subsequently however found by him and briefly described in a later paper but not figured. It is about 2 mm. in length, the female measuring about double that size.

The Cephalothorax has five segments the head segment being distinct from the rest. The second and third segments have each a pair of dorsal papillæ projecting laterally and upwards, and the fourth has one larger dorsal papilla. The abdomen is about equal in length to the rest of the body and is composed of three segments each being about twice as long as broad, and terminated like the female with short caudal segments armed with hook spines. The two pair of antennæ are similar to those of the female as are the other appendages and first four pair of swimming feet. The fifth pair are however wanting in the female, while the male possesses a pair of two jointed fifth feet each terminated by a single seta.

As was the case with the specimens examined by Brady the wing-like expansions of the females we found were somewhat lacerated from immersion in alcohol but their general form and long pointed apices are very characteristic. The terminal posterior wing is decidedly larger than that in Brady's drawing and though too lacerated to be certain of its form, it affords indication of the three pointed terminations figured from Hesse. The cephalothorax in our female specimens is much more robust than in Brady's drawing the last body segment being the widest and filled with ova. The first and second abdominal segments are funnel shaped, the narrow extremity of which is the same width as the two terminal segments which are of similar size to those of the male.

It is difficult to imagine any use to the animal of the extraordinary appendages in the female so much resembling in general appearance the wings of a butterfly.

Family Harpacticidæ.

Longipedia coronata, Claus. (Pl. XVIII, fig. 7.)

Length 1.25 mm. One of the commonest of British species. Common both as a free swimmer and in material dredged from a sandy bottom. It is easily recognised by its beautiful plumed anterior antennæ and by the length of the inner branch of the second swimming feet.

Ectinosoma spinipes, Brady. (Pl. XVIII, fig. 8.)

Length 1.25 mm. Frequent in dredged material from a muddy bottom about low water mark.

Ectinosoma curticorne, Boeck. Pl. XVIII, fig. 8. *e.*)

Length 1.25 mm. This species is so nearly allied to the foregoing that I feel very doubtful as to its separate identity. The only important difference appears to be in the fifth feet and even here the gradation from one to the other is very slight.

Ectinosoma erythrops, Brady. (Pl. XVIII, fig. 8. *c. d.*)

Length 0.75 mm. Occasionally dredged in 10 fathoms off Puffin Island, and in 4 fathoms in Port Erin Bay. Its two brilliant red eye spots and the small size of the fifth feet are its distinguishing features.

Ectinosoma melaniceps, Brady. (Pl. XXI, fig. 2. *a.*)

Length 0.75 mm. Very similar in character to the three former species. Brady says "it is much smaller and more delicate in structure than *E. spinipes*, and is moreover always distinguished by a cloudy blackish patch on the head." We have taken it in the dredge at Port St. Mary and off the Calf of Man.

Ectinosoma atlanticum, Brady & Rob. (Pl. XIX, fig. 1.)

Length 0.50 mm. An easily distinguished species of slender build, long and narrow. Taken by townet in the open sea occasionally, and on one occasion by electric light in Port Erin Bay.

Tachidius brevicornis, Müller. (Pl. XXI, fig. 2. *b. c.*)

Length 0.80 mm. A brackish water species. We have taken it in quantity from material sent by Mr. Dwerry· house from a brackish tributary of the Mersey at Hale, also at the mouth of the Alt. The broad square fifth feet of the female (*b*) serve to distinguish it.

Tachidius littoralis, Poppe. (Pl. XIX, fig. 2.)

Length 0.60 mm. Very similar to *T. brevicornis* but differing chiefly in the anterior antennæ and the fifth feet. Found in fucus about low water mark at Penmon Point and Puffin Island.

Euterpe acutifrons,* Dana. (Pl. XIX, fig. 3.)

Length 0.50 mm. Frequently taken by townet in the open sea and near to Puffin Island during the autumn months especially. Males and females equally common. I have generally been able to detect this species in material from its crescent shaped appearance.

Robertsonia tenuis, Brady & Robertson. (Pl. XIX, fig. 4.)

Length 0.60 mm. A rare species. Taken by dredge on two occasions in 10 fathoms off Puffin Island.

Amymone sphærica, Claus. (Pl. XIX, fig. 5.)

Length 0.38 mm. Occasionally dredged off Puffin Island and found in dredged material sent by Mr. A. O. Walker from Colwyn Bay, and recently in Port Erin Bay.

Although some of our specimens differ from Claus's drawings in being less spinous I can see no good reason for supposing them not to be the same species.

Amymone longimana, Claus. (Pl. XIX, fig. 5. *b*.)

Length 0.50 mm. The only specimen we have taken was dredged in 5 fathoms off Port Erin. Distinguishable from the previous species by the posterior foot jaw (*b*).

Stenhelia hispida, Brady. (Pl. XIX, fig. 6.)

Length 0.35 mm. Found in rock pools at Hilbre and Puffin Islands; also in mud taken at Garth Ferry at low water, and in Port Erin Bay. The chitinous spear like inner branch of the male second foot is a distinguishing feature.

* *E. gracilis* in plate.

Stenhelia ima, Brady. (Pl. XXI, fig. 2. *d. e. f.*)

Length 1.25 mm. Dredged in Soderick Bay, Rhos Colin Bay, and Port Erin Bay, but nowhere common. Recognizable by the swollen bases of the caudal setæ (*f*).

Stenhelia denticulata, n. sp. (Pl. XXX, fig. 1—11.)

Length 1 mm. Body ovate with long rostrum. Anterior antennæ (fig. 2) 8 jointed, the first and third joints being about twice as long as broad; the second and fourth about three times as long as broad, the latter having a long filament at apex; the four terminal joints are together, about the length of the fourth. The first joint has a small tooth and the second joint has a strong tooth on the under side. Posterior antennæ (fig. 3) three jointed with inner branch also three jointed. Mandible (fig. 4) has toothed apex and two one jointed lateral protuberances.

Anterior foot jaw (fig. 6) two jointed, the apical joint terminated by several spinous setæ and having two lateral branches. Second foot jaw (fig. 7) with falciform claw. Four first pair of swimming feet (figs. 8 and 9) have inner and outer branches all three jointed. Fifth feet composed of triangular basal joint with lengthened tapering joint springing from it, both bearing spinous setæ. Abdomen five jointed, about the same length as the rest of the body. Caudal segments about as long as broad; each having two long central apical setæ and one small one on either side. Two specimens only, both females were dredged from the muddy bottom inside Port Erin breakwater.

Stenhelia hirsuta, n. sp. (Pl. XXXI, fig. 1—13.)

Length 1 mm. Rostrum long and pointed. Anterior antennæ (figs. 2, 3) eight jointed, the first, second and fourth being much larger than the others; thickly covered with long setæ. Inner branch of posterior antennæ (fig. 4) three jointed, the middle one very small. Claw of second foot jaw (fig. 8) is swollen at base, the inner margin of hand bearing two spinous setæ and several short setæ.

First, second, third, and fourth swimming feet (figs. 9—11) all three jointed in both branches with the exception of the inner branch of the second feet in the male (fig. 10) in which a pair of stout claws takes the place of the 3rd joint. The inner branch of the first pair (fig. 9) is nearly twice the length of the outer, its basal joint being about equal in length to the two following joints. Basal joint of fifth feet (fig. 12) broad and long in the female with fine terminal spinous setæ. Second joint ovate with several lateral spines and long terminal spine. The fifth feet of the male (fig. 13) are smaller and more angular than those of the female and have fewer spines. The caudal stylets are slightly tapering towards the apex and are about three times as long as broad. A few specimens, male and female were dredged in mud at 39 fathoms in the Irish Sea about 12 miles west from Port Erin. The hirsute character of the antennæ, the inner branch of the second foot in the male together with the caudal stylets serve to distinguish the species from others of the genus.

Ameira longipes, Boeck. (Pl. XIX, fig. 7.)

Length 0.45 mm. Dredged in 20 fathoms off the Calf of Man, also off Puffin Island, and the Little Orme. Brady speaks of the perplexing resemblance between this species and *Stenhelia ima*. The length of the caudal segments however readily distinguishes them, being about five times as long as broad in the former and very short in the latter species.

Ameira attenuata, n. sp. (Pl. XXXII, figs. 1—11.)

Length 0.40 mm. Rostrum short, obtuse. Anterior antennæ (figs. 3 and 4) eight jointed in the female, seven jointed in the male, the short penultimate joint being absent in the latter. The second joint is much longer and wider than any of the others. In the male (fig. 4) a hinge occurs between the 5th and 6th joints. A long filament springs from the 4th joint. Posterior antennæ (fig. 5) two jointed, the inner branch being composed of one joint with three terminal setæ.

Hand and claw of the second foot jaw slender. First joint of the inner branch of first pair of swimming feet (fig. 7) about the same length as the entire outer branch, the middle joint has two small setæ on the inner side; the outer side of the outer joint is ciliated. Both branches of the second, third and fourth feet (fig. 8) are three jointed. The basal joint of the fifth pair of female (fig. 9) is triangular, bearing three terminal setæ: the second joint is long, slightly oval, ciliated at each side and bearing four setæ. The fifth feet of the male (fig. 10) are very similar to those of the female but are rather smaller, and not ciliated and have fewer setæ. The abdomen of the female is five jointed, in the male four jointed. Caudal segments about four times as long as broad and slightly tapering, terminated by two long and several short setæ.

Several specimens of this species nearly all females were lately found in mud dredged from seven fathoms inside Port Erin breakwater. Their extreme minuteness and delicacy render dissection difficult and the mouth organs I have not been able to make out clearly.

Jonesiella fusiformis, Brady & Rob. (Pl. XIX, fig. 8.)

Length 1.25 mm. Dredged off the Calf of Man in 20 fathoms and off Puffin Island.

Jonesiella hyænæ, Thompson, (Pl. XX, fig. 1.)

Length 0.65 mm. First dredged from steamer "Hyæna" in Port Erin Bay, and since found there in considerable number on a muddy bottom. It is described in Appendix to 3rd Report on the Copepoda of Liverpool Bay. Proc. L'pool Biol. Soc., 1888-9, Vol. III, p. 192.

Bradya typica, Boeck. (Pl. XIX, fig. 8. *b. c.*)

Length 0.80 mm. A few specimens all females were recently dredged with mud in Port Erin Bay.

Delavalia palustris, Brady. (Pl. XX, fig. 2.)

Length 0.80 mm. Several of this mud loving species have been found in mud taken about Puffin Island, Port Erin, Garth Ferry, and Hale. Among them is one male which so far as I am aware has not been hitherto known.

Delavalia reflexa, Brady and Robertson. (Pl. XX, fig. 3.)

Length 0.70 mm. One specimen a female was dredged in 20 fathoms in Redwharfe Bay, Anglesea, and one male was found in mud from Garth Ferry taken at low water.

Mesochra lilljeborgii, Boeck. (Pl. XX. fig. 4.)

Taken by townet off Puffin Island, also found in mud taken in a brackish tributary of the Mersey at Hale.

Paramesochra dubia, Scott. (Pl. XXVII, fig. 8. *a*.)

Length 0.65 mm. Quantities of this species recently described and figured by Mr. Thomas Scott, F.L.S. (Tenth Annual Report of the Fishery Board for Scotland) I found in mud dredged at 7 fathoms in Port Erin Bay, males and females being equally plentiful. Since then I find it in mud collected by Mr. Corbin from the Duddon cockle beds at the mouth of the River Duddon near Barrow.

Tetragoniceps bradyi, Scott. (Pl. XXVII, fig. 8. *b*.—*f*.)

Length 1 mm. Found only at same times and habitat as the last named species, (*Paramesochra dubia*) Scott found no males; they were however plentiful in the Port Erin gathering. The conspicuous 5th feet (*c*) at once render the female of this species recognisable.

Diosaccus tenuicornis, Claus. (Pl. XX, fig. 5.)

Length 1.30 mm. Found in rock pools at Hilbre and Puffin Islands, and dredged in Port Erin Bay. It is distinguishable by its long anterior antennæ (*a*).

Laophonte serrata, Claus. (Pl. XX, fig. 6.)

Length 1.0 mm. Taken in townet by electric light at Port Erin, also between the Isle of Man and Liverpool and off Puffin Island, but rare.

Laophonte spinosa, n. sp. (Pl. XXXIII, figs. 1—13.)

Length 1 mm. Body elongated, the first segment being about equal in length to the five following segments. Rostrum short and blunt. Anterior antennæ (figs. 2, 3) four jointed, and with marked differences bearing a general similarity in both sexes to those of *Laophonte serrata* and even more serrated than in the latter species. The second joint has a large, strong spine in both sexes. The third joint in the female is longer than the others and is less setose than that of *L. serrata*. Fourth joint of male very similar to that of *L. serrata*, the others being dissimilar. Posterior antennæ (fig. 4) very similar to *L. serrata*. Mandible (fig. 5) bluntly spinous with small setiferous palp. Posterior foot jaw (fig. 7) is slender with very long slender claw.

The peduncle of first pair of feet (fig. 8) is composed of two long slender joints, the outer branch two jointed and very slender springing from the middle of second peduncle joint and about half the length of the first joint of inner branch which is armed with a strong falciform terminal claw. The two jointed outer branch of second, third and fourth feet (figs. 9, 10) in the female is nearly as long as the three jointed inner branch.

The fifth pair of feet in the female (fig. 12) have large triangular basal joints with three curved lines of fine markings on the surface; they have five plumose setæ. The second joint is ovate and is attached laterally to first joint and also has five plumose spinous setæ. The fifth feet of the male (fig. 11) are very small and two jointed. The caudal segments (fig. 13) are about four times as long as broad and have each a strong curved claw extending dorsally situated rather above the centre, two strong spinous setæ adorning the opposite side. The caudal segment is terminated by a strong central spine, and on the inner side has a stout bluntly rounded spine about half the length of the caudal segment, and a short fine seta on the outer side.

Two specimens, male and female of this strongly marked Copepod were lately dredged at a depth of seven fathoms on the muddy ground inside Port Erin breakwater. In the general character of the antennæ this species somewhat resembles *L. serrata* for which it might at first sight be mistaken, but the swimming feet are different, and the caudal segments and their remarkable appendages clearly distinguish it from any known species.

Laophonte thoracica, Boeck. (Pl. XXI, fig. 5. *e.—g.*)

Length 0.60 mm. Our only specimen was taken by townet amongst the Algæ round Puffin Island.

Laophonte horrida, Norman. (Pl. XX, fig. 7.)

Length 1.25 mm. This ferocious looking animal is at once recognisable by its array of dorsal projecting spines. A few specimens male and female were recently dredged at four fathoms in Port Erin Bay and one specimen was dredged at 39 fathoms, 12 miles from Port Erin. They were imbedded in mud which was so tenaciously held by the spines that it was most difficult to clean them. It appears to be an exceedingly rare species.

Laophonte similis, Claus. (Pl. XXI, fig. 5. *a.—d.*)

Length 1 mm. Found in tidal pools about the submarine forest at Leasowe, also in dredged material from Colwyn Bay.

Laophonte curticauda, Boeck. (Pl. XXI, fig. 3.)

Length 1 mm. Found in tidal pools at Hilbre Island, Leasowe, and Puffin Island.

Laophonte lamellifera, Claus. (Pl. XX, fig. 8.)

Length 0.85 mm. Frequently taken by townet amongst the Algæ about Puffin Island.

Laophonte hispida, Brady & Robertson. (Pl. XXI, fig. 4.)

Length 1.80 mm. One specimen only was taken by surface townet near Puffin Island.

Normanella dubia, Brady and Robertson. (Pl. XXI, fig. 6.)

Length 0.40 mm. A few specimens of this very minute species were dredged in mud from four fathoms in Port Erin Bay.

Cletodes limicola, Brady. (Pl. XXI, fig. 7.)

Length 0.80 mm. Found in mud taken at low water at Penmont Point, Anglesea, and at Garth Ferry.

Cletodes longicaudata, Brady & Rob. (Pl. XXI, fig. 8. *f*.)

Length 0.50 mm. Found sparingly in mud from Llanfairfechan shore at low water. The long, thin caudal segments (*f*) readily distinguish it.

Cletodes linearis, Claus. (Pl. XXI, fig. 8. *a.*—*c.*)

Length 1 mm. Found in mud from Hale shore taken at low water.

Cletodes monensis, n. sp. (Pl. XXXIV, figs. 1—11.)

Length about 1.20 mm. First joint of cephalothorax about equal to the two following and armed with a strong slightly hooked spine on the dorsal side. A double spine terminates the posterior dorsal end of abdomen. A minute row of spines clothes the edges of all the cephalothoracic and abdominal segments, with the exception of the first.

Anterior antennæ (fig. 2) seven jointed, the first being the longest, and the second about equal to any two of the following. Posterior antennæ (fig. 3) three jointed a single stout seta taking the place of an inner branch. First pair of swimming feet (fig. 8) very small, the second, third and fourth gradually increasing in length, the fourth (fig.

9) being more than double the length of the first. The inner branch of all four is very short, two jointed, and terminated by a long seta; the outer branch of each is much longer than the inner and is three jointed, it being in the fourth feet at least six times the length of the inner branch. The fifth feet (fig. 10) are each composed of three inner spines, the central one plumose, then a long single segment with spinous apex, and the foot terminated by a short segment bearing a long seta. Caudal stylets (fig. 11) long and narrow with one outer seta near apex and a central inner seta, and long terminal spines. Several specimens all females of this striking species were taken by the mud dredge at a depth of 39 fathoms about 12 miles out from Port Erin. It is easily recognised by the anterior and posterior dorsal spines, its stout build and long diverging caudal stylets.

Enhydrosoma curvatum, Brady & Rob. Pl. XXII, fig. 1.)

Length 0.60 mm. Found in mud from Llanfairfechan and Garth shores at low water. Its minute size and its adherence to its muddy surroundings render it difficult of detection or examination.

Platychelipus littoralis, Brady. (Pl. XXII, fig. 2.)

Length 1.20 mm. This striking species occurs in abundance in mud taken at low water at Puffin Island, Llanfairfechan, Garth Ferry and Hale, males and females being about equally plentiful.

Dactylopus tisboides, Claus. (Pl. XXII, fig. 3.)

Length 1.90 mm. Frequently dredged off Puffin Island and Port Erin, also found in tidal pools. It is easily distinguishable by the first pair of feet (*b*) and by the markings on the fifth feet (*c*).

Dactylopus stromii, Baird. (Pl. XXII, fig. 4. *a. b.*)

Length 1. mm. Frequently found in tidal pools and attached to Algæ. It bears considerable resemblance to

D. tisboides the anterior antennæ of the latter however is nine jointed, that of *D. stromii* being eight jointed.

Dactylopus tenuiremis, Brady & Rob. Pl. XXII, fig. 4. *c. d.*)

Length 0.80 mm. One specimen only taken by surface townet near Port Erin. Its caudal segments (*d*) form a distinguishing feature.

Dactylopus flavus, Claus. (Pl. XXIII, fig. 5. *a.—d.*)

Length 0.80 mm. This is evidently a rare species. We have occasionally taken it, by dredge off or near the Calf of Man in 20 fathoms. It is of a dark yellow colour and easily recognizable by its short compact somewhat boat-shaped appearance.

Dactylopus brevicornis, Claus. (Pl. XXII, fig. 4. *e. f. g.*)

Length 0.60 mm. A few specimens were found in tidal pools at Douglas, Isle of Man. The short, densely setose anterior antennæ at once distinguish it from others of the genus.

Dactylopus minutus, Claus. (Pl. XXII, fig. 5. *e. f.*)

Length 1. mm. A single specimen was dredged in 20 fathoms near the Calf of Man. It is evidently one of the rarest species of the genus.

Thalestris helgolandica, Claus. (Pl. XXII, fig. 7.)

Length 0.80 mm. A few specimens have been dredged off the Little Orme and near Puffin Island, also in Port Erin Bay. The presence of a middle joint in the inner branch of the posterior antennæ and the shape of the fifth feet sufficiently distinguish this species.

Thalestris rufocincta, Norman. (Pl. XXII, fig. 6.)

Length 1.25 mm. Common both free swimming and in dredged material throughout the district. It is of a yellowish colour, the edges of the body segments being usually lined with crimson. This together with the plumose character of the spines on the swimming feet (*a*) easily distinguish it.

Thalestris harpactoides, Claus. (Pl. XXII, fig. 8.)

Length 1.25 mm. Frequent in rock pools about Puffin Island and Douglas. This rarer species somewhat resembles *T. rufocincta* in colour. It is however more slender and may be recogniſed by the aculeate character of its caudal setæ.

Thalestris clausii, Norman. (Pl. XXII, fig. 6. *b. c.*)

Length 1 mm. Found in tidal pools at Fleshwick Bay, Isle of Man, and at Puffin Island. The first pair of swimming feet serve to distinguish it.

Thalestris rufo-violescens, Claus. (Pl. XXIII, fig. 1.)

Length 1. mm. A rare species in the district. A few specimens were found in mud dredged from 4 fathoms in Port Erin Bay. The chitinous character of the edges of most of its segments is a very distinguishing feature. This is specially noticable on the joints of the anterior antennæ (*a*) and in the fifth feet (*d*).

Thalestris serrulata, Brady. (Pl. XXIII, fig. 2. *a.*)

Length 2. mm. One specimen was taken by surface townet off Puffin Island. The widely separated serrated markings on the outer edge of the caudal segments (*a*) seem a strong distinguishing feature.

Thalestris hibernica, Brady & Rob. (Pl. XXIII, fig. 2. *b.—f.*)

Length 0.80 mm. A few specimens were found in rock pools at Hilbre and Puffin Islands. It may be recognized by the fifth feet (*e*).

Thalestris longimana, Claus. (Pl. XXIII, fig. 3. *a. b.*)

Length 1.30 mm. Common in rock pools at Hilbre and Puffin Islands. The powerful posterior foot jaw renders it easily recognizable.

Thalestris peltata, Boeck. (Pl. XXXIII, fig. 3. *c. d.*)

Length 0.80 mm. A few specimens were found in material dredged off Little Orme and more recently at 20 fathoms off Port Erin. Its ovate form, rostrum and eye spot distinguish this species from the others of the genus.

Westwoodia nobilis, Baird. (Pl. XXXIII, fig. 4.)

Length 1. mm. Occasionally found in rock pools at Hilbre and Puffin Islands. The one jointed inner branch of the feet of the first pair at once distinguishes this species.

Harpacticus chelifer, Müller. (Pl. XXXIII, fig. 5.)

Length 1.25 mm. Common throughout the district as a free swimmer and in dredged material. The chelifate posterior foot jaw (*c*) clearly distinguishes this species.

Harpacticus fulvus, Fischer. (Pl. XXXIII, fig. 6. *a.b. c.*)

Length 1.25 mm. Abundant in rock pools at Puffin Island, generally of a bright red colour and very conspicuous on the green alga *Enteromorpha.*

Prof. Herdman's experiments as to the capacity of this crustacean to adapt itself to various degrees of salt and fresh water are given in Report III of the Marine Biological Station on Puffin Island, 1889, p. 36.

Harpacticus flexus, Brady & Rob. (Pl.XXXII,fig. 6.*d.e.f.*)

Length 1.25 mm. Very similar in general appearance and characters to *H. chelifer*, but smaller and recognizable by the second foot jaw which is slender and without the excavated toothed hand so characteristic of that species.

Zaus spinatus, Goodsir. (Pl. XXIII, fig. 7.)

Length 0.65 mm. A pretty minute species frequently found in tidal pools at Hilbre and Puffin Islands, &c. ; also dredged in Port Erin Bay.

Zaus goodsiri, Brady. (Pl. XXXIII, fig. 8.)

Length 1.30 mm. Dredged off the Calf of Man in 20 fathoms and off the Little Orme, and in Colwyn Bay. In some of the specimens from the first locality the three central body segments are of a brilliant crimson colour.

Alteutha depressa, Baird. (Pl. XXIV, fig. 1. *c.*)

Length 1.30 mm. Common throughout the district, chiefly a littoral species, also frequently found in the night surface townets as a free swimmer. On some occasions when we have left a townet tied to a buoy all night, numbers of this species have been captured.

Alteutha interrupta, Goodsir. (Pl. XXIV, fig. 1. *a. b.*)

Length 1.30 mm. Frequently found in similar situations to the last species. The shape of the terminal joint of the fifth feet (*b*) and the number of the spines thereon distinguish this from the preceding species.

Alteutha crenulata, Brady. (Pl. XXIV, fig. 2.)

Length 1 mm. A gaily coloured uncommon species. Our examples have been taken in Redwharfe Bay, Anglesea, and about Puffin Island, chiefly amongst the littoral Algæ.

Porcellidium tenuicauda, Claus. (Pl. XXIV, fig. 3.)

Length 1 mm. Our only specimen was dredged from the "Mallard" (1892) outside Port Erin Bay in 20 fathoms.

Porcellidium viride, Philippi. (Pl. XXIV, fig. 3. *a.*)

Length 0.80 mm. One specimen only was dredged in Port Erin Bay amongst mud, at 4 fathoms. The caudal segments of this species (*a*) distinguish it from the preceding species.

Idya furcata, Baird. (Pl. XXIV, fig. 4.)

Length 1.25 mm. Common throughout the district amongst Algæ and in rock pools; also common as a free swimmer near the land. The tufts of plumose setæ at the apices of the spines of the first pair of feet at a glance distinguish this species.

Scutellidium tisboides, Claus. (Pl. XXIV, fig. 5, *a* to *c*.)

Length 0.65 mm. One specimen only recorded in the district, taken by townet in Douglas Bay.

Scutellidium fasciatum, Boeck. (Pl. XXIV, fig. 5. *d* to *f*.)

Length 1 mm. Not uncommon in tidal rock pools at Hilbre Island; also dredged in Port Erin Bay, where it was also taken by townet during electric light illumination. One specimen, found in a tidal pool at Hilbre Island, has minute nodules in the middle of many of the setæ of the swimming feet.

Cylindropsyllus lævis, Brady. (Pl. XXV, fig. 6.)

Length 1.20 mm. One specimen only of this easily recognizable species was recently taken by the dredge on the muddy bottom inside of Port Erin breakwater, the only specimen recorded in the L.M.B.C. district. Under high magnification the entire surface is seen to be finely dotted. A spermatophore is in this specimen attached to the first abdominal segment.

Family Monstrillidæ.

Monstrilla rigida, Thompson. (Pl. XXIV, fig. 6. *a*.)

Length 1.75 mm. One specimen taken by townet off Puffin Island. This species has two abdominal segments, and three setæ on each furcal segment.

Monstrilla danæ, Claparède. (Pl. XXIV, fig. 6. *b*.)

Length 1.30 mm. One specimen was taken by townet about two miles from Puffin Island, and lately several have turned up near Port Erin Bay, one haul of a townet capturing three. This species has three abdominal segments, and four setæ on each furcal segment.

Monstrilla anglica, Lubbock. (Pl. XXIV, fig. 7.)

Length 1.75 mm. Two specimens have been taken by townet off Puffin Island, three years apart. This species has four abdominal segments and five setæ on each furcal segment.

Monstrilla longicornis, Thompson. (Pl. XXIV, fig. 8.)

Length 1.50 mm. One specimen was taken by townet off Puffin Island in 1889. This species has four abdominal segments and four setæ on each furcal segment. It may be easily recognised by its long straight antennæ which are nearly as long as the entire body. It appears to be identical with a single specimen recently described by

Giesbrecht (Pelagischen Copepoden des Golfes von Neapel, 1892) as *M. longiremis* but as his only specimen was a female, and mine a male, there must still remain some doubt as to their identity.

Family Sapphirinidæ.

Lichomolgus fucicolus, Brady. (Pl, XXV, fig. 1.)

Length 1 mm. Frequently found amongst Algæ round Puffin Island, also in dredged material from Colwyn Bay, and Port Erin Bay.

Lichomolgus liber, Brady & Rob. (Pl. XXV, fig. 2. *a. b.*)

Length 1.30 mm. Dredged off Calf of Man in 20 fathoms, and in Port Erin Bay in 4 fathoms.

Lichomolgus thorellii, Brady & Rob. Pl. XXV, fig. 2. *c.*)

Length 1.80 mm. One specimen found in mud dredged in Port Erin Bay, in 4 fathoms.

Lichomolgus furcillatus, Thorell. (Pl. XXV, fig. 3.)

Length 1 mm. A few specimens occurred in mud dredged in Port Erin Bay, in 4 fathoms.

Lichomolgus albens, Thorell. (Pl. XXV, fig. 3. *c.*)

Length 1·20 mm. In algæ on rocks at Puffin Island.

Lichomolgus agilis, Scott. (Pl. XXV, figs. 4* and 8. *d.*)

Length 1.25 mm. This species was very recently described by Scott (Ann. and Mag. of Nat. Hist., Sept., 1892) who found it plentiful in the shell of the cockle (*Cardium edule*) in specimens from Morecambe, Lancashire, and from the Firth of Forth. Upon examining fresh cockles of our district I found several specimens of this active little Copepod in every bivalve opened. They may be readily found by carefully taking up the water contained in the shell by means of a camel hair brush and washing it into water contained in a watch glass under the microscope when they will probably be seen actively

* Labelled *L. albens* by mistake.

darting about. In general appearance it much resembles *L. albens*, Thorell, but is easily distinguishable from this and other species of the genus by the inner branch of the fourth pair of swimming feet which is three jointed (fig. 4. *d.*) while in the other species it is two jointed. The anterior antennæ are also diagnostic.

Lichomolgus maximus, n. sp. (Pl. XXXV.)

Length of female 2.60 mm. Length of male 1.65 mm. Cephalothorax ovate, composed of five segments, the first being more than half the entire length. Rostrum short and blunt. Anterior antennæ (fig. 3) about two-thirds the length of the first segment, seven jointed and alike in male and female. The proportionate lengths of the joints are about as follows:

1	2	3	4	5	6	7
6	16	4	12	9	6	4

and all are well supplied with setæ. Posterior antennæ (fig. 4) stout, four jointed, the first and second joints being of about equal length, the third and fourth rather smaller. The apical joint is terminated by a pair of powerful curved claws and four hooked spines.

Mandible (fig. 5) is curved with a fringe of short spines at the upper apical portion, short cilia fringing the similar portion of the under side; the palp has two fine terminal spines. Anterior foot jaw (fig. 6) is long and sickle shaped with tooth shaped spines on the upper side gradually increasing in size from the apex. The posterior foot jaws differ in the two sexes. That of the male (fig. 7) is three jointed, the middle joint of which is lined with short setæ upon the inner edge, the third joint being very small. From the latter springs a long curved falciform terminal claw with a slight protuberance in the middle on the under side. There is also a small curved spine springing from the same base. The female foot jaw (fig. 8) is three jointed and bears at the apex a small papilla or protuberance without any spine or setæ.

The first four pairs of swimming feet have both branches three jointed. In the outer branch of the first pair (fig. 9) the second joint has one and the third joint three spines with foliaceous expansions and aculeate edges. The spines of the other swimming feet are mostly foliaceous but not aculeate. The fourth pair (fig. 10) has two foliaceous spines on the third segment of the outer branch, being terminated by a long dagger-like spine and having five very long lateral plumose setæ. The third inner joint of the fourth pair has one long and one short terminal spine but no lateral setæ. The fifth feet (fig. 11) which are alike in both sexes are composed of one joint with one long and one short terminal spine.

The abdomen of the male is five jointed, that of the female being four jointed. In the male the first joint has two leafy pointed folds each terminating posteriorly with three short spines. The four terminal joints are nearly equal in length and gradually narrower to the extremity. The first joint in the female abdomen is broad and rounded posteriorly and devoid of spines; the other joints are much the same as those of the male. The caudal segments are about eight times as long as broad and equal in length to the two last abdominal segments. Each has four terminal setæ and one lateral seta at one sixth of the distance from the extremity.

About half a dozen specimens of each sex were obtained by carefully washing the branchial folds and other parts of specimens of *Pecten maximus* dredged at 20 fathoms near Port Erin Bay. I was led to look for this unknown Copepod through the similar habitat of *Lichomolgus. agilis*, Scott, as parasitic on *Cardium edule*. Its size, nearly twice that of any hitherto described species of

Lichomolgus renders the name appropriate. It agrees with *L. agilis* in having the inner branch of the fourth pair of swimming feet three jointed but differs from it in most particulars, especially in the posterior antennæ and foot jaws. It seems probable that many more parasitic species may be found in similar habitats.

Sabelliphilus sarsii, Claparède. (Pl. XXV, fig. 5.)

Length 2 mm. This species was first found in the L.M.B.C. District and sent to me by Mr. H. Chadwick of Manchester upon the tentacles of a species of *Sabella* found on the Beaumaris shore, to which they were tenaciously adherent. Finding no record of it I described the species as *Lichomolgus sabellæ*, but since then find it is synonymous with *Sabelliphilus sarsii*, Claparède, to which I now assign it. I have since found it on Puffin Island adherent to the tentacles of *Sabella*.

Family Artotrogidæ.

Cyclopicera nigripes, Brady & Robertson. (Pl. XXV, fig. 7.)

Length 1.25 mm. Occasionally dredged off Puffin Island.

Cyclopicera lata, Brady. (Pl. XXV, fig. 8.)

Length 1.75. Isolated specimens have been dredged off Puffin Island, and in the Isle of Man, off Port Soderick and in Port Erin Bay.

Cyclopicera gracilicauda, Brady. (Pl. XXVI, fig. 1.)

Length 0.75 mm. Taken by townet off Puffin Island; and by dredge in Redwharfe Bay, and during "Mavis" expedition, 15 miles off Southport. Also more recently in April, 1893, during a dredging expedition in "Lady Loch" when I found numbers of this species in washings from dredgings taken off Port Erin at a depth of 20 fathoms.

Artotrogus boeckii, Brady. (Pl. XXV, fig. 2.)

Length 1.30 mm. Dredged off the Calf of Man in 20 fathoms.

Artotrogus magniceps, Brady. (Pl. XXVI, fig. 3.)

Length 1.25 mm. Dredged off the Calf of Man, and the Little Orme, and taken in townet off Puffin Island.

Artotrogus normani, Brady & Robertson. (Pl. XXVI, fig. 5.)

Length 1.25 mm. A single specimen was dredged off the Calf of Man in 20 fathoms.

Artotrogus orbicularis, Boeck. (Pl. XXVI, fig. 4.)

Length 1.65 mm. A single specimen of this beautiful and striking copepod was found by Prof. Herdman underneath a stone on the spit at Puffin Island. Though diligently searched for we have never succeeded in finding another.

Acontiophorus scutatus, Brady & Rob. (Pl. XXVI, fig. 8.)

Length 0.80 mm. A few specimens have been found in rock pools at Hilbre and Puffin Islands.

Family Chondracanthidæ.

Lernentoma lophii, Johnston. (Pl. XXVII, fig. 1.)

Numerous specimens of this species were recently found by Mr. Corbin adherent to Cod, Ling and Lophius taken off Barrow. The female is from $\frac{1}{4}$ to $\frac{1}{2}$ an inch or more in length and is adorned with numerous blunt spines or tubercles over the surface of the body. The oviferous tubes are very long, slender and twisted. The males of this genus are very small and rudimentary, living parastically on the body of the female.

Family Caligidæ.

Caligus rapax, M. Edwards. (Pl. XXVII, fig. 4.)

Length 4.50 mm. This species is common throughout the district, being frequently taken at night by the townet as a free swimmer, and is often found parasitic upon the cod and other fishes.

Caligus curtus, Leach. (Pl. XXVII, fig. 3.)

Length 5.0 mm. Less common than the preceding species, but found under similar conditions and attached to the cod and plaice. The conspicuous lunules or sucking discs situated on the lower surface of the frontal plates and having the appearance of eyes distinguish the genus Caligus from the rest of the family Caligidæ.

Lepeoptheirus stromii, Baird. (Pl. XXVII, fig. 6. *b*.)

Length 2.50 mm.

Lepeoptheirus nordmannii, M. Edw. (Pl. XXVII, fig. 5. *a*.)

Length 4.50 mm.

Lepeoptheirus hippoglossi, Kroyer. (Pl. XXVII, fig 6. *a*.)

Length 4.50 mm.

Lepeoptheirus obscurus, Baird. (Pl. XXVII, fig. 5. *b*.)

Length 2.60 mm. All the specimens I have received of the above four species of the genus *Lepeoptheirus* were sent to me from Bull Bay by the late Mr. Frank Archer who had obtained them from the local fishermen.

Family Lernæidæ.

Lernæa branchialis, Linn. (Pl. XXVI, fig. 7.)

Two very minute Crustacea (fig. 1) were taken in the tow-net off Puffin Island, which appeared to be larval forms of a *Lernæa*. Since then two more highly developed specimens (one from the same locality) have been found, apparently belonging to the same species as the larval specimens. They agree in the main with *Lernæa branchialis*, Linn., described and figured by Claus in his "Beobachtungen ueber Lernæocera, Penicillus und Lernæa, 1868," corresponding in most particulars with the male and female described by Claus, and I have provisionally included them under this species. Our specimens differ from those figured by Claus chiefly in the form of the prehensile posterior antennæ and in the segmentation of the abdomen; but this animal appears to vary much in these very particulars according to age and sex, and it is therefore quite likely that Claus's specimens may represent slightly different stages of development. The group is extremely interesting, as exhibiting progressive and retrogressive development, and deserves more attention than it appears to have hitherto received. The female is about 1-18th inch in length, the male rather smaller, and the larval form about half the size of the female.

Since the above were recorded Prof. Herdman has found a number of adult specimens of *Lernæa branchialis* adherent to the gills of whitings taken in the Rock Channel.

Family Lernæopodidæ.

Anchorella uncinata, Müller. (Pl. XXVII, fig. 2.)

Length (without ovaries) 2.20 mm. Several specimens were found by Mr. Corbin on the gills of whiting taken in the Mersey estuary. Microscopical examination of one of them in situ shows the parasite impaled by the rounded knob at end of arms to one of the clusters of gill rakers which occurs at regular intervals along the concave side of the branchial arches. These rakers serve to arrest the passage of any solid substances into the gill cavities and appear also to form a secure anchorage for parasites which in *Anchorella* are surrounded by a tough transparent membrane. There are no males among those I have examined.

Explanation of Plates.

Plate XV.

Fig. 1. *Calanus finmarchicus*, Gunner. *a*, Rostrum, *b*, terminal spine of swimming feet.

Fig. 2. *Metridia armata*, Boeck. *a*, terminal spine of swimming feet. *b*, fifth foot of male. *c*, fifth foot of female.

Fig. 3. *Pseudocalanus elongatus*, Baird. *a*, Posterior antenna. *b*, fifth pair of feet of male.

Fig. 4. *Pseudocalanus armatus*, Boeck. *a*, Foot of second pair. *b*, foot of fifth pair of male.

Fig. 5. *Paracalanus parvus*, Claus. *a*, termination of swimming feet. *b*, fifth foot of male. *c*, fifth foot of female.

Fig. 6. *Acartia clausii*, Giesbrecht. *a*, terminal spine of swimming feet. *b*, fifth foot of female. *c*, Caudal segments of *Acartia discaudatus*.

Fig. 7. *Temora longicornis*, Müller. *a*, terminal spine of swimming feet. *b*, caudal segments.

Fig. 8. *Eurytemora clausii*, Boeck. *a*, terminal spine of swimming feet. *b*, fifth foot of female.

Plate XVI.

Fig. 1. *Eurytemora affinis*, Poppe. *a*, anterior antenna of male. *b*, fifth foot of female.

Fig. 2. *Isias clavipes*, Boeck. *a*, fifth foot of male. *b*, fifth foot of female.

Fig. 3. *Centropages hamatus*, Lilljeborg. Fifth foot of male. *a*, terminal spine of swimming feet.

Fig. 4. *Parapontella brevicornis*, Lubbock. *a*, fifth pair of feet of male. *b*, fifth foot of female. *c*, Abdomen of male.

Fig. 5. *Labidocera wollastoni*, Lubbock. *a*, anterior antenna of male. *b*, right foot of fifth pair of male. *c*, left foot of fifth pair of male. *d*, fifth pair of feet of female.

Fig. 6. *Labidocera acutum*, Dana. *a*, fifth pair of feet of male. *b*, fifth foot of female. *c*, abdomen and

posterior thoracic angles of male. *d*, abdomen and posterior thoracic angles of female.

Fig. 7. *Anomalocera patersonii*, Templeton.

Fig. 8. *Euchæta marina*, Prestandrea. *a*, posterior antenna.

Plate XVII.

Fig. 1. *Oithona similis*, Claus.

Fig. 2. *Cyclopina littoralis*, Brady. *a*, posterior antenna. *b*, mandible and palp. *c*, fifth foot.

Fig. 3. *Cyclopina gracilis*, Claus. *a*, posterior antenna. *b*, mandible and palp. *c*, anterior foot jaw. *d*, posterior foot jaw.

Fig. 4. *Thorellia brunnea*, Boeck. *a*, posterior antenna. *b*, mandible and palp. *c*, posterior foot jaw. *d*, last thoracic segment with fifth feet and first two abdominal segments.

Fig. 5. *Hersiliodes puffini*, Thompson. *a*, anterior antenna. *b*, mandible. *c*, one of fifth feet.

Fig. 6. *Giardella callianassæ*, Canu. *a*, posterior antenna. *b*, one of fifth feet.

Fig. 7. *Notodelphys allmani*, Thorell. *a*, posterior antenna. *b*, one of fifth feet.

Fig. 8. *Doropygus pulex*, Thorell. *a*, female. *b*, male.

Plate XVIII.

Fig. 1. *Doropygus poricauda*, Brady. *a*, posterior antenna. *b*, one of fifth feet.

Fig. 2. *Doropygus gibber*, Thorell. *a*, posterior antenna. *b*, one of fifth feet.

Fig. 3. *Botachus cylindratus*, Thorell. *a*, male. *b*, female.

Fig. 4. *Ascidicola rosea*, Thorell. *a*, mandible and palp.

Fig. 5. *Notopterophorus papilio*, Hesse. *a*, side view, male. *b*, dorsal view, male.

Fig. 6. Ventral view, female.

Fig. 7. *Longipedia coronata*, Claus.

Fig. 8. *Ectinosoma spinipes*, Brady. *a*, first foot jaw. *b*, second foot jaw. *c*, *Ectinosoma erythrops*, Brady, first foot jaw. *d*, second foot jaw. *e*, *Ectinosoma curticorne*, Boeck, fifth foot.

Plate XIX.

Fig. 1. *Ectinosoma atlanticum*, Brady and Robertson. *a*, anterior antenna, female. *b*, posterior antenna. *c*, anterior foot jaw. *d*, posterior foot jaw.

Fig. 2. *Tachidius littoralis*, Poppe. *a*, anterior antenna, male. *b*, posterior antenna. *c*, posterior foot jaw. *d*, fifth pair of feet, female. *e*, *Tachidius brevicornis*, Müller, antenna of female.

Fig. 3. *Euterpe gracilis*, Claus, male. *a*, anterior antenna, female. *b*, posterior antenna. *c*, fifth foot, male. *d*, fifth foot, female.

Fig. 4. *Robertsonia tenuis*, Brady and Robertson, female. *a*, anterior antenna, male. *b*, posterior antenna. *c*, posterior foot jaw. *d*, fifth foot, female.

Fig. 5. *Amymone sphærica*, Claus, male. *a*, mandible and palp. *b*, *Amymone longimana*, Claus, posterior foot jaw.

Fig. 6. *Stenhelia hispida*, Brady, female. *a*, posterior foot jaw. *b*, second foot of male. *c*, fifth foot of female.

Fig. 7. *Ameira longipes*, Boeck, female. *a*, anterior antenna, female. *b*, anterior antenna, male. *c*, posterior foot jaw. *d*, fifth foot, female.

Fig. 8. *Jonesiella fusiformis*, Brady and Robertson. *a*, anterior antenna, female. *b*, *Bradya typica*, Boeck, anterior antenna, female. *c*, tail.

Plate XX.

Fig. 1. *Jonesiella hyænæ*, Thompson, female. *a*, posterior antenna. *b*, anterior foot jaw. *c*, posterior foot jaw. *d*, fifth foot, female.

Fig. 2. *Delavalia palustris*, Brady, male. *a*, anterior antenna, female. *b*, foot of first pair.

Fig. 3. *Delavalia reflexa*, Brady and Robertson, female. *a*, posterior foot jaw. *b*, fifth foot.

Fig. 4. *Mesochra lilljeborgii*, Boeck, female. *a*, anterior antenna, female. *b*, anterior antenna, male. *c*, posterior foot jaw. *d*, fifth foot, female.

Fig 5. *Diosaccus tenuicornis*, Claus. *a*, anterior antenna, female. *b*, first foot. *c*, fifth foot, female.

Fig. 6. *Laophonte serrata*, Claus, male. *a*, anterior antenna, female. *b*, posterior antenna. *c*, posterior foot jaw. *d*, mandible and palp.

Fig. 7. *Laophonte horrida*, Norman, female. *a*, dorsal view. *b*, lateral view. *c*, posterior foot jaw. *d*, first foot. *e*, fifth foot, female.

Fig. 8. *Laophonte lamellifera*, Claus. *a*, anterior antenna, female. *b*, posterior foot jaw. *c*, fifth foot, female. *d*, tail.

Plate XXI.

Fig. 1. *Misophria pallida*, Boeck. *a*, anterior antenna, female. *b*, posterior antenna. *c*, mandible and palp.

Fig. 2. *a*, *Ectinosoma melaniceps*, Boeck, second foot jaw. *b*, *Tachidius brevicornis*, Müller, fifth feet, female. *c*, fifth foot, male. *d*, *Stenhelia ima*, Brady, second foot jaw. *e*, fifth foot, female. *f*, one of tail segments.

Fig. 3. *Laophonte curticauda*, Boeck, female. *a*, anterior antenna, female. *b*, posterior antenna. *c*, pos-

terior foot jaw. *d*, Inner branch of second foot, male.

Fig. 4. *Laophonte hispida*, Brady and Robertson. *a*, anterior antenna, female. *b*, posterior foo jaw. c, one of caudal segments. *d*, fifth foot.

Fig. 5. *Laophonte similis*, Claus. *a*, anterior antenna. *b*, fifth foot, female. *c*, fifth foot, male. *d*, appendages of first abdominal segment. *e*, *Laophonte thoracica*, Boeck, anterior antenna. *f*, posterior foot jaw. *g*, fifth foot.

Fig. 6. *Normanella dubia*, Brady and Robertson. *a*, anterior antenna, female. *b*, mandible. *c*, posterior foot jaw. *d*, first foot.

Fig. 7. *Cletodes limicola*, Brady. *a*, anterior antenna, female. *b*, anterior antenna, male. *c*, posterior antenna. *d*, fifth foot, female. *e*, fifth foot, male.

Fig. 8. *Cletodes linearis*, Claus. *a*, anterior antenna, female. *b*, posterior foot jaw. *c*, inner branch of posterior antenna. *d*, outer branch of foot of third pair, male. *e*, fifth foot, male. *f*, *Cletodes longicaudata*, Brady and Robertson, caudal segments.

Plate XXII.

Fig. 1. *Enhydrosoma curvatum*, Brady and Robertson. *a*, anterior antenna, female. *b*, anterior antenna, male. *c*, posterior antenna. *d*, anterior foot jaw. *e*, posterior foot jaw. *f*, fifth pair of feet.

Fig. 2. *Platychelipus littoralis*, Brady. *a*, anterior antenna, female. *b*, anterior antenna, male. *c*, posterior foot jaw. *d*, foot of first pair.

Fig. 3. *Dactylopus tisboides*, Claus. *a*, posterior antenna. *b*, first foot. *c*, fifth foot, female.

Fig. 4. *a*, *Dactylopus stromii*, Baird, anterior antenna, female. *b*, inner branch of second foot, male. *c*, *Dactylopus tenuiremis*, Brady and Robertson, anterior antenna, male. *d*, one of tail segments. *e*, *Dactylopus brevicornis*, Claus, anterior antenna, female. *f*, second foot jaw. *g*, fifth foot, female.

Fig. 5. *Dactylopus flavus*, Claus. *a*, anterior antenna, female. *b*, fifth foot, male. *c*, fifth foot, female. *d*, caudal segments, female. *e*, *Dactylopus minutus*, Claus, anterior antenna, female.

Fig. 6. *Thalestris rufocincta*, Norman. *a*, one of swimming feet, showing aculeate spines. *b*, *Thalestris clausii*, Norman, first pair swimming feet. *c*, posterior foot jaw.

Fig. 7. *Thalestris helgolandica*, Claus. *a*, anterior antenna, male. *b*, posterior antenna. *c*, fifth pair of feet, female.

Fig. 8. *Thalestris harpactoides*, Claus. *a*, anterior antenna, female. *b*, anterior antenna, male. *c*, posterior antenna. *d*, posterior foot jaw. *e*, fifth foot, female.

Plate XXIII.

Fig. 1. *Thalestris rufo-violescens*, Claus. *a*, anterior antenna, female. *b*, posterior antenna. *c*, posterior foot jaw. *d*, fifth foot, female.

Fig. 2. *a*, *Thalestris serrulata*, Brady, caudal segments. *b*, *Thalestris hibernica*, Brady and Robertson, anterior antenna. *c*, inner branch, posterior antenna. *d*, posterior foot jaw. *e*, fifth foot, female. *f*, fifth foot, male.

Fig. 3. *Thalestris longimana*, Claus. *a*, fifth foot, female. *b*, fifth foot, male. *c*, *Thalestris peltata*, Boeck,

anterior antenna, rostrum, and eye spot, female. *d*, fifth foot, female.

Fig. 4. *Westwoodia nobilis*, Baird. *a*, posterior antenna. *b*, posterior foot jaw. *c*, first foot.

Fig. 5. *Harpacticus chelifer*, Müller. *a*, inner branch of posterior antenna. *b*, spine of posterior antenna. *c*, posterior foot jaw. *d*, fifth pair of feet.

Fig. 6. *a*, *Harpacticus fulvus*, Fischer. Inner branch of second foot, male. *b*, posterior foot jaw. *e*, first foot. *d*, *Harpacticus flexus*, Brady and Robertson, posterior foot jaw. *c*, inner branch of second foot, male. *f*, fifth foot, female.

Fig. 7. *Zaus spinatus*, Goodsir. *a*, anterior antenna, male. *b*, posterior antenna. *c*, mandible and palp. *d*, foot of fifth pair, female.

Fig. 8. *Zaus goodsiri*, Brady. *a*, posterior foot jaw. *b*, fifth foot, female.

Plate XXIV.

Fig. 1. *Alteutha interrupta*, Goodsir. *a*, anterior antenna, male. *b*, fifth foot. *c*, *Alteutha depressa*, Baird, anterior antenna, male. *d*, fifth foot.

Fig. 2. *Alteutha crenulata*, Brady. *a*, anterior antenna, female. *b*, anterior antenna, male. *c*, posterior foot jaw. *d*. foot of fifth pair, male, and angle of first abdominal segment.

Fig. 3. *Porcellidium tenuicauda*, Claus. *a*, *Porcellidium viride*, Philippi, fifth pair of feet, abdomen, and tail of male.

Fig. 4. *Idya furcata*, Baird. *a*, posterior antenna. *b*, foot of first pair. *c*, fifth foot, female.

Fig. 5. *Scutellidium tisboides*, Claus. *a*, first foot. *b*, anterior foot jaw. *c*, posterior foot jaw. *d*, *Scutellidium fasciatum*, Boeck, anterior foot jaw.

e, posterior foot jaw. *f*, fifth foot, female.

Fig. 6. *Monstrilla rigida*, Thompson. *a*, anterior antenna, male. *b*, *Monstrilla danæ*, Claparède, abdomen and caudal segments.

Fig. 7. *Monstrilla anglica*, Lubbock. *a*, anterior antenna, male. *b*, feathery plume on apical segment.

Fig. 8. *Monstrilla longicornis*, Thompson. *a*, anterior antenna, male. *b*, genital appendage on first abdominal segment of *M. anglica*, male.

Plate XXV.

Fig. 1. *Lichomolgus fucicolus*, Brady. *a*, posterior antenna. *b*, posterior foot jaw of male. *c*, posterior foot jaw of female. *d*, fourth foot.

Fig. 2. *Lichomolgus liber*, Brady and Robertson. *a*, foot of fifth pair. *b*, abdomen of male. *c*, *Lichomolgus thorellii*, Brady and Robertson, abdomen and tail of female.

Fig. 3. *Lichomolgus furcillatus*, Thorell. *a*, anterior antenna, female. *b*, mandible. *c*, *Lichomolgus albens*, Thorell. Abdomen, tail, and fifth feet.

Fig. 4. *Lichomolgus agilis*, Scott. *a*, anterior antenna, female. *b*, posterior foot jaw, male. *c*, posterior foot jaw, female. *d*, foot of fourth pair.

Fig. 5. *Sabelliphilus sarsii*, Claparède. *a*, anterior antenna, female. *b*, posterior antenna. *c*, posterior foot jaw. *d*, foot of fifth pair.

Fig. 6. *Cylindropsyllus lævis*, Brady. *a*, anterior antenna, female. *b*, posterior antenna. *c*, foot of fifth pair, female. *d*, foot of fifth pair, male.

Fig. 7. *Cyclopicera nigripes*, Brady and Robinson. *a*, anterior antenna, female. *b*, posterior antenna. *c*, posterior foot jaw. *d*, fifth foot, female.

Fig. 8. *Cyclopicera lata*, Brady. *a*, abdomen and fifth feet, female. *b*, anterior antenna, female. *c*, posterior antenna. *d*, *Lichomolgus agilis*. Scott.

Plate XXVI.

Fig. 1. *Cyclopicera gracilicauda*, Brady. *a*, posterior antenna. *b*, anterior foot jaw. *c*, posterior foot jaw. *d*, fifth foot.

Fig. 2. *Artotrogus boeckii*, Brady. *a*, posterior antenna. *b*, posterior foot jaw. *c*, maxilla. *d*, fifth foot.

Fig. 3. *Artotrogus magniceps*, Brady. *a*, anterior antenna. *b*, anterior foot jaw. *c*, posterior foot jaw. *d*, foot of fifth pair.

Fig. 4. *Artotrogus orbicularis*, Boeck.

Fig. 5. *Artotrogus normani*, Brady and Robertson. *a*, anterior antenna. *b*, pittings on shell. *c*, posterior antenna. *d*, posterior foot jaw.

Fig. 6. *Dyspontius striatus*, Thorell. *a*, anterior antenna. *b*, posterior foot jaw. *c*, abdomen of female.

Fig. 7. *Lernæa branchialis*, Linn. *a*, adult male. *b*, adult female.

Fig. 8. *Acontiophorus scutatus*, Brady and Robertson. *a*, anterior antenna, female. *b*, posterior antenna. *c*, fifth foot, female.

Plate XXVII.

Fig. 1. *Lernentoma lophii*, Johnston.

Fig. 2. *Anchorella uncinata*, Müller.

Fig. 3. *Caligus curtus*, Leach.

Fig. 4. *Caligus rapax*, Mln. Edwards.

Fig. 5. *a*, *Lepeoptheirus normanni*, Mln. Edw. *b*, *Lepeoptheirus obscurus*.

Fig. 6. *a*, *Lepeoptheirus hippoglossi*, Kroyer. *b*, *Lepeoptheirus stromii*, Baird.

Fig. 7. *a*, *Cervinia bradyi*, Norman. *b*, anterior antenna. *c*, posterior antenna. *d*, foot of second pair. *e*, foot of fifth pair.

Fig. 8. *a*, *Paramesochra dubia*, Scott, female. *b*, *Tetragoniceps bradyi*, Scott, anterior antenna, female. *c*, abdomen, female. *d*, foot of fifth pair, male. *e*, caudal stylet, female. *f*, caudal stylet, male.

Plate XXVIII.

Fig. 1. *Herdmania stylifera*, n. sp., female.
Fig. 2. Anterior antenna, female.
Fig. 3. ,, male.
Fig. 4. Posterior antenna.
Fig. 5. Mandible and palp.
Fig. 6. Maxilla.
Fig. 7. First foot jaw.
Fig. 8. First foot.
Fig. 9. Third foot.
Fig. 10. Fourth foot.
Fig. 11. Fifth foot, female.
Fig. 12. ,, male.

Plate XXIX.

Fig. 1. *Cyclops marinus*, n. sp., female.
Fig. 2. Anterior antenna.
Fig. 3. Posterior antenna.
Fig. 4. Mandible and palp.
Fig. 5. Maxilla.
Fig. 6. Anterior foot jaw.
Fig. 7. Posterior foot jaw.
Fig. 8. Foot of first pair.
Fig. 9. Fifth pair of feet and abdomen.

Plate XXX.

Fig. 1. *Stenhelia denticulata*, n. sp., female.
Fig. 2. Anterior antenna.
Fig. 3. Posterior antenna.
Fig. 4. Mandible and palp.
Fig. 5. Maxilla.
Fig. 6. Anterior foot jaw.
Fig. 7. Posterior ,,
Fig. 8. Foot of first pair.
Fig. 9. Foot of third pair.
Fig. 10. Foot of fifth pair.
Fig. 11. Caudal segments.

Plate XXXI.

Fig. 1. *Stenhelia hirsuta*, n. sp., female.
Fig. 2. Anterior antenna, female.
Fig. 3. Anterior antenna, male.
Fig. 4. Posterior antenna.
Fig. 5. Mandible and palp.
Fig. 6. Maxilla.
Fig. 7. First foot jaw.
Fig. 8. Second foot jaw.
Fig. 9. Foot of first pair.
Fig. 10. Inner branch of second foot, male
Fig. 11. Foot of third pair.
Fig. 12. Fifth foot, female.
Fig. 13. Fifth foot, male.

Plate XXXII.

Fig. 1. *Ameira attenuata*, n. sp., female.
Fig. 2. ,, ,, male
Fig. 3. Anterior antenna, female.
Fig. 4. ,, male.
Fig. 5. Posterior antenna.

Fig. 6. Second foot jaw.
Fig. 7. Foot of first pair.
Fig. 8. ,, third pair.
Fig. 9. ,, fifth pair, female.
Fig. 10. ,, ,, male.
Fig. 11. Caudal segments.

Plate XXXIII.

Fig. 1. *Laophonte spinosa*, n.sp., male.
Fig. 2. Anterior antenna.
Fig. 3. ,, female.
Fig. 4. Posterior antenna.
Fig. 5. Mandible and palp.
Fig. 6. Maxilla.
Fig. 7. Second foot jaw.
Fig. 8. First foot.
Fig. 9. Third foot.
Fig. 10. Fourth foot.
Fig. 11. Fifth foot, male.
Fig. 12. ,, female.
Fig. 13. One of caudal segments.

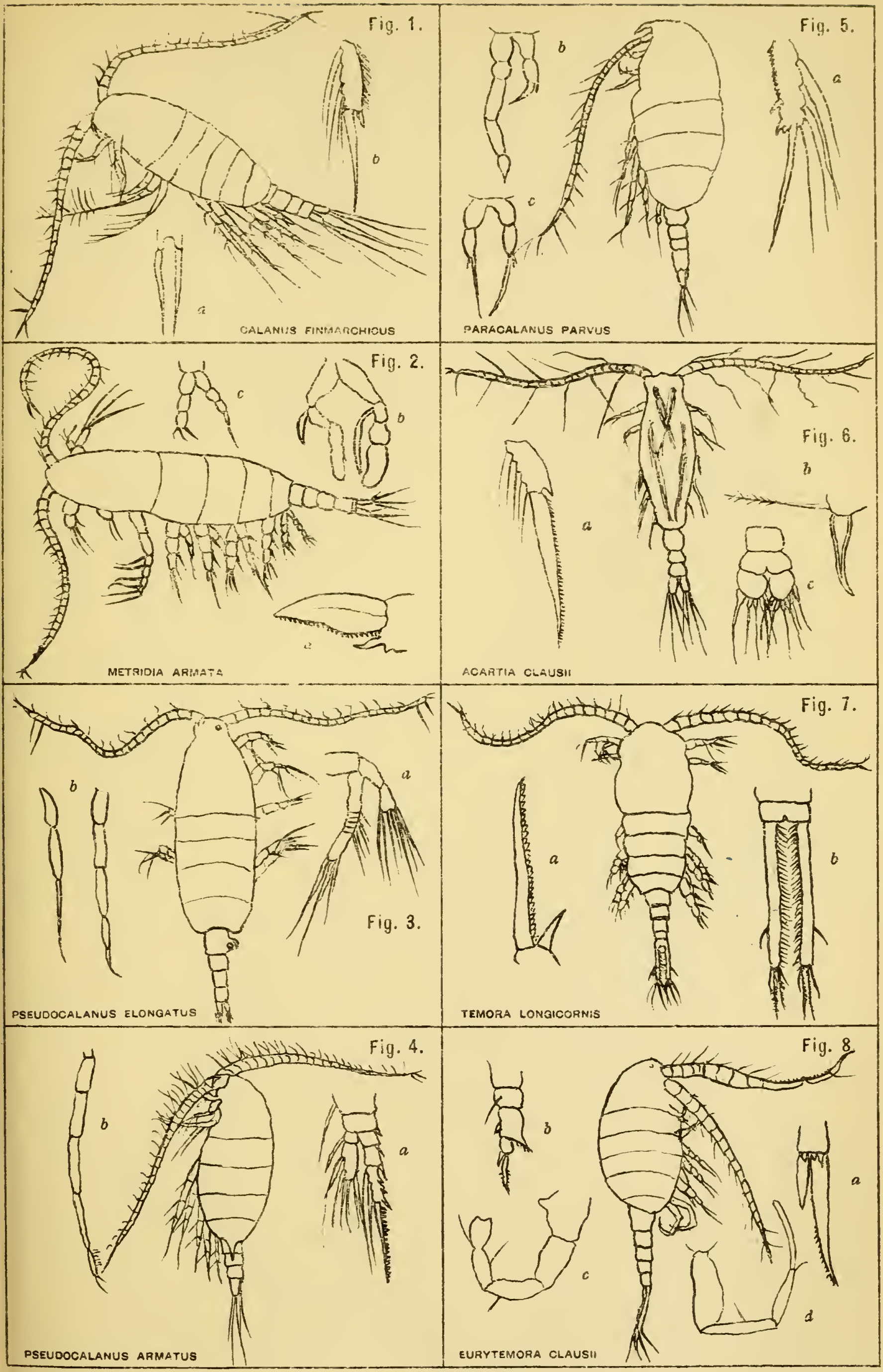
Plate XXXIV.

Fig. 1. *Cletodes monensis*, n. sp., female.
Fig. 2. Anterior antenna, and dorsal anterior end of cephalothorax.
Fig. 3. Posterior antenna.
Fig. 4. Maxilla.
Fig. 5. Mandible and palp.
Fig. 6. Anterior foot jaw.
Fig. 7. Posterior foot jaw.
Fig. 8. Foot of first pair.
Fig. 9. Foot of fourth pair.
Fig. 10. Fifth pair of feet.
Fig. 11. Caudal stylets.

PLATE XXXV.

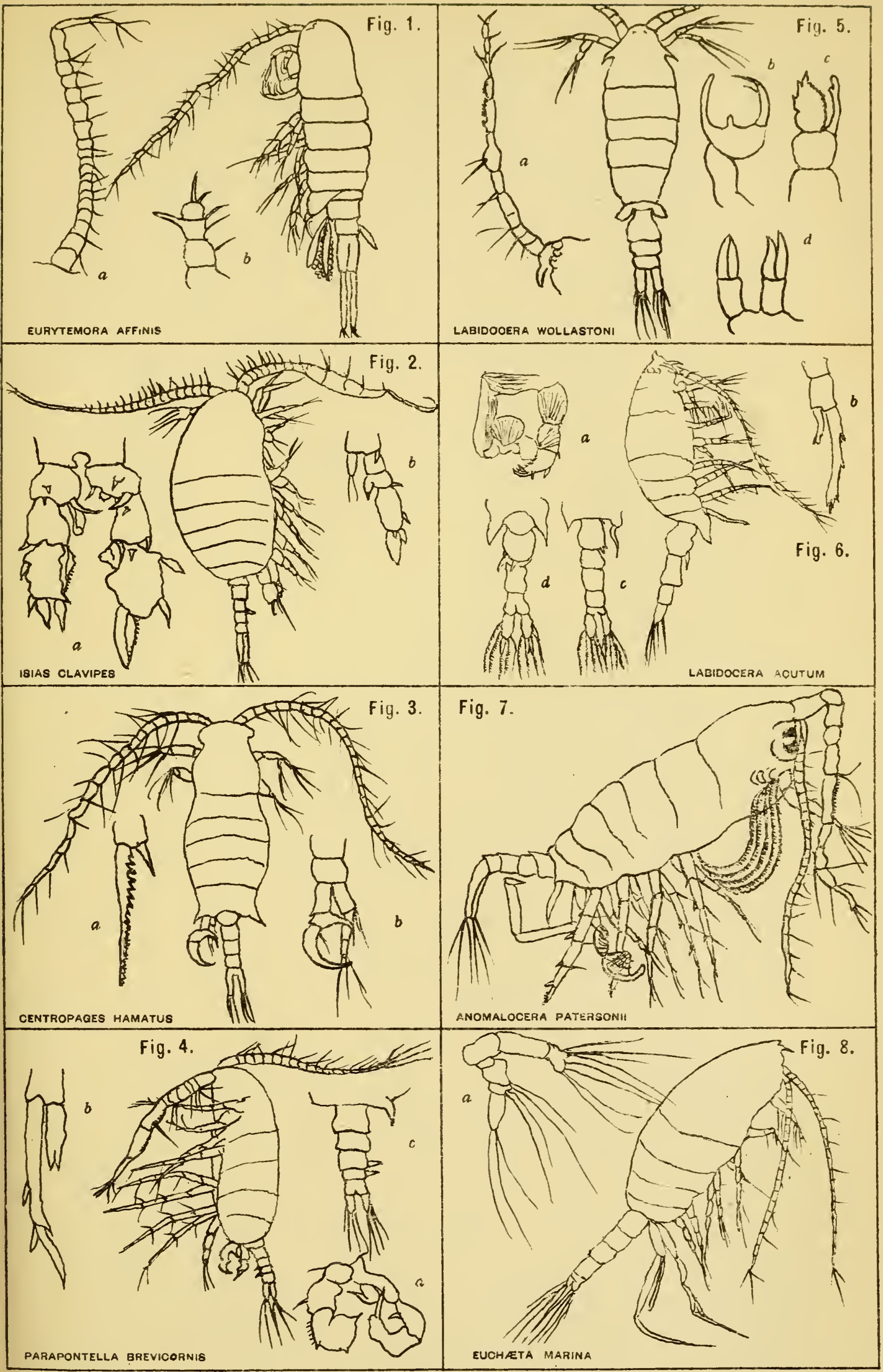
Fig. 1. *Lichomolgus maximus*, n. sp., male.
Fig. 2. ,, ,, female.
Fig. 3. Anterior antenna.
Fig. 4. Posterior antenna.
Fig. 5. Mandible and palp.
Fig. 6. Anterior foot jaw.
Fig. 7. Posterior foot jaw, male.
Fig. 8. ,, ,, female.
Fig. 9. Foot of first pair.
Fig. 10. Foot of fourth pair.
Fig. 11. Foot of fifth pair.

ALPHABETICAL INDEX TO SPECIES.



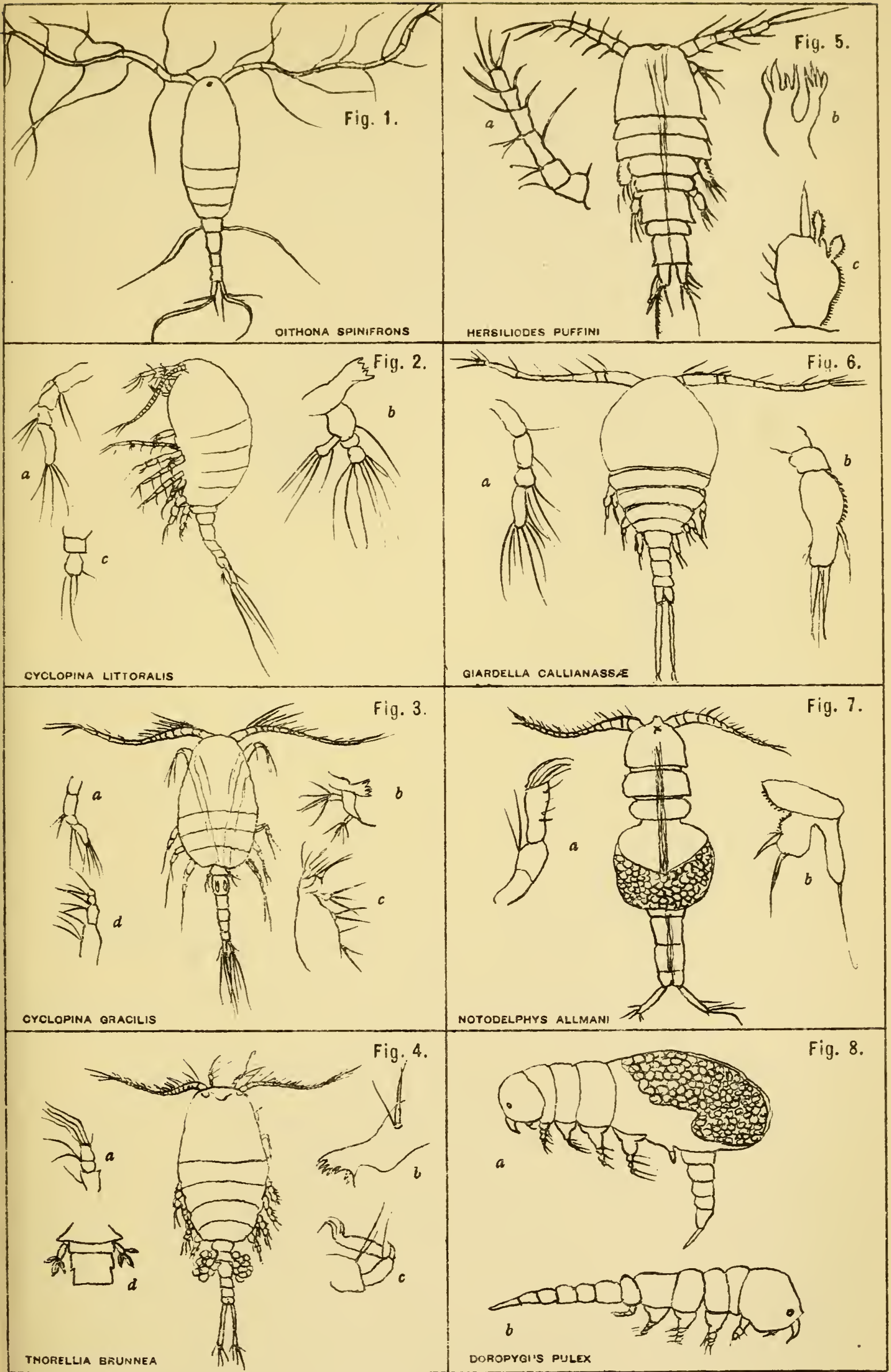
I. C. T., del.

COPEPODA OF LIVERPOOL BAY.



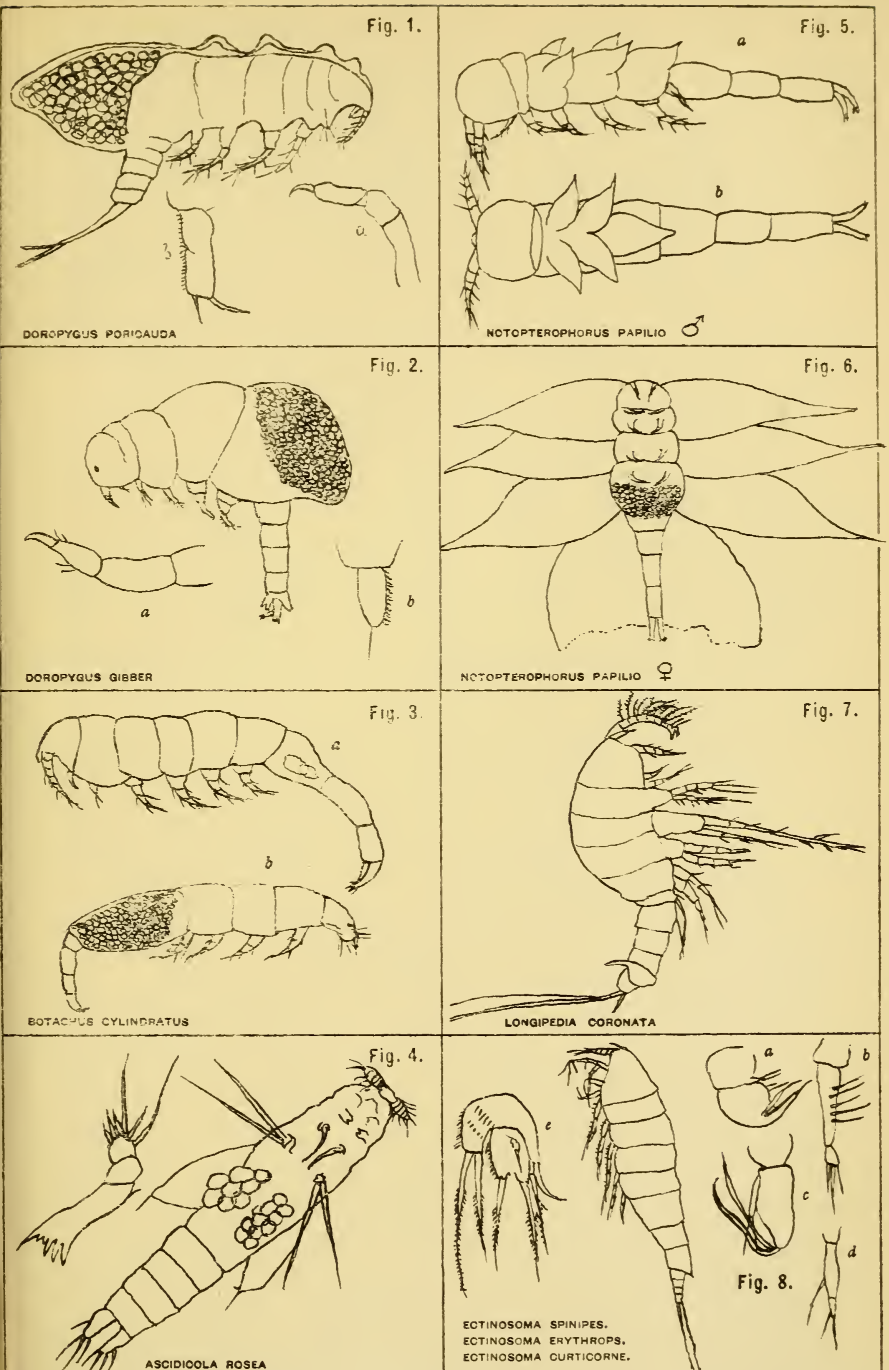
I. C. T., del.

COPEPODA OF LIVERPOOL BAY.



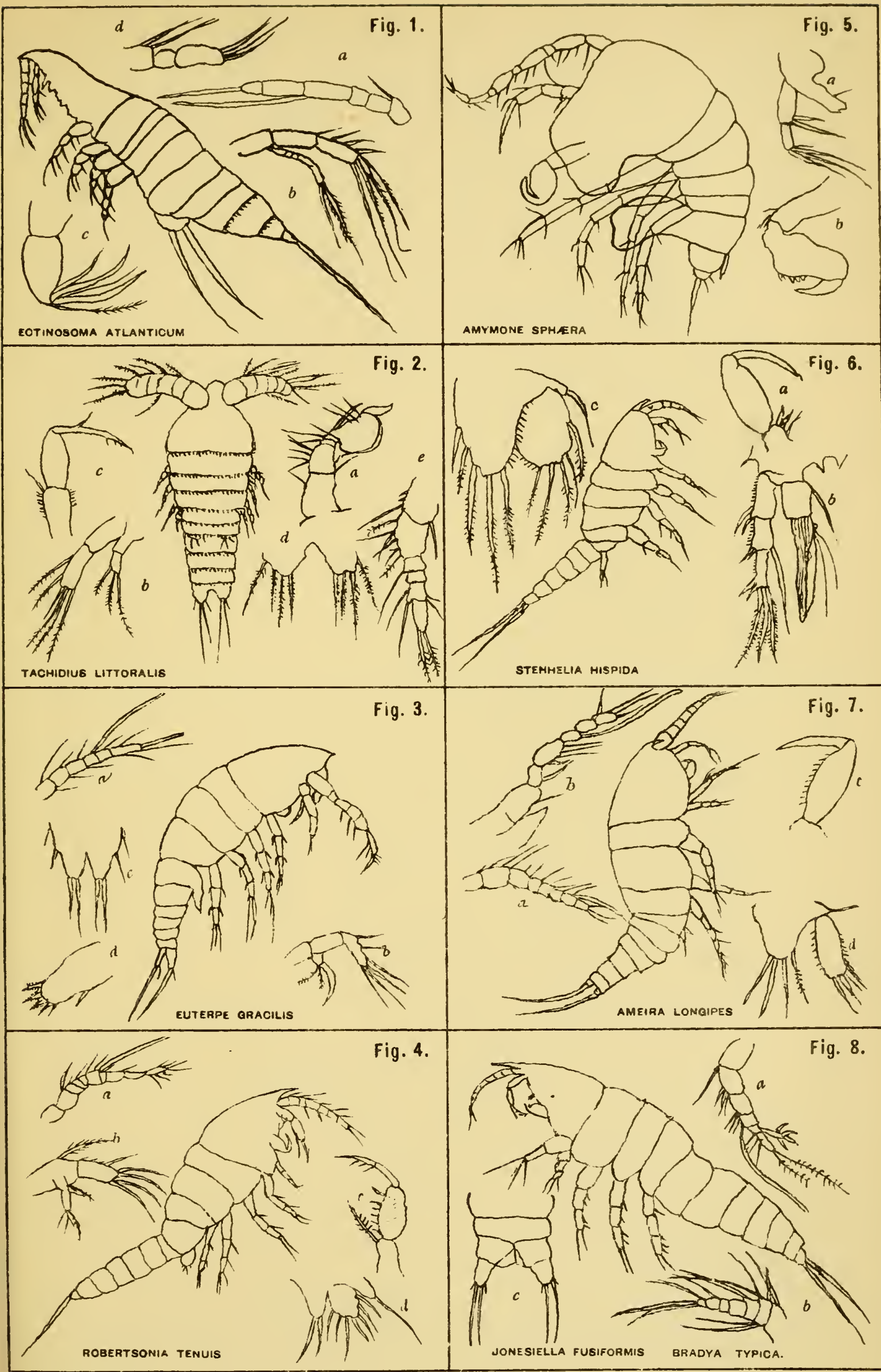
I. C. T., del.

COPEPODA OF LIVERPOOL BAY.



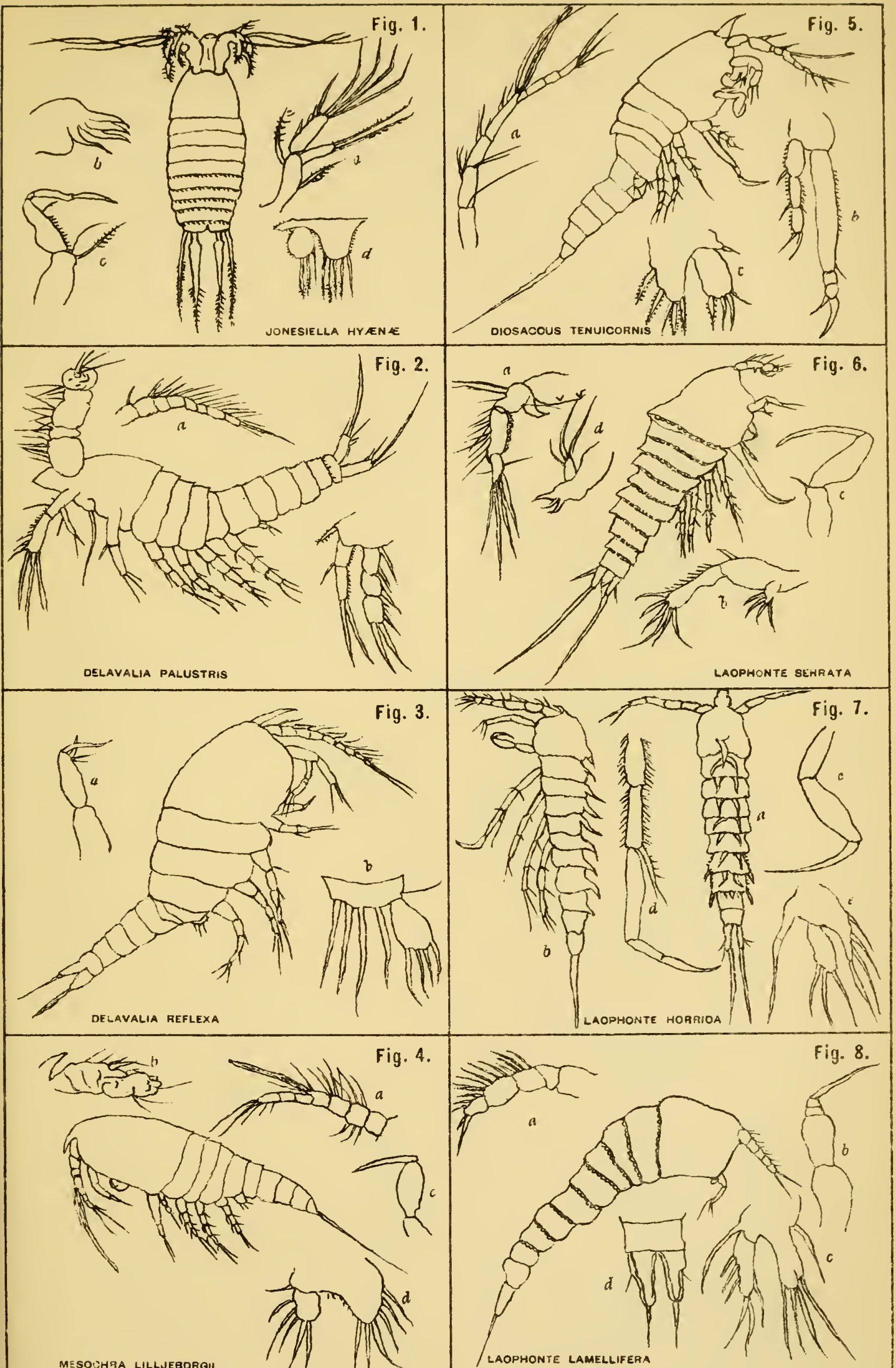
I. C. T., del

COPEPODA OF LIVERPOOL BAY.



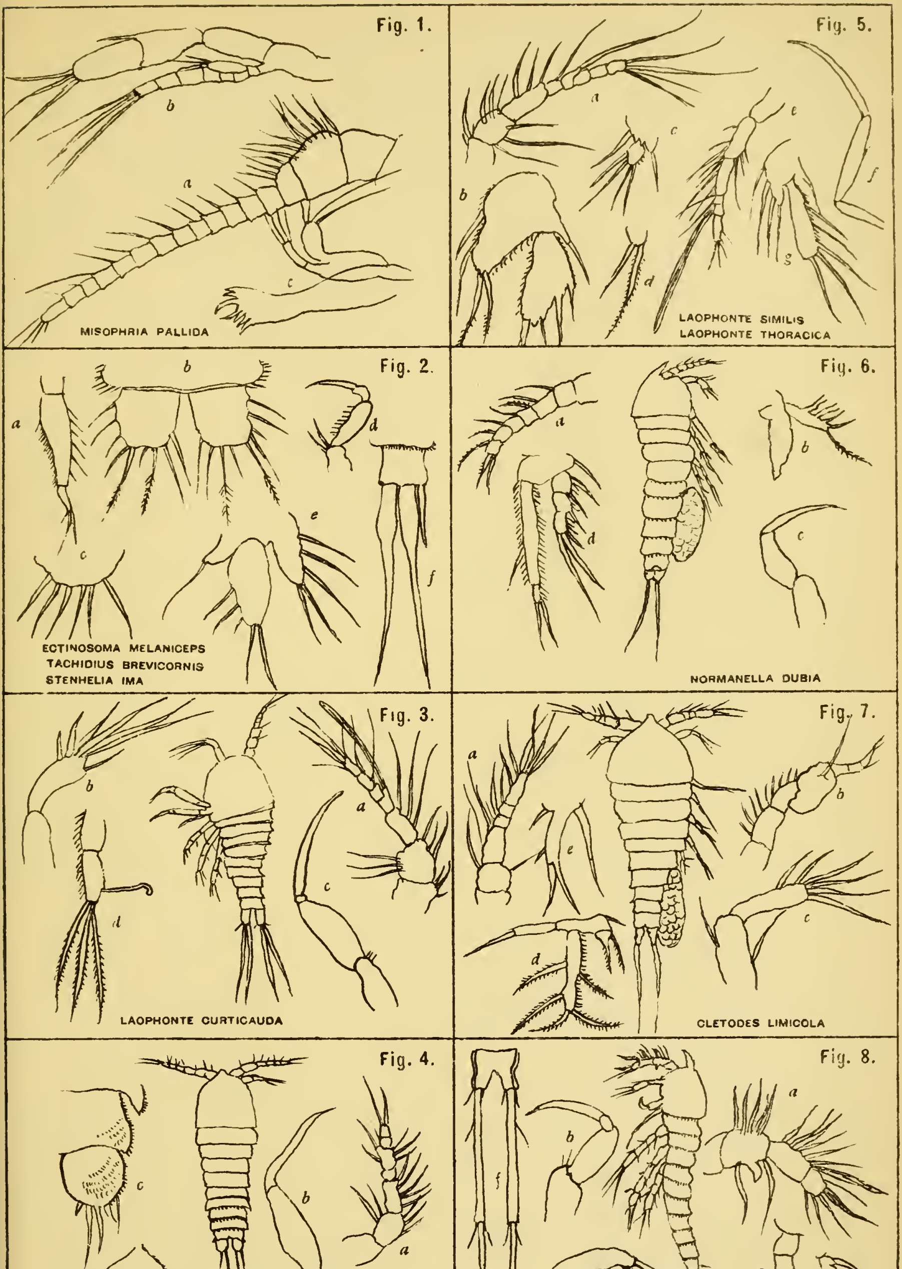
I. C. T., del.

COPEPODA OF LIVERPOOL BAY.



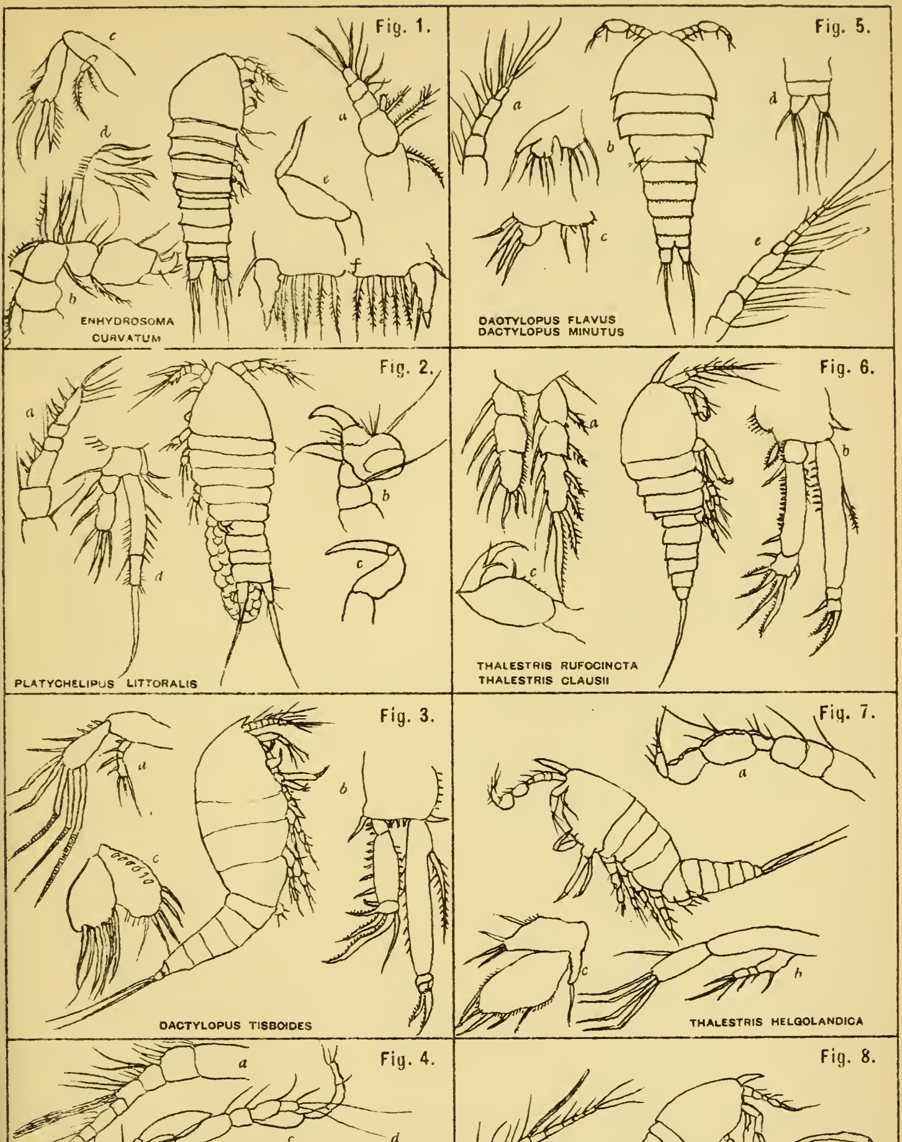
I. C. T., del.

COPEPODA OF LIVERPOOL BAY.



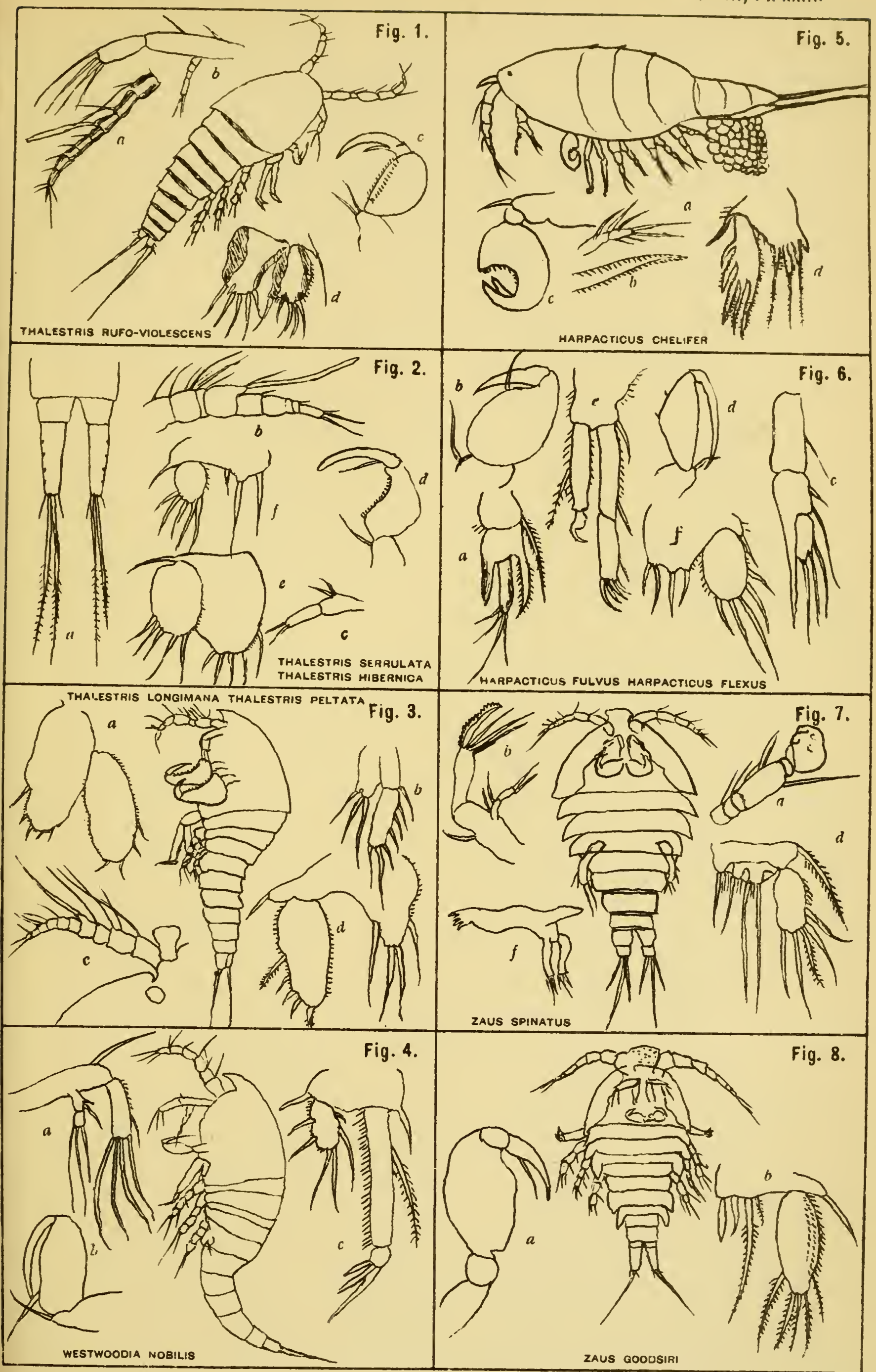
I. C. T., del.

COPEPODA OF LIVERPOOL BAY.



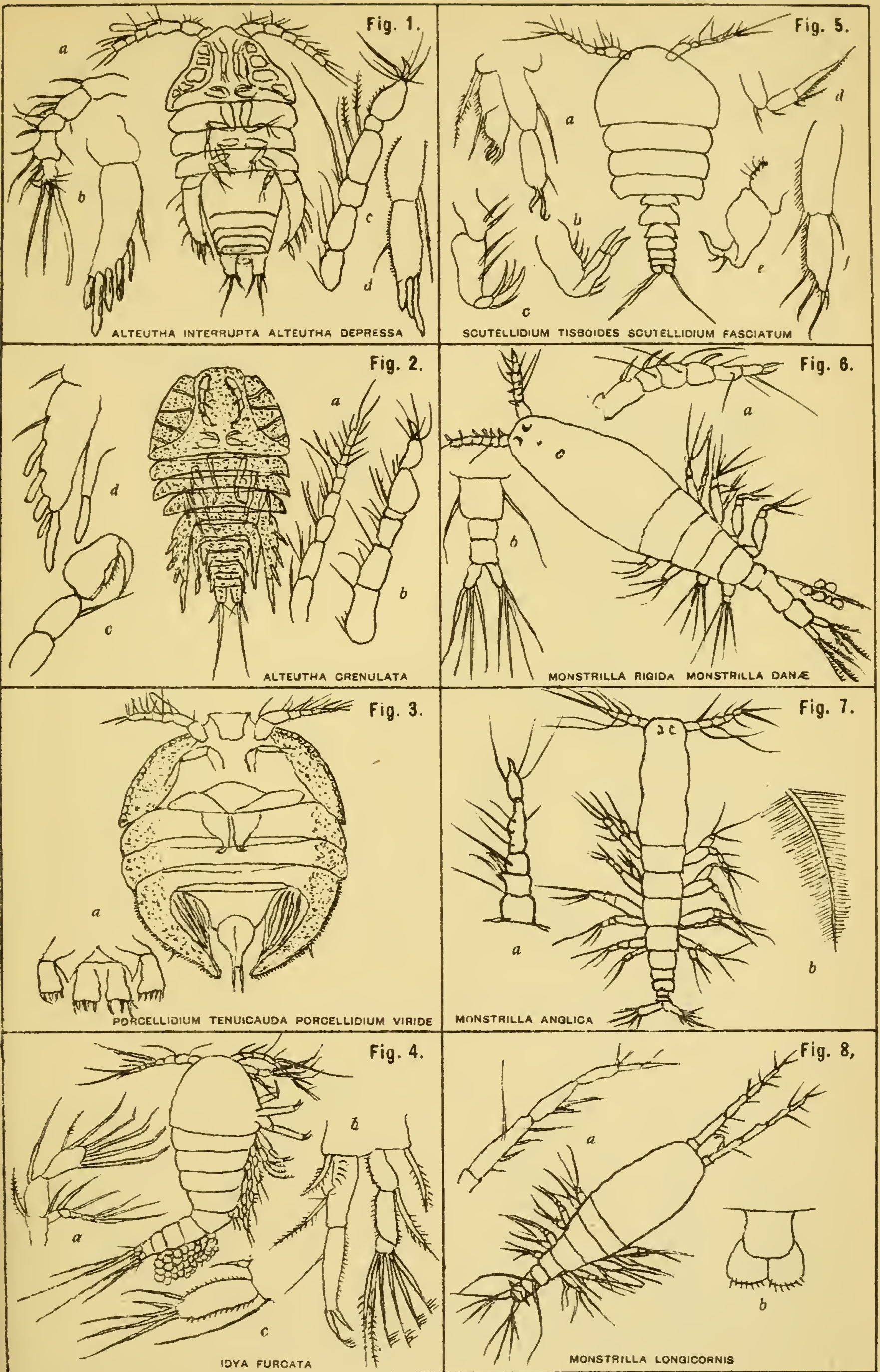
I. C. T., del.

COPEPODA OF LIVERPOOL BAY.



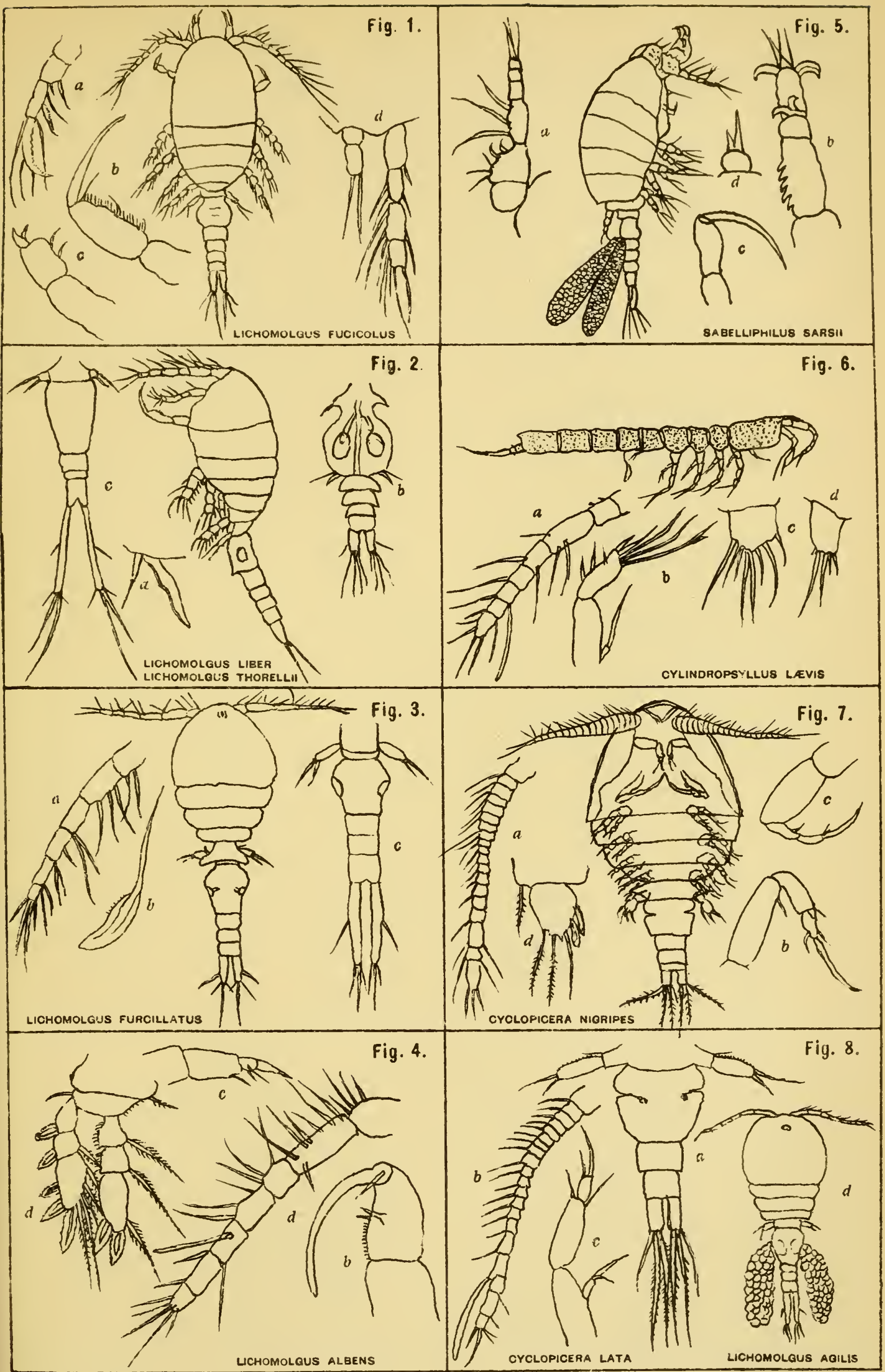
I. C. T., del.

COPEPODA OF LIVERPOOL BAY.



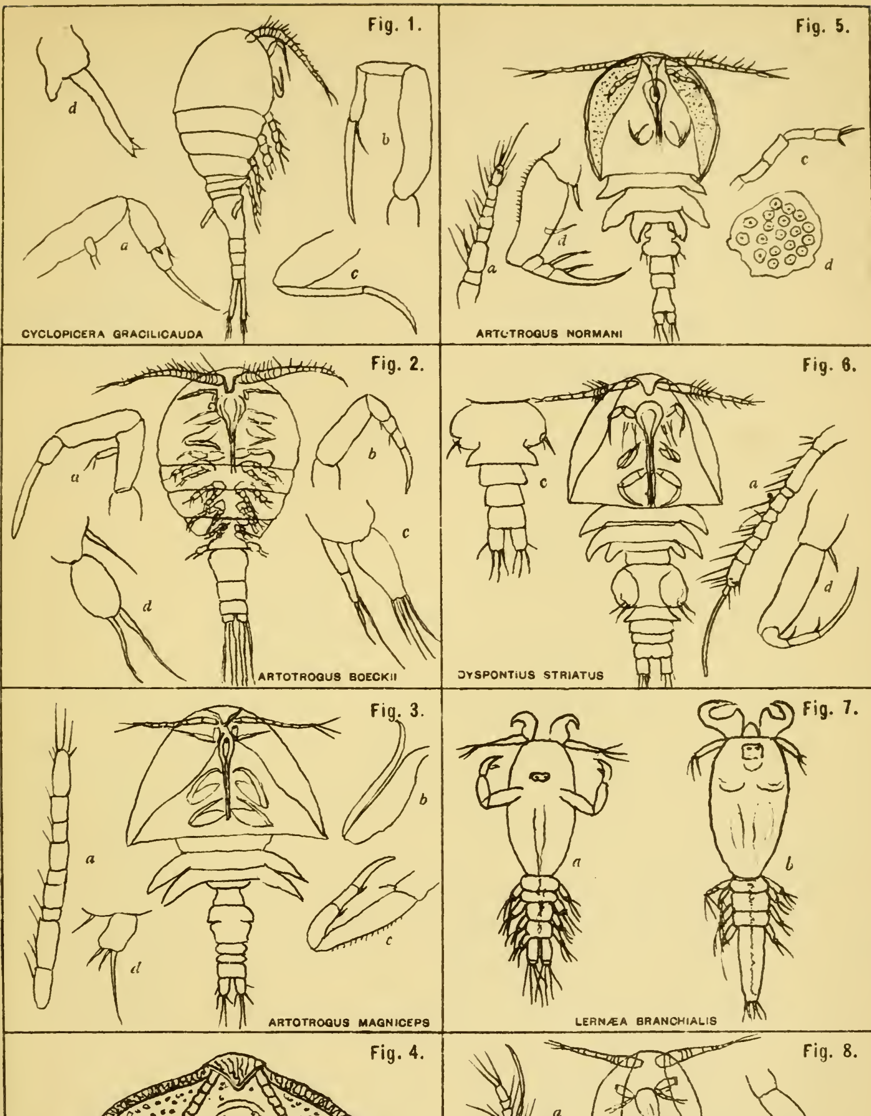
I. C. T., del.

COPEPODA OF LIVERPOOL BAY.



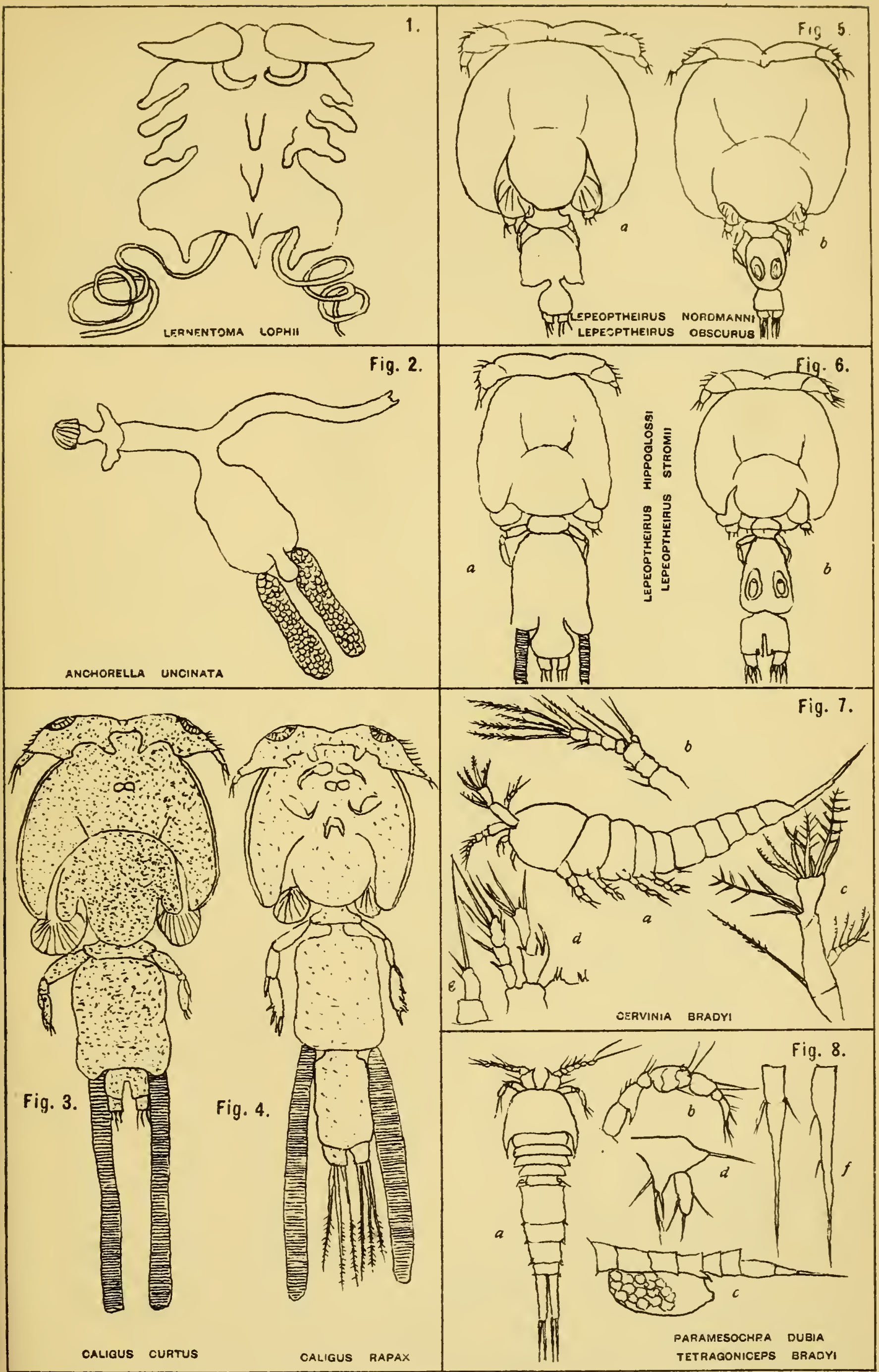
I. C. T., del.

COPEPODA OF LIVERPOOL BAY.



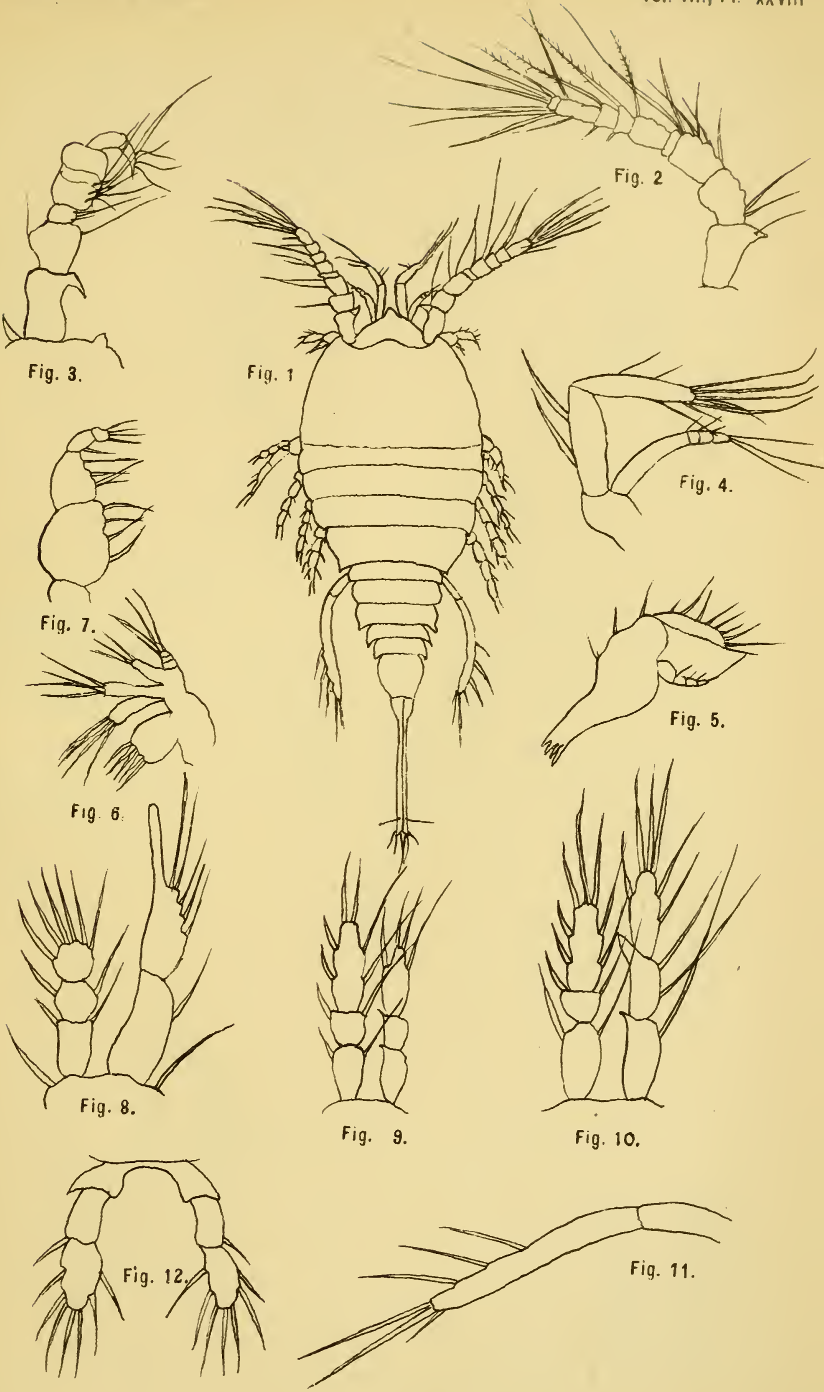
I. C. T., del.

COPEPODA OF LIVERPOOL BAY.



I. C. T., del.

COPEPODA OF LIVERPOOL BAY.



I. C. T., del.

HERDMANIA STYLIFERA, n. sp.


Fig. 5.

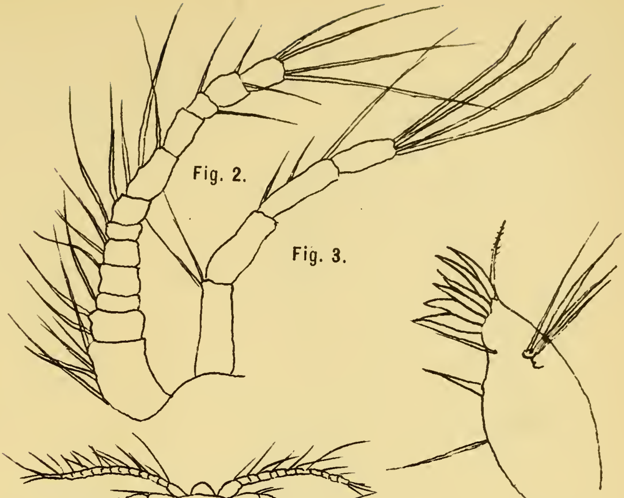


Fig. 2. Fig. 3.


Fig. 6.

Fig. 4.

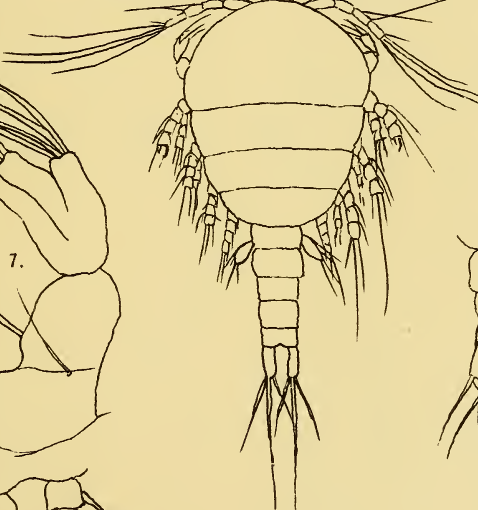


Fig. 1.

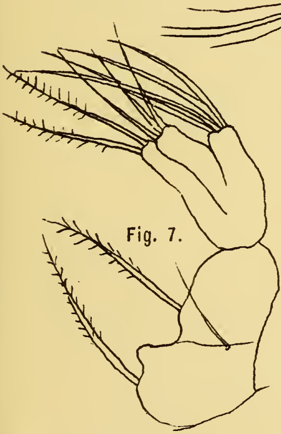


Fig. 7.

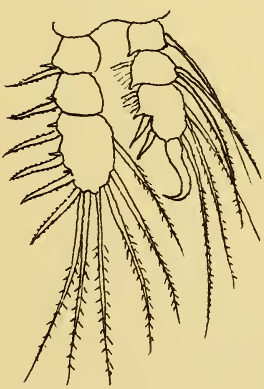


Fig. 8.

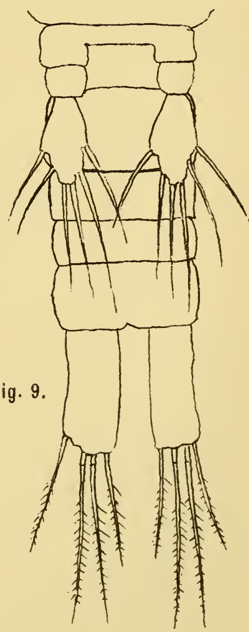
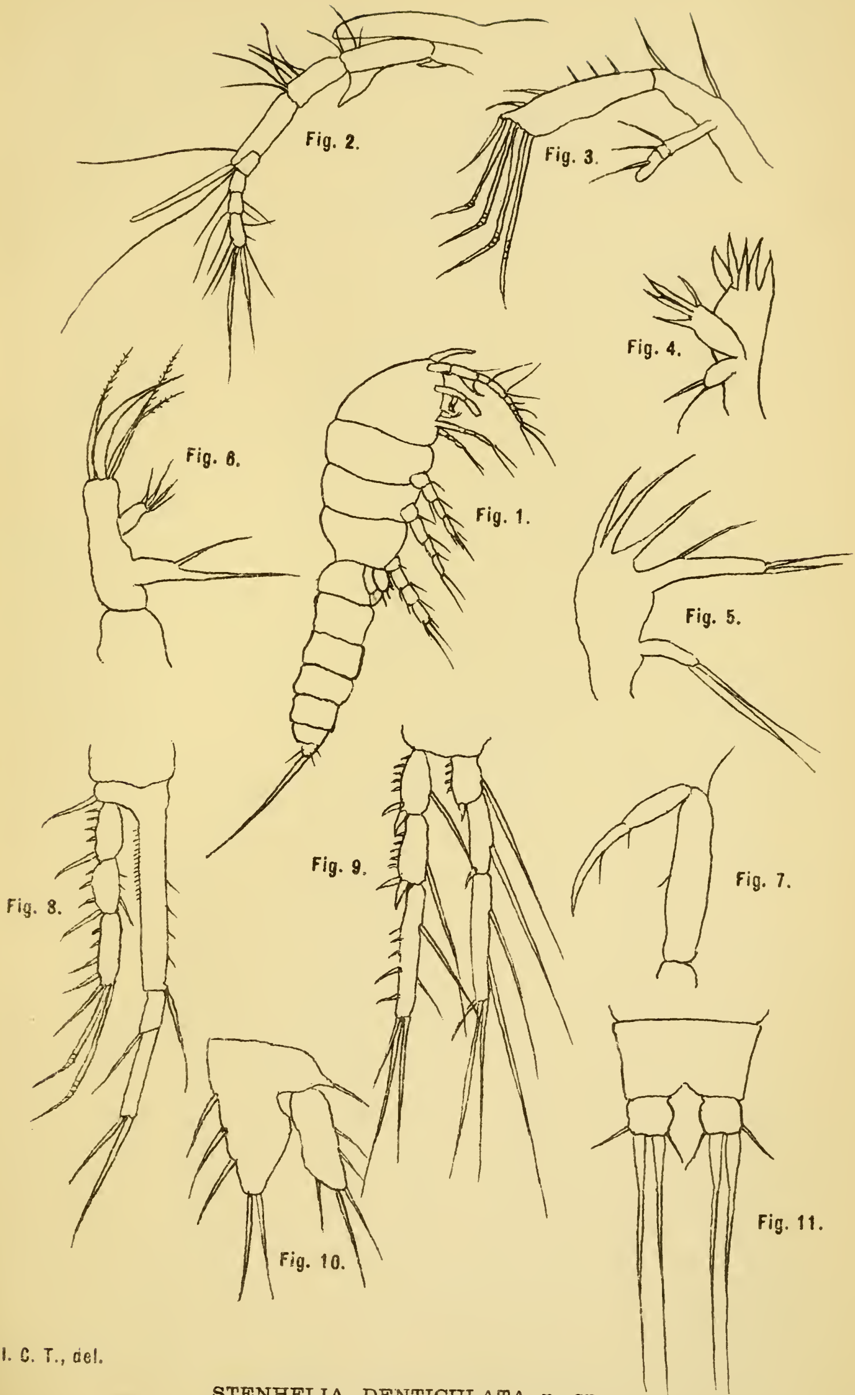


Fig. 9.

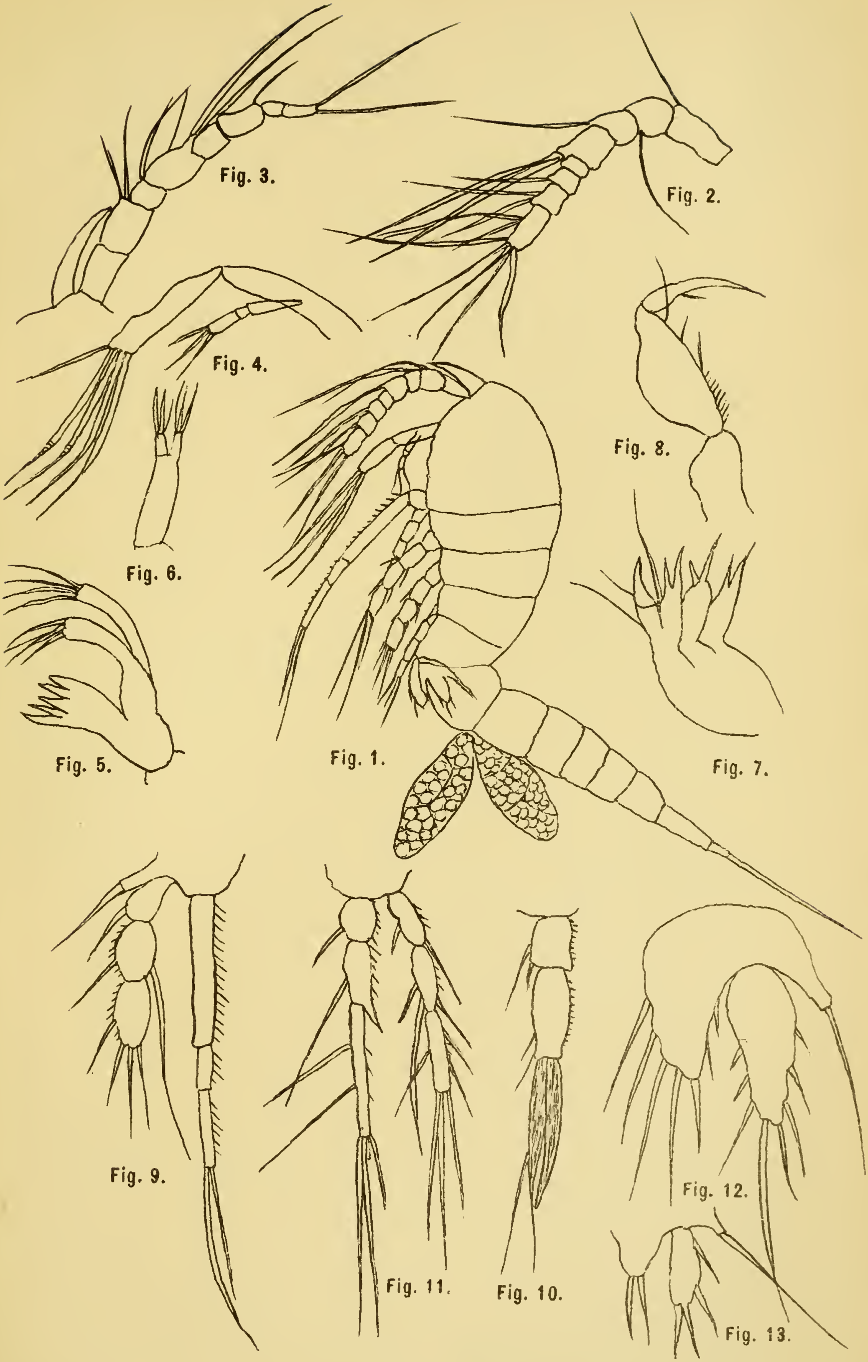
I. C. T., del.

CYCLOPS MARINUS. n. sp.



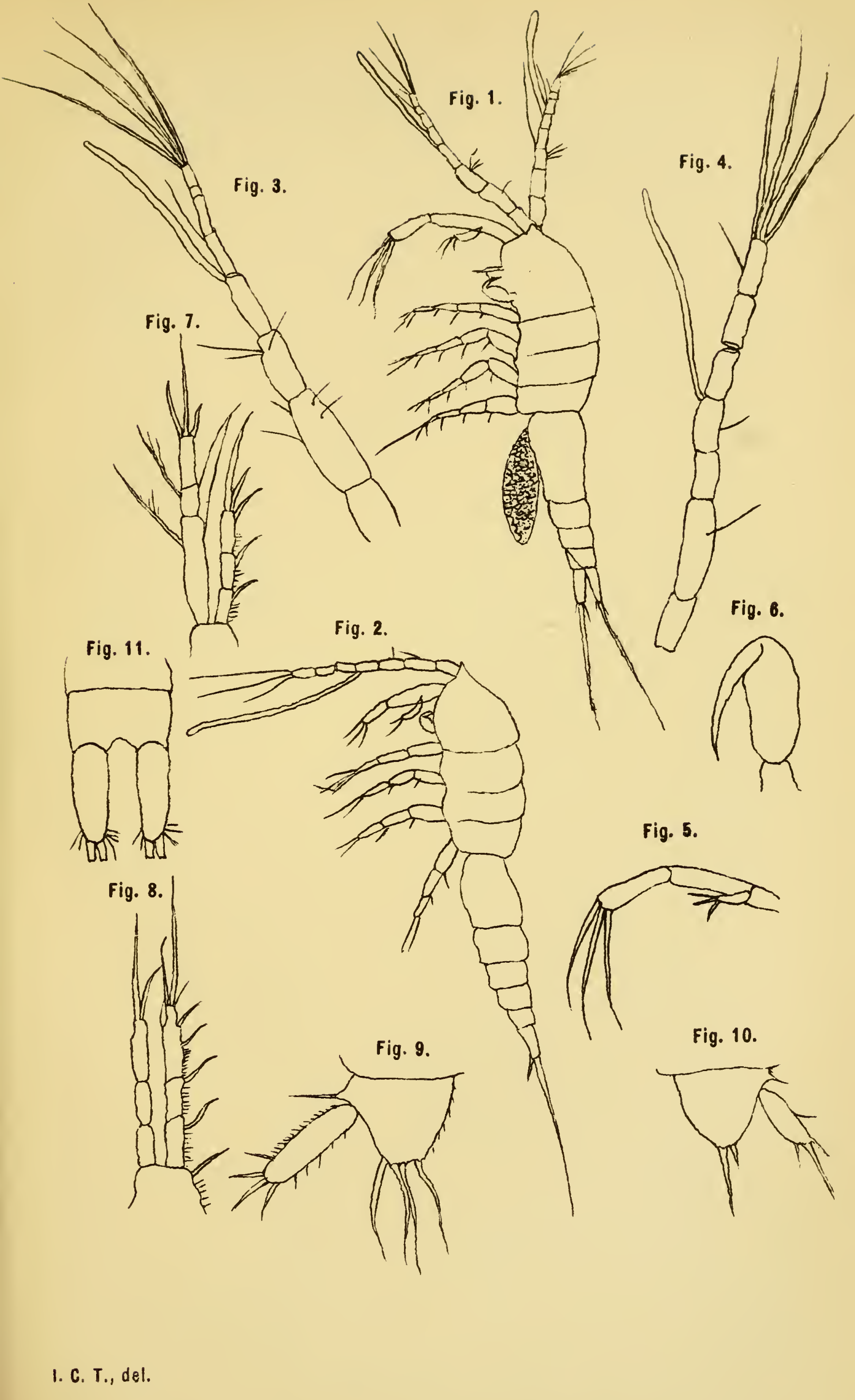
I. C. T., del.

STENHELIA DENTICULATA, n. sp.

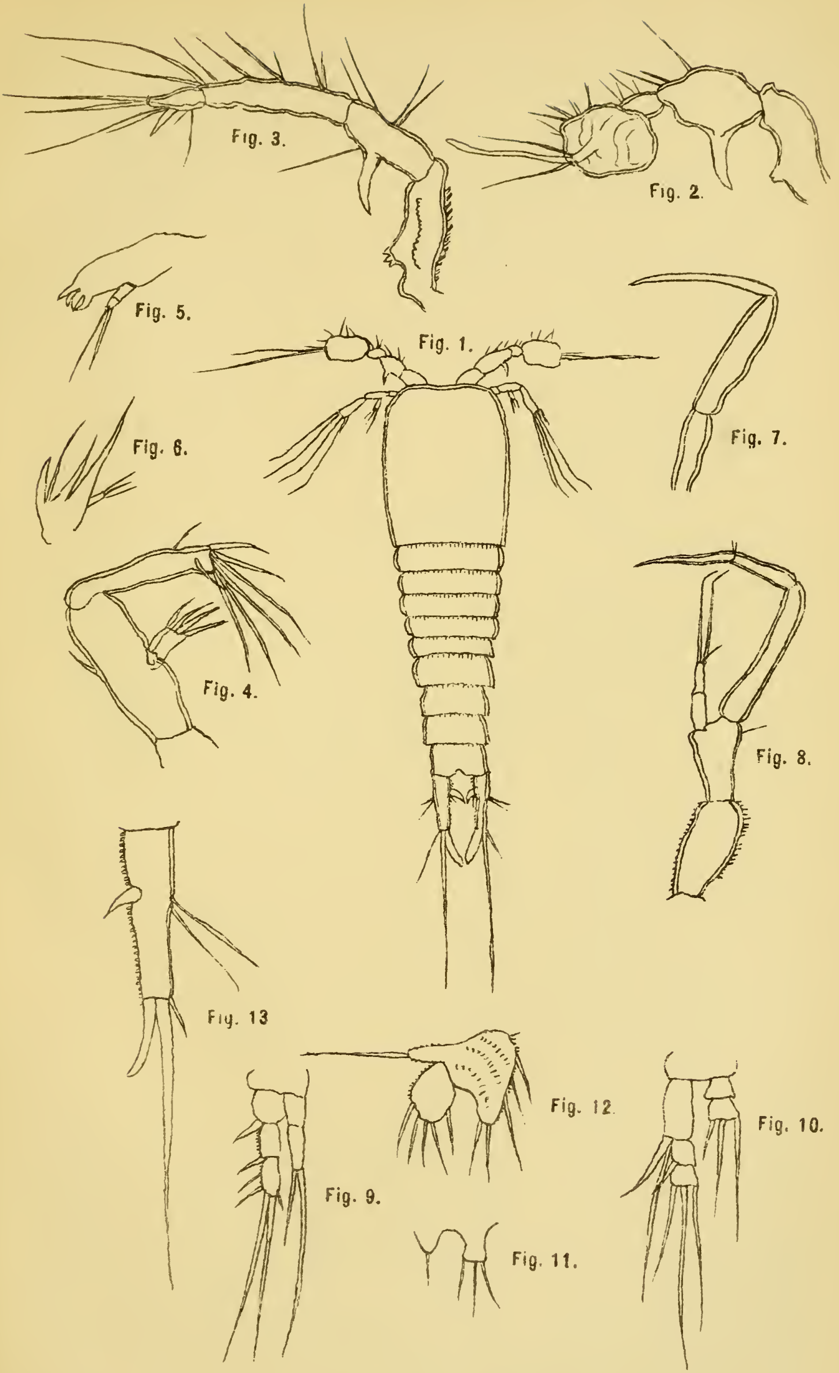


I. C. T., del.

STENHELIA HIRSUTA. n. sp.

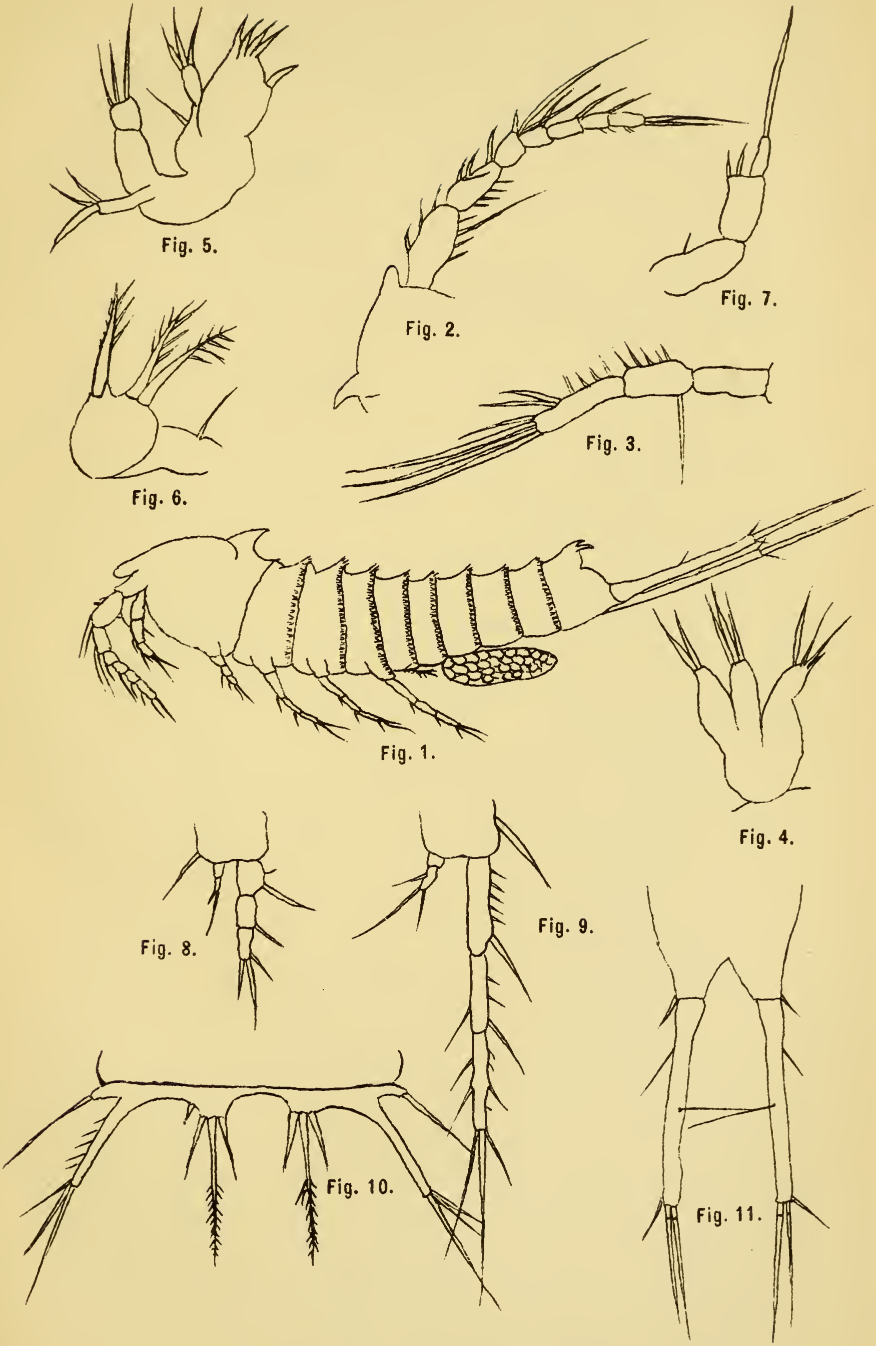


AMEIRA ATTENUATA, n. sp.



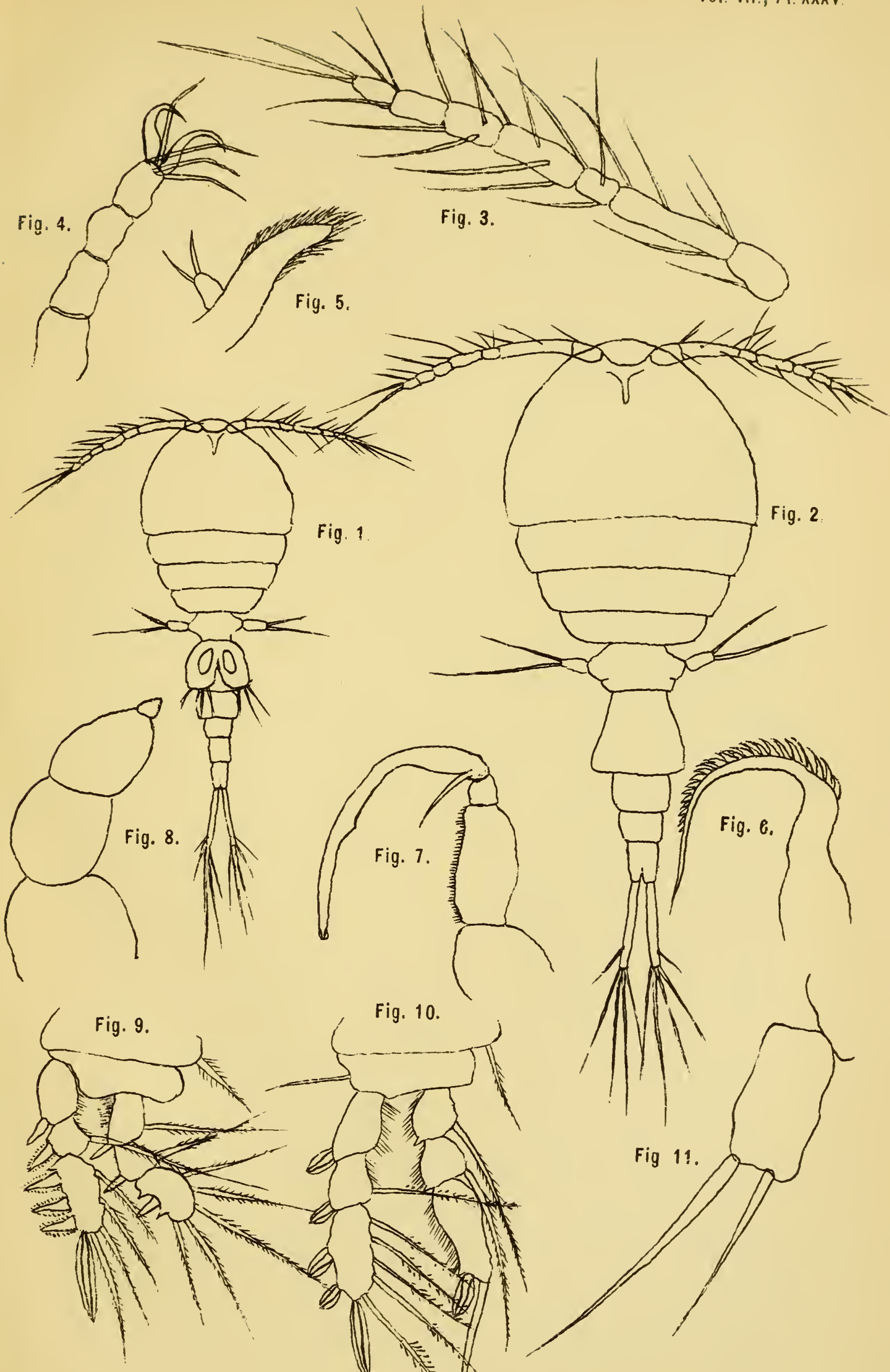
I. C. T., del.

LAOPHONTE SPINOSA, n. sp.



. C. T., del.

CLETODES MONENSIS, n. sp.



I. C. T., del.

LICHOMOLGUS MAXIMUS, n. sp.

[WORK FROM THE PORT ERIN BIOLOGICAL STATION.]

NOTES on the HÆMAL and WATER-VASCULAR SYSTEMS of the ASTEROIDEA.

By Herbert C. Chadwick.

With Plates XXXVI to XXXIX.

[Read 10th March, 1893.]

Eighteen months ago, at the suggestion of Prof. Milnes Marshall of Owens College, I undertook a re-examination of the structures which together form what is commonly known as the blood-vascular system of the Asteroidea. To those who are acquainted with the literature of the Echinodermata, especially that published during the past twelve or fifteen years, such a research may, at first sight appear quite superfluous, the structures just named having been described by Ludwig, Perrier, Hamann, Cuénot, and quite recently by Durham. I was, however, fully aware that a certain amount of scepticism existed in the minds of other workers in the same field, as to the accuracy of the descriptions given by one or other of these zoologists, and on that account was not unwilling to examine some of the doubtful points for myself. Though not yet quite complete, my work is sufficiently far advanced to warrant my acceptance of the invitation of the Council of the Liverpool Biological Society to submit my results for the consideration of its members. The close anatomical relation in which the so-called blood-vascular system stands to the water-vascular system has led me to a study of the latter scarcely less detailed than that of the former, and for convenience sake I shall discuss the two systems together.

My thanks are due to Prof. Marshall for placing at my disposal the resources of the Owens College Zoological Laboratory, and for his ever ready kindness and advice; also to Mr. R. Standen of the same Laboratory, for the readiness and goodwill with which he has assisted me in the preparation of my material, nearly the whole of which has been collected at various points within the marine area of the Liverpool Marine Biology Committee. To that Committee my thanks are tendered for the facilities afforded by the Marine Biological Station at Port Erin, for the examination and preservation of the material collected in that neighbourhood. With regard to methods of preservation, I must admit that mine have not been in error on the side of refinement. Previous experience of the slowness with which osmic acid penetrates, and the brittleness which it produces, led me to neglect the use of this otherwise valuable re-agent. In nearly every case my specimens were fixed with saturated solution of corrosive sublimate, care being taken to expose well the parts required for sectioning. Decalcification was effected by immersion in 10 °/° solution of nitric acid for about 24 hours, more or less according to the size of the specimen. In one case I put the living starfish, after severing the rays from the disc, into the nitric acid solution, and hardened it in alcohol afterwards. This method is not without its value on account of the extremely small amount of contraction produced. Before discussing the results of my own work and that of my predecessors, I propose to give a brief account of the hæmal* and water-vascular systems of the Asteroidea, and of such other structures as are in relation thereto. In this way I hope to make the

* Agreeing with Durham I regard this term as more appropriate than 'blood vascular."

following account of the structures upon which my interest has been chiefly centred more intelligible.

The majority of the Asteroidea assume the form of a five-rayed star, but in some few genera (*Solaster*, *Brisinga*) the rays are more numerous. Other genera (*Asterina*, *Porania*) are pentagonal. Except in *Brisinga*, a form which has not yet been found in our area, the rays are not sharply marked off from, but are continuous with the central disc. The oral face of each ray presents a deep groove, the ambulacrum, in which the tube feet are lodged. The mouth always occupies the centre of the ventral surface of the disc, and is surrounded by a membranous peristome. It opens directly into a capacious stomach, divided by a deep constriction into a wide cardiac and a shallow pyloric portion. The walls of the former extend a short distance into the cavity of the rays as cardiac sacs. The pyloric portion is, in the five-rayed species, of pentagonal form, the angles of the pentagon being radial. Tubular prolongations of the pylorus arise at each angle, and entering the rays, from the aboral walls of which they are suspended by mesenteric folds, each one divides into two parallel and densely sacculated portions which terminate blindly near the tips of the rays. An aperture in the centre of the aboral face of the pylorus, closed by valvular folds, opens into a very short and inconspicuous intestine, which has in connection with it a lobulated cæcum. In some species a minute anal pore opens upon the aboral face of the disc.

What I have already referred to as the hæmal system consists of an elongated plexiform body, often spoken of as the heart (Pl. XXXVIII, fig. 2; Pl. XXXIX, fig. 1, *c.pl.*), which lies in close proximity to the water tube (*wt*), and communicates with similarly constituted circum-oral (*cohr*) and aboral (*ahr*) rings. From the former plexiform strands traverse the rays (*rhs*), while the latter gives origin to similar strands which are distributed to the genital glands (*gs*). There are also two strands which pass from the central plexus to the pyloric portion of the gut (*ghs*). On the aboral face of the disc, between the origins of two of the rays, is a rounded or pentagonal, more or less convex plate, the madreporite (Pl. XXXVIII, fig. 2, *m*). Its surface is traversed by meandering grooves, radiating from the centre. Numerous perforations through its substance (Pl. XXXVI, figs. 1 and 2; Pl. XXXIX, fig. 1, *mp*) conduct the surrounding water into a tubular canal, supported by ring-like ossicles lodged within its walls, the water-tube or stone-canal (Pl. XXXVIII, fig. 2; Pl. XXXIX, fig. 1, *wt*).

Passing downwards towards the oral aspect, the water-tube opens into a pentagonal vessel which surrounds the mouth, the circum-oral water vessel. (Pl. XXXVIII, figs. 1 and 2; Pl. XXXIX, fig. 1, *cowv*). In *Astropecten* and *Luidia* five pairs of glandular cæca, the "brown bodies" of Tiedemann (*bb*) are seated, interradially, upon the inner border of the circum-oral water vessel, and communicate with its cavity. In *Asterias* and *Solaster* one of these bodies is absent from the madreporic interradius. The circum-oral water vessel has also communicating with it a number of sacs with muscular walls, the Polian vesicles (Pl. XXXVIII, fig. 1, *pv*). These open upon its outer border, immediately opposite the brown bodies, and are, therefore, interradial. In *Astropecten* and *Solaster* the Polian vesicles are large and pear shaped, while those of *Asterias* are small and inconspicuous. From the circum-oral water vessel, vessels corresponding in number with that of the rays radiate (Pl. XXXVIII, figs. 1 and 2, *rwv*) and traversing the oral aspect of its ray, immediately external to the conjoined inner ends of the ambulacral ossicles each one gives off on either side a great number of lateral branches which open into the cavities of the tube-feet. The fluid which occurs in these vessels contains amœboid corpuscles. Of the tube-feet there are two usually straight, but in *Asterias* sharply zig-zaged rows, lodged in the ambulacral grooves. Each tube-foot is provided with a vesicular ampulla lodged within the cavity of the ray. Communication between the two is established by a canal which passes upwards from the base of the foot through a corresponding pore formed by grooves in the two adjacent ambulacral ossicles. In many genera the tube-feet terminate in sucker-discs, but those of *Astropecten* and *Luidia* are conical at their free ends.

The nervous system consists of a plexus of nerve fibrils and ganglion cells which underlies the ectoderm. At the bottom of the ambulacral grooves the fibres are much more numerous, and run parallel with the axis of the ray. In transverse sections they appear as minute dots between the filiform inner ends of the ectoderm cells, which are here enormously elongated, and form a ridge-like thickening, the ambulacral nerve. Each radial nerve joins its fellows on either side to form the circum-oral nerve-ring (Pl. XXXVIII, figs. 1 and 3, *nr*). The generative organs consist of sacculated glands, of which there is a pair in each ray. Each gland is attached to the lateral wall of the ray, near its base, and opens by a single pore, or rarely by a number of pores. In the genus *Brisinga* each ray contains a number of distinct glands, arranged serially along each side of the ray, and opening by separate pores.

Having thus briefly surveyed the general organisation of starfishes, I now proceed to a discussion of the minute anatomy of the two systems mentioned at the outset. Careful examination of a large number of sections of the madreporite of *Asterias*, *Cribrella*, *Astropecten* and *Aste-*

rina has led me to support the view advanced by Tiedemann, Müller, Agassiz, and much more recently by Ludwig, viz., that all the pores which traverse this plate open directly into the water-tube (Pl. XXXVI, fig. 1, *mp*). Hoffmann, supported by Greeff and Teuscher held on the other hand that some of the marginal pores open into the cœlom, and others into the axial perihæmal canal. A condition of things differing from either of the latter is presented by one of my series of sections, cut from the disc, 6 mm. in diameter, of a specimen of *Asterias rubens*. In this three or four of the madreporic pores opens directly into the lacunar system of the body-wall (Pl. XXXVI, fig. 2). In young specimens of *Cribrella*, 2 mm. in diameter, Durham (1) found but a single pore opening into the cavity of the axial perihæmal canal, into which the water-tube also opens; and Cuénot (2) shows that in some species this state of things may continue throughout life.

Communicating with the exterior through one of the madreporic pores in the specimen just alluded to is an elongated glandular structure, lodged in one of the lacunæ of the body wall (Pl. XXXVI, fig. 2, *gb*). It is composed entirely of small rounded cells with comparatively large nuclei, and does not present any cavity or lumen. I am not at present able to offer an opinion as to whether this organ should be regarded as an example of the structure described by Greeff and Ludwig, and alluded to by Carpenter (3) as a diverticulum of the water-tube, or as an independent and perhaps hitherto undescribed structure. It is certainly independent of the water-tube, through lying in close proximity to it. Still more perplexing is its occurrence in only one specimen out of a dozen carefully examined. In its passage downwards to the oral aspect of the disc, the water-tube is supported by the free edge of a projecting fold formed by the junction of the rays on either side of the madreporic interradius, and this fold encloses a cavity known as the axial perihæmal canal (Pl. XXXVII, figs. 1, 2 and 4; Pl. XXXIX, fig. 1, *ax. pc*). Within the perihæmal canal, and supported by its wall lies the dorsal organ, or, as I prefer to call it, the central plexus (*cpl*).

Discovered long ago by Spix, the central plexus and its homologue in other groups of the Echinodermata has been repeatedly described, and its function speculated upon. Tiedemann, with a nearer approach to what I believe to be the truth than some of his successors, regarded it as a heart. Greeff described it as a gill-like organ, Hoffmann, a little latter propounding a view which still has its adherents, viz., that it is a glandular body. Later still Teuscher, followed by Ludwig, revived Tiedemann's view that it is a heart, but in his later papers Ludwig discards the term "heart" substituting for it the more appropriate term "central plexus." The organ presents a very similar appearance in the four genera of Asteroidea in which I have examined it. In young specimens of *Asterias rubens*, whose discs measure 3—4 mm. in diameter, it appears as a thickened band of undifferentiated cells, closely applied to the wall of the perihæmal canal (Pl. XXXVII, fig. 1, *cpl*). In very slightly larger specimens, however, I find it to have assumed the adult condition. At its aboral end it is more or less lobulated (Pl. XXXVIII, fig. 2), and occupies a considerable portion of the cavity of the perihæmal canal. Gradually tapering towards its oral end, it becomes continuous with an oblique perforated septum about which I shall have more to say shortly. Examined by means of thin sections the organ is seen to consist of anastomosing tubular strands, the walls of which appear in transverse sections as an exceeedingly thin membrane (Pl. XXXVII, fig. 2; see also the figures illustrating

Durham's paper, quoted above). In longitudinal sections fine fibrils may be seen, especially in the tapering oral end. The whole organ is densely crowded with small cells, similar as Durham remarks, to the leucocytes of the cœlomic fluid (Pl. XXXVII, fig. 3). Upon its surface, a number of clear vesicle-like spaces may be seen. These, in the opinion of the author just quoted, are points at which the fluid contained in the tubules is more abundant. Upon some of them the cells already mentioned form a reticulum by means of their pseudopodial processes (x). As far as I can make out there is no regular epithelium within or without the membranous wall of the tubules, such as is described and figured by Hamann (4). There certainly is such an epithelial lining within the tubules of the central plexus of *Antedon*; but in Crinoids the organ and its connections appear to me to be of a more highly specialised character than in Asterids. Allusion has already been made in the introductory part of this paper to the so-called gastric blood vessels, which are described as passing from the central plexus to the pyloric portion of the gut. I have had no difficuty in making out the intimate relation of these strands to the epithelial lining of the gut, (Pl. XXXVII, fig. 4; Pl. XXXIX, fig. 1, *ghs*) and, in the case of one of them, to the central plexus. The continuity of the other stand with the latter organ is, however, not so obvious, and though I have examined it carefully in all my series of sections I have not been able to arrive at a definite conclusion with regard to it. Whatever the true nature of these strands may be, they are certainly something more than "mesenteric bridles," under which term MacBride (5) alludes to their presence in Ophiurids.

At or near the point from which the gastric strand passes from the central plexus, the latter joins the aboral hæmal ring (Pl. XXXVIII, fig. 2; Pl. XXXIX, fig. 1, *ahr*) from which arise the ten genital strands (*gs*), two at each interradius. Cuénot's (6) studies of the development of the genital organs of Asterids have led him to the conclusion that they are simply the largely developed ends of the genital strands, and that the cells of the strands give rise to ova or spermatoblasts. With the exception of the gastric strands, the whole hæmal system is enclosed in perihæmal canals, with which the axial perihæmal canal is continuous. I have already said that at its oral end the central plexus becomes continuous with an oblique perforated septum. This latter imperfectly separates the circum-oral perihæmal canals, into the inner of which the axial perihæmal canal opens, while the outer unites the perihæmal canals of all the rays (Pl. XXXIX, fig. 1, *ipc*, *opc*). Serial sections in which the septum appears show that at many points it presents lacunar spaces to which the term "oral blood-vascular ring" has been applied (Pl. XXXVIII, fig. 3, *cohr*), the lacunæ being described as vessels. They are, however, simply lacunar spaces, and except when distended with coagulum, or with amœboid cells, are not easy to see. It has been asserted that they and the hæmal lacunæ of the rays are nothing more than spaces occupied before decalcification of the specimen by calcareous skeletal matter. I am satisfied, however, that such is not the case, for the connective tissue basis upon which the skeleton is formed is always left intact after decalcification, and no such connective tissue is seen here. The perihæmal canals of the rays are, like the circumoral canals, imperfectly separated by a vertical septum which is continuous with the oblique septum already described. These also present lacunar spaces, frequently distended with coagulum, or with amœboid cells, and are the radial bloods vessels of Ludwig and other authors (Pl. XXXIX, fig. 2).

Perrier and Poirier (7), followed by Cuénot, deny the existence of these radial hæmal strands; but the latter author admits that there is what he calls a "glandular" tract in the vertical septum, and figures one of the lacunar spaces. At regular intervals strands which appear in sections as oblique septa, and were described as such by Cuénot, pass from the radial hæmal strands to supply the tube-feet. The radial perihæmal canals are continuous, through the medium of lateral extensions passing between the tube-feet, with a system of lacunar spaces everywhere present in the body wall. I have already more than once referred to the existence of coagulum in the hæmal system. It is present at all points in larger or small quantities, the tubules of the central plexus frequently being much distended with it. Whether the fluid which gives rise to it merits the term blood or not may be open to question, but I am satisfied that it is a nutrient fluid, derived from the gut, and conveyed by the gastric hæmal strands to the central plexus, and from thence along the genital and radial strands. That such is its course is demonstrated by a series of sections cut from a young specimen of *Asterias rubens*, for which I am indebted to the kindness of Mr. W. Garstang. Into the stomach of the specimen in question, a number of very small cyst-like bodies, about $\frac{1}{5000}$th of an inch in diameter, and of a dark green colour, had found their way. Many of these had been ruptured, setting free large numbers of still smaller spore-like bodies, of which hundreds are now to be seen lodged between the bases of the epithelium cells lining the stomach, in the tubules of the gastric hæmal strands, and of the central plexus. Cuénot maintains that the true blood-fluid circulates in the perihæmal canals, but the very large number of sections which I have examined lend no support to this view, there being no coagulum in these spaces. Here again my results confirm those of Durham. Besides being concerned in the distribution of nutrient material to the tissues the central plexus is, according to Cuénot, Prouho, and others, the seat of the production of the pigmented corpuscles which occur in the hæmal strands, in the vessels of the water vascular system, and in the cœlom. According to the first named author this function is also discharged by the brown bodies of Tiedemann and the Polian vesicles. However true this may be, I am not disposed to agree with his assertion that their histological structure is identical. The cells of which the tissue of Tiedemann's bodies is composed do appear to be similar to those of the central plexus, but the ramified tubules which together form the lumen of these bodies have a well defined epithelial lining of cuboid cells, continuous with that of the circum-oral water vessel.

NOTE ON THE HISTOLOGY OF THE TUBE FEET :—

Some time ago, my attention was arrested by a statement on page 259 of Mr. G. J. Romanes' interesting little work entitled "Jelly-fish, Star-fish and Sea-urchins," to the effect that "each of the tube-feet is provided in its membranous walls with a number of annular or ring-shaped muscular fibres;" and a little further on that "if the contraction of these fibres is strong, the tube shrinks up entirely, i.e., is retracted within the body of the animal." On purely physical grounds the first of these statements seemed to me to be highly improbable; and being at the time unaware of the existence of Hamann's description and figures of the minute structure of these organs, I set to work to investigate the question for myself, with the result anticipated. The muscular fibres account for rather more than half the thickness of the tubular portion of the tube-foot, and are separated from its cavity by a delicate lining of ill-defined epithelial cells. They are wholly longitudinal in every species examined. On approaching the terminal sucker (*Asterias, Solaster*) the fibres converge towards its centre, from which point they are distributed in beautifully regular radiating strands to its periphery. External to the muscular layer is (1) a layer of connective tissue; (2) a layer of nerve fibrils with ganglion cells; (3) an epithelial layer in which the cells are of considerable length, and consist of supporting cells, sensory cells, and gland cells, the latter occurring largely in the sucker; and (4) the structureless cuticle. It seems to me that contraction of annular fibres such as Romanes described would result rather in the extension of the tube-foot at the expense of its diameter, for a valvular arrangement prevents the reflux of the contained fluid from the tube-feet into the radial water-vessel. Extension is, moreover, brought about by the contraction of the ampullæ, while the longitudinal disposition of the muscular fibres is quite sufficient to account for all contractile movements. The second statement, with reference to complete retraction of the tube-feet within the body of the animal is entirely without foundation. Even after immersion in the strongest alcohol the tube-feet are never so retracted. The ectodermal and nerve layers are certainly thrown into numerous annular folds, and it is possible that a superficial examination of these led Mr. Romanes to describe them as annular muscles.

List of works referred to in the text.

1. Durham, H. E.—"On Wandering cells in Echinoderms, etc.," Quart. Journ. Micr. Sci., XXXIII, (1891).

2. Cuénot, L.—"Contributions à l'Etude anatomique des Astérides," 'Thèses prés. Fac. d. Sc.,' Paris, 1887.

3. Carpenter, P. H.—"The Minute Anatomy of the Brachiate Echinoderms," 'Quart. Journ. Micr. Sci., N.S., LXXXIII, (1881).'

4. Hamann, O.—'Histologie der Echinodermen,' I, II, III, IV. (Fischer, Jena).

5. MacBride, E. W.—"The Development of Amphiura squamata," 'Quart. Journ. Micr. Sci., XXXIV,' (1892).

6. Cuénot, L.—'Comptes Rendus.' CIV, (1887) pp. pp. 88—90.

7. Perrier, E. and Poirier, J.—'Comptes Rendus,' XCIV, (1882), pp. 658—61.

Explanation of Plates XXXVI to XXXIX.

List of reference letters.

ahr Aboral hæmal ring; *axpc* axial perihæmal canal; *bb* Tiedemann's bodies; *bm* buccal membrane; *cohr* circum-oral hæmal ring; *cowr* circum-oral water vessel; *cp* central plexus; *g* gut; *gb* glandular body; *ghs* gastric hæmal strands; *gs* genital strands; *int.m* interradial muscles; *ipc* inner perihæmal canal; *lac* lacunar spaces; *m* madreporite; *mp* madreporic pores; *nr* nerve ring; *oa* oral angles, *œ* œsophagus; *opc* outer perihæmal canal; *pv* Polian vesicles; *rhs* radial hæmal strands; *rwv* radial water vessel; *tf* tube-foot; *wt* water-tube; *x* vesicular spaces.

Plate XXXVI.

Fig. 1. Part of a horizontal section of a young *Asterias rubens*, showing the opening of the pore-canals of the madreporite into the water-tube.

Fig. 2. A similar section from a slightly older specimen. It passes through the periphery of the madreporite, and shows the opening of several pore-

canals into the lacunar system of the body-wall. The scale applies to both figures.

PLATE XXXVII.

Fig. 1. Horizontal section of the madreporic interradius of a young *Asterias rubens.*

Fig. 2. A similar section from an older specimen.

Fig. 3. Part (peripheral) of a tranverse section of the central plexus of an adult *Cribrella sanguinolenta.*

Fig. 4. A section similar to figs. 1 and 2 showing the relation of the gastric hæmal strands to the central plexus and the gut.

PLATE XXXVIII.

Fig. 1. Diagram of the central portions of the water-vascular and nervous systems of *Asterias rubens,* constructed from thirteen consecutive horizontal sections of the disc.

Fig. 2. Diagram of the central portions of the water-vascular and hæmal systems of *Asterias rubens,* constructed from several series of sections. Compare with Fig. 1, Plate XXXIX.

Fig. 3. Vertical section through the peristome of *Asterias rubens.* The scale applies to figs. 1 and 3.

PLATE XXXIX.

Fig. 1. Diagram of the central portions of the water-vascular and hæmal systems of *Asterias rubens,* constructed from ten consecutive sagittal sections through the madreporic interradius.

Fig. 2. Transverse section of the vertical septum which divides the radial perihæmal canals, showing four hæmal lacunæ. The dotted line in the upper ones represents coagulum.

Fig. 3. Longitudinal section of the oral end of the central plexus of *Asterias rubens.*

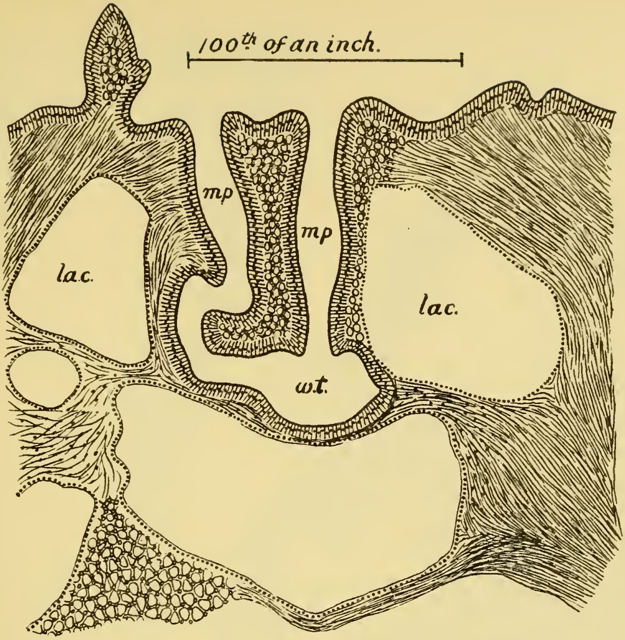


Fig. 1.

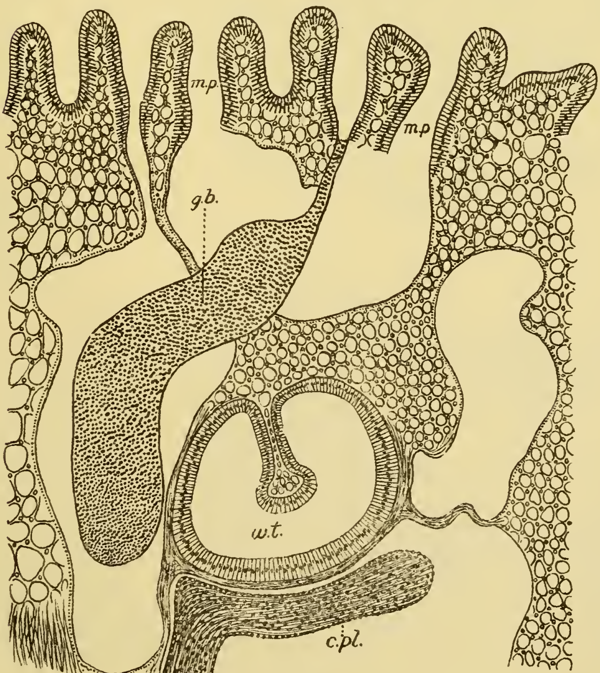


Fig. 2.

H. C. C., del.

ASTEROIDEA.

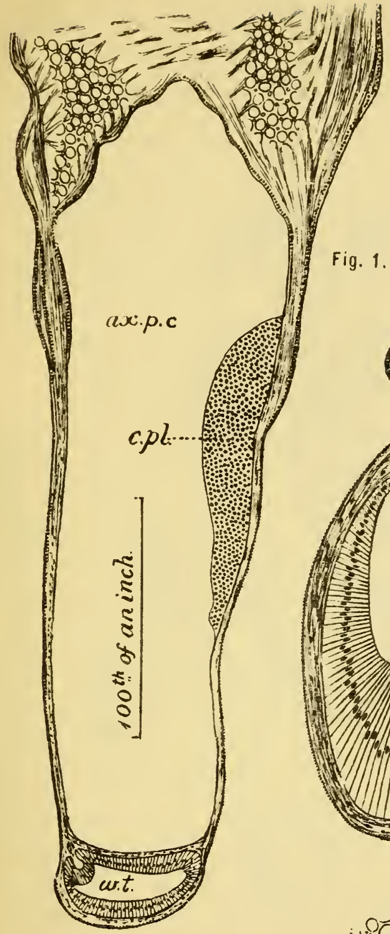


Fig. 1.

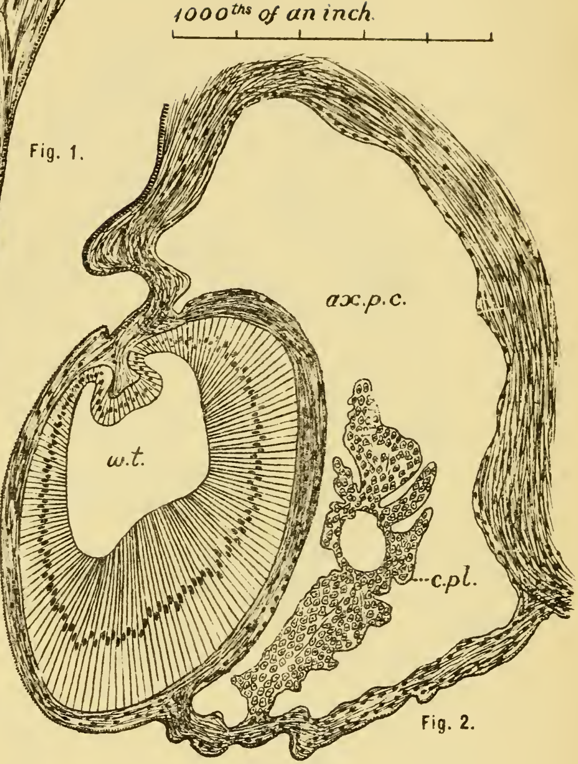
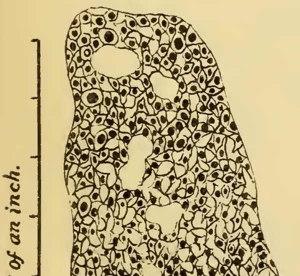


Fig. 2.

Fig. 3.



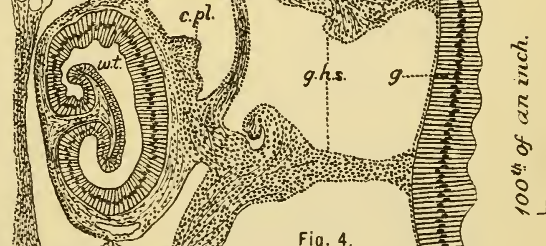
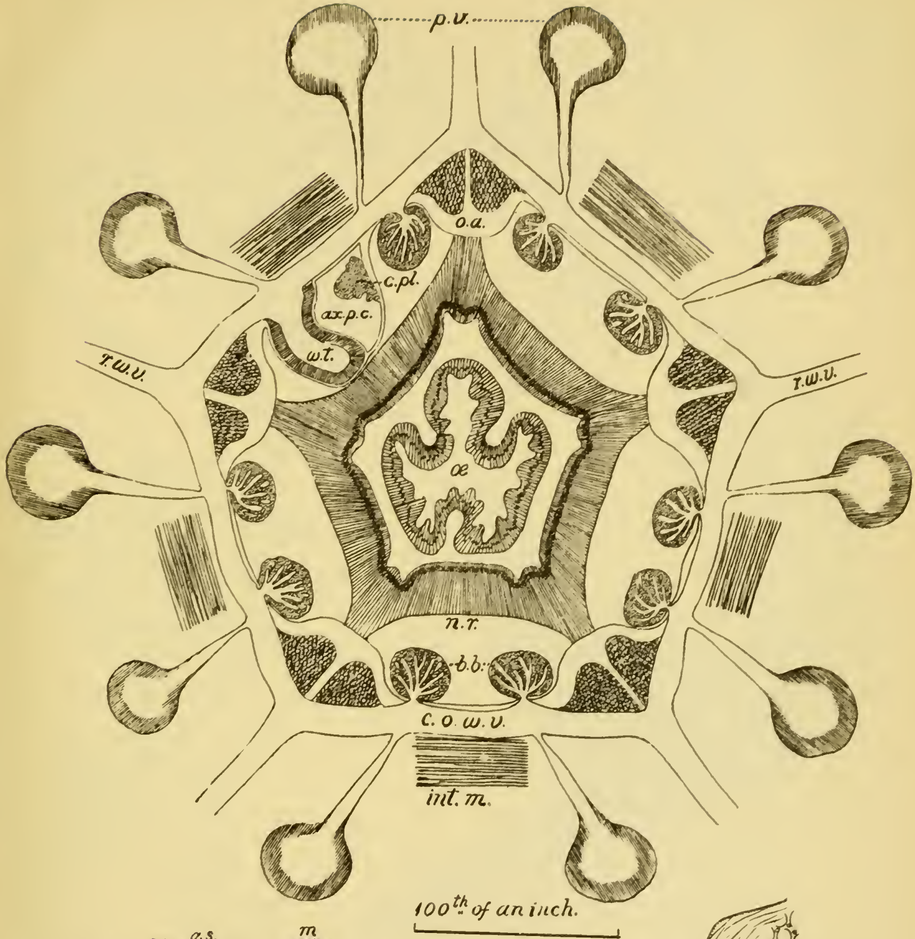


Fig. 4.

H. C. C., del.

ASTEROIDEA.

Fig. 1.



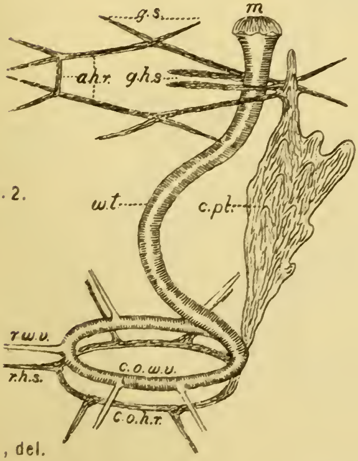


Fig. 2.

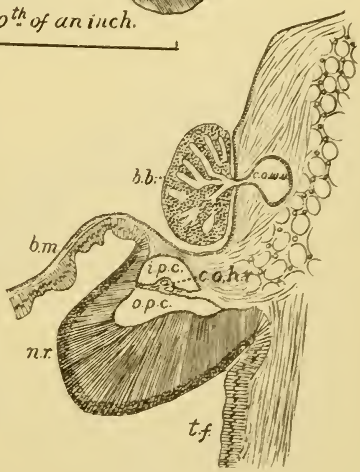
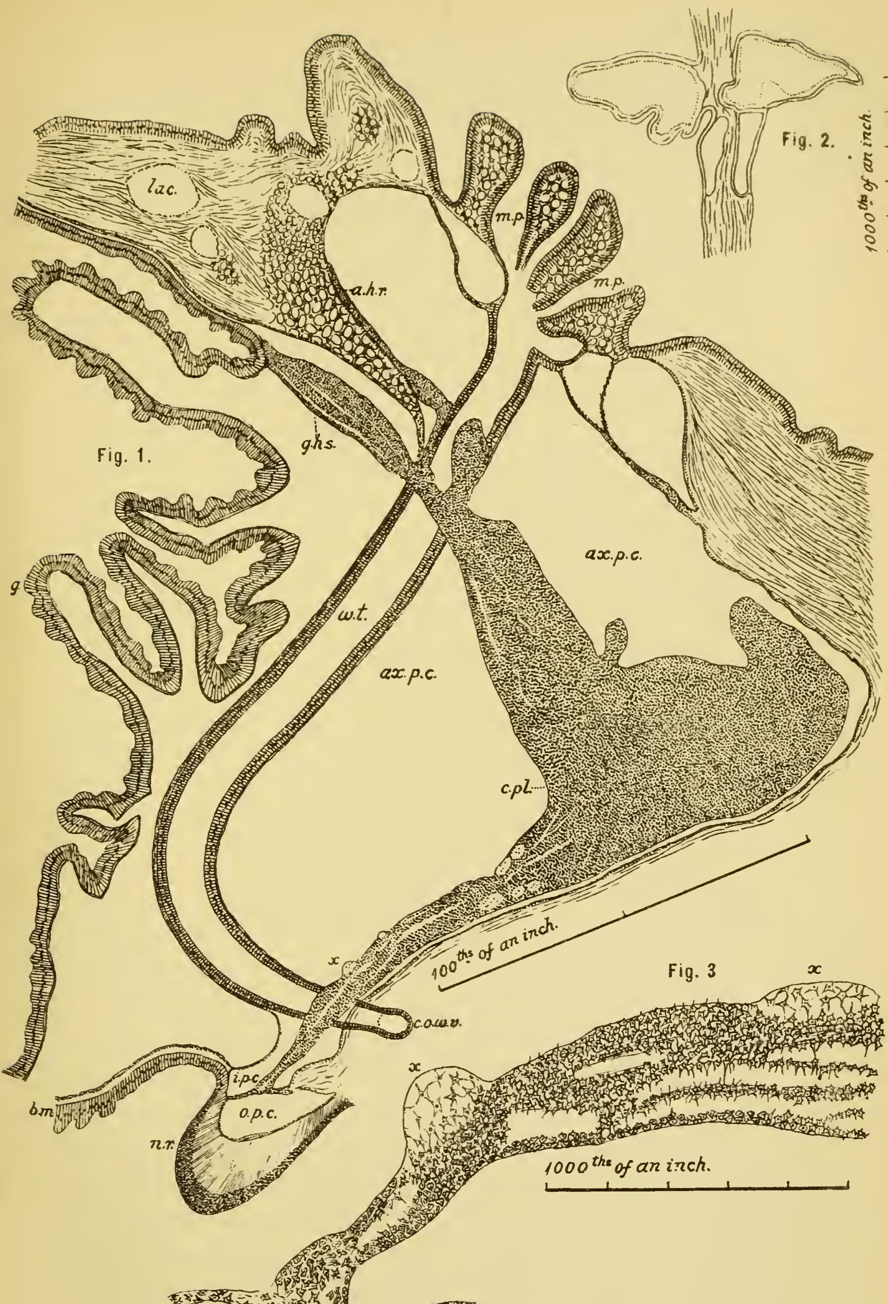


Fig. 3.

H. C. C., del.

ASTEROIDEA.



H. C. C., del.

ASTEROIDEA.

[WORK FROM THE PORT ERIN BIOLOGICAL STATION.]

NOTE on LUCERNARIANS occurring in the neighbourhood of PORT ERIN, ISLE OF MAN.

By W. I. Beaumont,

EMMANUEL COLLEGE, CAMBRIDGE.

[Read May 12th, 1893.]

Three species of this interesting group have been found in the neighbourhood of Port Erin; of these, one—*Depastrum cyathiforme*—is fairly abundant, though apparently local in its distribution, and the examination of a number of specimens has enabled me to set at rest the divergent views which have been held with regard to it. The other two species have so far been found very sparingly: one is a well known and widely distributed form, the other will, I believe, prove to be a new species. The specimens were collected and examined while I was working at the L.M.B.C. Biological Station at Port Erin in the summer of 1892 and again in the spring of 1893.

Clark, in his Prodromus, (12)* divides the family Lucernaridæ (most of the members of which were originally described under the generic name of *Lucernaria*) into two sub-families:—

1. Cleistocarpidæ, characterised by the development of the gonads in "genital claustra" (mesogonial pouches and gastrogenital pouches of other authors) which are diverticula of the central enteric space or stomach. To this group belong *Depastrum*, *Craterolophus*, *Halicyathus*.

2. Eleutherocarpidæ, in which mesogonial pouches or claustra are absent, the gonads being formed in the subumbral or axial wall of the 4 perradial gastral pouches

* The numbers in brackets refer to the List of Authorities at the end.

(the 4 cameræ of Clark). *Lucernaria* (as now restricted) and *Haliclystus* belong to this sub-family.

Between the publication of Clark's Prodromus (12) in 1863, and of Haeckel's "System der Medusen," 1879 (15) there had been found a number of species closely allied to the already known Lucernarians but having the stalk in a rudimentary condition, and thus forming a link with the ordinary free-swimming medusæ. For these Haeckel founded the family Tesseridæ, which with the family Lucernaridæ constitute his order Stauromedusæ, the latter family coinciding with Clark's Lucernaridæ, except that *Depastrum* is removed from it and placed among the Tesseridæ on account of its supposed relationship to *Depastrella*, a species of the Tesseridæ discovered by himself in the Canary Islands, which unlike the rest of the sub-family has a well developed stalk for attachment. Now although *Depastrum* has some points in common with *Depastrella*, yet in internal structure it differs very materially, and I prefer to follow Clark in retaining it among the Lucernaridæ.

Sub-family—CLEISTOCARPIDÆ.

Depastrum cyathiforme, (Sars.)

This species was discovered last year by myself and Mr. Gamble on the S. side of Port Erin Bay. I found it again during the recent vacation in the same locality, and also on the limestone rocks at Poylivaaish. It is fairly abundant in both localities, attached to the under surface of stones, being apparently most plentiful above the Laminarian zone, though occurring in that zone also more sparingly, but according to my experience of larger size. It is very firmly attached, and I doubt whether it ever moves from the spot where it first attaches itself; I have never seen a detached specimen re-attach itself, indeed I do not think it is capable of doing so. In this respect it differs from most Lucernarians. This species has been the subject of no little confusion, into the discussion of which I must enter at some length.

It was first described and figured in 1846 as *Lucernaria cyathiformis*, by Michael Sars, in the "Fauna Littoralis Norvegiæ," (4). In 1858 Gosse in his "Synopsis of the British Actiniæ" (5) founded the genus *Depastrum*, based, I think, chiefly on specimens found by himself at Weymouth, which he regarded as identical with the *Lucernaria cyathiformis* of Sars. In 1859 Allman who had also discovered (in the Orkney Islands), what he considered the *Lucernaria cyathiformis* of Sars, in ignorance of Gosse's name, instituted a second one—*Carduella* (6), and in the following year gave a more detailed account of his species (7) with figures. Similarly a third generic name was founded by Milne Edwards (10) viz., *Calicinaria*. Gosse then pointed out (8) the claims of his name *Depastrum* to priority, he also gave further details with figures of the Weymouth specimens which he now elevated to specific rank as *Depastrum stellifrons* as it appeared to differ in certain points from Allman's species which retained the name *Depastrum cyathiforme* since he (Gosse) regarded it as identical with the *Lucernaria cyathiformis* of Sars. To this Allman replied (9) that the points of difference between *Depastrum* and *Carduella* were of generic not specific value merely, and that the name *Carduella cyathiformis* must stand for his own and the Norwegian form, which he also regarded as identical. Thus the matter rested until the publication of Clark's Prodromus in 1863 (12) wherein the matter was practically cleared up, Clark having had the advantage of being able to compare specimens of the Orkney form from Allman with specimens of various ages sent to him by Sars from Norway.

Now the points insisted on as distinguishing *Depastrum* from *Carduella* were these:—that while in both the tentacles are arranged in 8 groups round the margin of the disc oral surface of bell or umbrella) yet in *Depastrum* the tentacles are very numerous, and are arranged in each group in *several rows or series,* one within another, and further that they spring *from the margin* of the *octagonal disc* or from *without* it, but that in *Carduella* there are only about 5 tentacles in each group arranged in a *single series* and arising completely *within* the margin of the *circular disc.* Further in *Carduella* there is a single tentacle (primary tentacle of Haeckel, corresponding to the marginal anchors of *Haliclystus*) in each interval between the groups of other tentacles; this does not seem to have been observed by Gosse in *Depastrum.* Clark pointed out that, according to the figures and description of Sars, confirmed and extended by his own examination of the specimens sent to him by the latter, the Norwegian species when adult has the tentacles arranged in several rows (3 or 4), but that the younger individuals have at first only one row and later two. Further he pointed out that Allman was in error in asserting that the Orkney form always had its tentacles in one row only, for some of those sent to him, being presumably older than those described by Allman, had more than one row. He accordingly concluded that *Carduella* as defined by Allman was merely the young form of the *Lucernaria cyathiformis* of Sars. With regard to this point, the examination of a large series of specimens at Port Erin has amply confirmed the conclusions of Clark. Now as to the *Depastrum* of Gosse, Clark inserts it provisionally as a distinct genus, but at the same time he gives some very good reasons for regarding it also as identical with *Lucernaria cyathiformis*, Sars. The difference in the number and arrangement of tentacles having been disposed of as far as the groups of secondary tentacles were concerned (as detailed above), there only remained the octagonal disc and absence of primary tentacles in *Depastrum* to separate it from *Carduella*.

With regard to the first point, as Clark points out, there is in Sars' figures (and in Allman's also) an octagonal area, the corners of which correspond to the intervals between the tentacular groups and whose outline is marked out by a distinct line of brown pigment; the tentacles arise from immediately without this line, and there can be little doubt that this is the octagonal margin o the disc spoken of by Gosse, but the real margin of the disc is formed by the circular muscle situated outside the origin of the tentacles, some of which are usually curved over it when the animal is fully expanded, the primary tentacles being invariably so apparently. This circular muscle is in life a delicate translucent structure and may have escaped Gosse's notice. Then as to the absence of primary tentacles in *Depastrum*. These in *Carduella* are similar in form and structure to the secondary tentacles of the groups, unlike those of *Haliclystus auricula* which have been modified into the so-called marginal anchors and function as adhesive organs. They are in *Carduella* not very conspicuous, being usually somewhat smaller than the secondary tentacles and constantly (as I have remarked above) reverted over the circular marginal muscle and closely applied to its surface. It is accordingly not unlikely these too escaped Gosse's observation, especially if his specimens had been kept long, as the tentacles seem apt to slough away when the animal is removed from its natural conditions. In addition I may mention that *Depastrum*, and apparently other members of this group also, is subject to much variation, especially in the number and arrangement of the tentacles; indeed of the many specimens examined at Port Erin very few had quite the typical arrangement. Sars also notices this and mentions one specimen with 7 pairs of gonads instead of the typical 4; the gonads seem more regular than the tentacles, but I have seen several individuals with 6 pairs, one of which had 13 groups of tentacles.

There can be, I think, little doubt that the Weymouth species is identical after all with *Carduella* and with the *Lucernaria cyathiformis* of Sars. And I may mention that a specimen recently found at Plymouth which has been kindly lent to me for comparison, differs in no way (externally) from the Port Erin form. That the latter is the *Lucernaria cyathiformis* there can hardly be a doubt, not only does it agree in external features with the figures of Sars and the description of Clark, but also as to its internal structure it is quite in accord with the account given by the latter (with one not very important exception).

This conclusion was at first accepted by Haeckel who inserts this species in his "System der Medusen" (15, p. 379) as *Depastrum cyathiforme*, Gosse, with *Lucernaria cyathiformis* and *Carduella* as synonyms; but in an appendix (15, p. 369) he departs from this view in consequence of having himself found on the Sutherland coast a form, agreeing with Allman's *Carduella* in having the tentacles in one row only, but which cannot be merely a young *Depastrum* since it is sexually mature, reproducing itself in that form with one row of tentacles. This, agreeing in its main structural features with the species *Depastrella carduella* discovered by himself in the Canary Islands (but at first called by him *Carduella depastrella*), Haeckel now names *Depastrella allmani*, giving *Carduella cyathiformis* Allman, as a synonym, and the Orkney Islands as one of its localities. Now whatever the *Depastrella allmani* from the Sutherland coast may be, there is very strong evidence that it is not the same species as the Orkney *Carduella*. First, since Clark had been able to compare undoubted specimens of the latter with specimens of *Lucernaria cyathiformis* from Sars, his opinion as to their identity must carry great weight; and secondly, Clark has given an account of the structure of this species, based on the above named specimens, the accuracy of which Haeckel acknowledges; and this account shows that these specimens differ materially in their internal organisation (more especially in the presence of mesogonial pouches) from the structure which is found in the genus *Depastrella* according to the type species from the Canary Islands—*Depastrella carduella*, of which he gives figures. He gives no figures of *Depastrella allmani* but describes it as having practically the same internal structure as *Depastrella carduella*, consequently if Haeckel's description of the Sutherland species be correct, it is obvious that its internal anatomy differs considerably from that of *Carduella*, however similar they may be in external features, and we may safely conclude that *Carduella cyathiformis*, *Depastrum cyathiformis* and *Lucernaria cyathiformis* are one and the same species.

Sub-family—Eleutherocarpidæ.

Haliclystus auricula, (Rathke).

A small *Haliclystus* was found near Port St. Mary by M. Chopin, in 1891, on a lobster pot I believe, and is now in the Zoological Museum at University College, Liverpool. I have seen the specimen and, as far as I can judge, it is *H. auricula*, but it may possibly be *H. octoradiata* (Lamarck, 3). The shape and size of the marginal anchors seem to be those typical of *H. auricula;* the characters of the gonads I have not been able to make out satisfactorily. With regard to these two species we again meet with confusion, but since I have seen specimens from Plymouth and Jersey which have all the distinguishing characters of the *Haliclystus auricula* described by Clark in his Prodromus (12) and again with great detail in a fully illustrated monograph in the Smithsonian Contributions, 1878, (14) I prefer to follow Clark in identifying his species with the European *Lucernaria auricula*, Rathke (2). Haeckel on the other hand considers it probable that *Haliclystus auricula*, Clark, is confined to the American side of the Atlantic, and identifies *L. auricula*, Rathke, with *L. octoradiata*, Lamk., which is described as a second European species by Clark. Rathke's figures as far as they go support Clark's view.

It may be noted further that *Lucernaria auricula*, Rathke, was confused by a number of the earlier writers with *L. auricula*, Fabricius (1), one of the Cleistocarpidæ [*Manania auricula* (Fab.) Clark, *Halicyathus lagena* (Müller) Haeckel].

Haliclystus, sp.

The third species of Lucernarian found at Port Erin differs materially from any species previously described as far as I know. The members of this family seem particularly liable to abnormalities affecting more especially the number and arrangement of the tentacles, as noticed under *Depastrum*, and I am loth to establish a new species on the scanty material at present available. After some consideration, I refer this species provisionally to the genus *Haliclystus*, for though it presents considerable divergence from the 3 species of that genus which have been already described, yet its structure, so far as I have been able to make it out, is in accordance with the generic definition both of Clark and Haeckel except as regards one point which is not I think of very great importance.

Three examples of this form were found last year:

they were attached to the undersides of stones on the S. side of Port Erin Bay, where *Depastrum* also occurs. During the recent vacation I made a most careful search in the same locality but failed to find a single specimen. On the first occasion in my ignorance of the "points" of a Lucernarian, I did not observe in the living animal the presence of primary tentacles, but in one of the three specimens these are now plainly enough to be seen, but in the others which are smaller and were not preserved in an expanded condition I have been unable to ascertain whether these important organs are present or not. Now in *Haliclystus auricula* additional tufts of tentacles seem not uncommon, and accordingly, until I have seen more specimens I hesitate to conclude that what certainly appear to be genuine primary tentacles (retaining the original tentacular structure instead of being modified into marginal anchors as in *H. auricula*) are really normal structures.

If on the other hand these primary tentacles are merely individual abnormalities, and if I am right in my interpretation of its internal structure, then this species must be relegated to the genus *Lucernaria* (as at present restricted). In the approximation of its arms in pairs it approaches *L. quadricornis,* Müller, but its complicated gonads differ from those of that species. I at first took the Port Erin specimens to be small and somewhat abnormally shaped *L. quadricornis*, before I had discovered the primary tentacles; they are referred to under this name in the L.M.B.C. Annual Report, 1892 (p. 33). I now append a description of the species :—

HALICLYSTUS sp. (? n. sp.)

Umbrella somewhat conical, passing gradually into the stalk without any marked distinction. Sub-umbrella cavity very shallow.

Stalk more or less round in transverse section with 4 longitudinal grooves marking the position of the 4 interradial muscles, decreasing in diameter from its junction with the umbrella and then expanding again at its aboral end into the disc for attachment. 1-chambered. (The other species of *Haliclystus* have the stalk 4 chambered.)

Arms 8, but so closely united in pairs, that there appear to be only 4, separated by 4 very wide perradial "bays," the interradial intervals being practically obliterated.

Primary tentacles 8. The 4 perradial ones are smaller than the secondary tentacles but similar in form, they stand out horizontally from just within the margin of the umbrella. The 4 interradial ones spring from the point of junction of the paired arms, between the tufts of secondary tentacles and resemble the latter.

Secondary tentacles are grouped in tufts on the ends of the arms, about 7 on each, but in consequence of the fusion of the arms in pairs, there appear to be only 4 tufts of tentacles, each of about 15; really each consists of the tufts belonging to a pair of arms together with what I regard as the intervening interradial primary tentacle. The tentacles are somewhat club shaped, the head not being distinct from the stalk.

Gonads. These consist of numerous saccules forming 4 adradial bands in the endoderm lining the subumbral wall of the 4 perradial gastral pouches. These walls are very much folded, and in transverse sections the whole gastral cavity appears almost packed with the genital saccules.

Size. Height including stalk—about 7 mm. Width of umbrella—about 3 mm.

Colour. A rather dull pale yellow.

LIST OF AUTHORITIES REFERRED TO:—

1.—1780. O. Fabricius—Fauna Groenlandica, p. 341.
2.—1806. Rathke—Müller's Zool. Danica, vol. IV.
3.—1816. Lamarck—Hist. Nat. anim. II.
4.—1846. M. Sars—Fauna Littoral. Norweg. Fasc. I.
5.—1858. Gosse—Ann. & Mag. Nat. Hist. vol. I, p. 419.
6.—1859. Allman—Report Brit. Assoc., Aberdeen.
7.—1860. ,, —Trans. Micros. Soc. VIII, p. 125 & Pl.
8.— ,, Gosse—Ann. & Mag. Nat. Hist. V, p. 481.
9.— ,, Allman— do. do. VI, p. 41.
10.— ,, Milne Edwards—Hist. des Corall. III, p. 459.
11.—1862. Keferstein—Zeitschr. für wiss. Zool. XII, p. 24.
12.—1863. Clark.—Prod.Lucernar.Jour.Boston Soc. N.H.
13.—1877. Taschenberg—Halle Zeits.Naturw,Bd.49,p.94.
14.—1878. Clark—Lucernar.Monog.Smithsonian Contrib.
15.—1879. Haeckel—System der Medusen.

[From Trans. Biol. Soc., L'pool. Vol. VIII.]

SEVENTH ANNUAL REPORT of the LIVERPOOL MARINE BIOLOGY COMMITTEE and their BIOLOGICAL STATION at PORT ERIN.

By Professor W. A. Herdman, D.Sc., F.R.S.

Last year's report was a somewhat exceptional one as it chronicled the establishment of the new biological station at Port Erin in the Isle of Man, and the formal inauguration of the institution on June 4th, 1892, by His Excellency the Lieutenant Governor, Spencer Walpole, Esq., LL.D. Moreover as this was the first report after the centre of our operations had been moved from Puffin Island to a more populous region where we might reasonably hope to enlist sympathizers and fellow-workers, some introductory matter was inserted explaining the objects and methods of our Committee, and the nature of marine biological investigations in general. Consequently it seems unnecessary to give any such information again in the present report,* which will therefore deal simply with the progress made in the scientific exploration of the Irish Sea during the year, and with the work carried on by investigators at the Port Erin Biological Station. The year has been a very good one both as regards weather and other facilities for work, and the following record, though in no way sensational, shows good solid progress in various directions and not a few contributions to knowledge. As on previous occasions I have to acknowledge the hearty assistance rendered me by my colleagues on the Committee and by the workers at the biological station

* Copies of last year's report (56 pages, 6 plates) in stiff boards can still be had, price one shilling each, on application to the Hon. Treasurer.

both in the actual investigations during the year and also in drawing up this annual record.

Station Record.

The following naturalists have been working at the Station during the year :—

DATE.	NAME.	WORK.
January.	I. C. Thompson	Dredging, shore collecting, and arranging details of new aquarium with builder.
—	A. O. Walker	
—	W. A. Herdman	
—	G. W. Herdman	
March.	I. C. Thompson	Copepoda.
—	F. E. Weiss	Algæ.
—	W. A. Herdman	Compound Ascidians.
—	R. L. Ascroft	Collecting.
—	F. J. P. Corbin	
—	W. I. Beaumont	Lucernarida.
—	M. C. Potter	Algæ.
—	G. S. Brady	Copepoda.
—	J. H. Vanstone	(Curator).
—	P. M. C. Kermode	Collecting.
—	Alfred Leicester	Mollusca.
—	W. J. Halls...	Hydroida.
April.	W. I. Beaumont	Lucernarida and Mollusca.
—	M. C. Potter	Algæ.
—	G. S. Brady	Copepoda.
—	W. A. Herdman	Compound Ascidians.
—	I. C. Thompson	Copepoda.
—	Alfred Leicester	Mollusca.
—	W. J. Halls...	Hydroida.
—	P. M. C. Kermode	Collecting.
—	J. H. Vanstone	Collecting.
—	F. E. Weiss...	Algæ.
—	E. T. Browne	Medusæ and Plankton.
—	A. O. Walker	Amphipoda.
May.	W. A. Herdman	Compound Ascidians.
—	E. T. Browne	Plankton.
—	A. O. Walker	Amphipoda.
—	J. Vicars	Fishes.
—	J. H. Vanstone	Nemertines.
—	I. C. Thompson	Copepoda.

DATE.	NAME.	WORK.
May.	P. M. C. Kermode	Collecting.
—	A. Leicester	Mollusca.
—	W. Cash	Dredging.
—	G. Dannevig	Fishes.
June.	E. T. Browne	Plankton.
—	G. W. Herdman	General.
—	J. H. Vanstone	Nemertines.
—	I. C. Thompson	Copepoda.
—	W. A. Herdman	Compound Ascidians
July.	G. B. Howes	Collecting.
—	W. A. Herdman	Compound Ascidians.
—	J. H. Vanstone	Nemertines.
August.	W. A. Herdman	Protective Colouring.
—	J. Vicars	Fishes.
—	Miss L. R. Thornely	Polyzoa.
—	W. J. Halls	Hydroida.
—	J. H. Vanstone	Nemertines.
—	A. Chopin	Sponges, &c.
—	A. Leicester	Mollusca.
—	P. M. C. Kermode	General.
—	I. C. Thompson	Copepoda.
—	W. E. Hoyle	Orthonectida.
September.	W. A. Herdman	Protective Colouring.
—	P. M. C. Kermode	General.
—	J. A. Clubb	Collecting.
—	W. E. Hoyle	General.
—	H. C. Chadwick	Echinoderms
December.	I. C. Thompson	Copepoda.
—	W. A. Herdman	Collecting.

Besides this list of over 60 workers who stayed at the Station for periods varying from a few days or a week to several months, there were several occasions on which large parties visited Port Erin for a day for the purpose of seeing the biological station and doing some collecting. Such visitors are not recorded in the list.

Much of the work referred to in the above table will be reported on in detail below, or will form the subject matter of separate papers to be laid before the Biological Society during the coming year.

The Aquarium.

During the first year's work (1892) at the new biological station it was constantly felt to be an inconvenience to have all the vessels of sea-water containing our stock of animals permanently in the laboratory along with the microscopes and dissecting instruments ; and moreover it was found that work was frequently interrupted by the arrival of visitors who though not naturalists were more or less interested in marine biology, and to whom it was certainly desirable in the interests both of the institution and also of the diffusion of knowledge that we should show whatever was possible of the interesting animals of the neighbouring seas without interfering too much with the progress of our investigations. Consequently the Committee became convinced of the necessity of having a separate aquarium and tank house for the storage of living marine animals and plants, for facilitating observations on habits and life-histories, and for exhibition to the public.

On consulting with our enterprising landlord, Mr. Thomas Clague, of the Bellevue Hotel, we found that he was willing to erect for us a small two-storeyed building on the beach alongside the biological station on a piece of ground only separated from the laboratory door by the flight of steps leading down to the shore (see Pl. II). Drawings were made of the necessary arrangement of tanks, pipes, work-tables, &c., and from these Mr. George Herdman, B.Sc., Edinburgh, kindly prepared for us the plans from which the builders constructed the house. This aquarium was commenced on February 6th and was finished at the end of March. The slate and plate glass tanks was made by Carter & Co., in Liverpool, were taken apart and sent over in separate pieces, and were then put together again under our own supervision in their permanent positions in the wall of the building.

The aquarium house (see Pl. III) measures 20 ft. by 17 ft. Its lower storey is of concrete and opens directly on to the beach a few feet merely from high tide mark so that dredged material can be readily conveyed in from the boat to be sorted out and placed in the tanks. Sunk in the floor are three large shallow tanks or concrete cisterns in which large animals such as skates, or stores of smaller such as mollusca, might be kept alive under fairly natural conditions, with stones, sea-weed and sand, for any special purpose. In one angle is the well, 9 ft. deep, into which water is led by a 3 in. iron pipe from the sea (see Pl. IV). In another corner, clamped to the wall, stands the water-motor and force-pump (see Pl. V), arranged for us by Mr. George Herdman, which draw the sea-water from the well and inject it into the concrete cisterns placed on the cliff behind the house. On the side next the sea are two large exhibition tanks having the sides, back and floor of masonry lined by concrete, while the front is plate glass. These tanks are illuminated by little windows placed in their outer walls above the water-line, and as there are wooden shutters in front, above the water-line, all the light in this lower storey enters through the water of these two tanks which gives them a very bright appearance. A straight flight of wooden steps in the centre of the room leads to the upper storey, which is also entered by a door from the platform on the stairs opposite the laboratory (see Pl. II). This room has three slate and plate glass tanks built into its north side, each partly illuminated by a sheet of dulled glass in its outer wall above the water-line. The opposite side of the room has a strong built-in work table running its whole length under the three windows, and on this, and on wooden stands above it, can be arranged as required a number of large and small movable aquaria, glass globes and jars, and other vessels suitable for certain animals or special investigations.

The gable wall opposite the door is fitted up with shelving upon which a small collection of preserved animals illustrating the Fauna of the Bay is arranged. On the side opposite the windows, between the tanks, we have also placed narrow glass cases in which dried specimens, such as Zoophytes, Polyzoa, Mollusca and Crustacea, can be conveniently displayed. It is certainly an advantage for visitors that we should have a certain amount of such museum material properly labelled constantly on exhibition, as the living animals in the tanks and aquaria are always a somewhat uncertain quantity—at one time, after a successful dredging expedition, they may be abundant and very interesting, at another, if there has been no recent collecting, or after some accident when a number have died, there may be comparatively few or they may be nearly all common shore animals. Hence the Committee are glad to be able to state that Mr. G. W. Wood has kindly offered them his considerable collection of Manx Invertebrata, which was exhibited at the Douglas International Exhibition last year. When this arrives it will be displayed in a suitable manner on the shelves round the walls of the Aquarium.

The arrangement of pipes for allowing the sea-water to circulate is as follows (see Pl. IV) :—From the sea the water is brought to the well, in which by screwing down the valve at high tide it can be stored. The pump, worked by a small water-motor supplied with fresh water from the pipes of the town, then forces the sea-water from the well into one division of the cistern ; and, after depositing any sediment, the water passes into the second division from which leads the supply pipe to the tanks. The double cistern is built on a platform of the cliff behind the house, and on a level with the roof, so as to be above the highest tank. The supply pipe goes first to the upper storey, gives off a branch to each tank, and a pipe with stop-cock to the work-table, and then passes through the floor to supply the tanks of the room below. The waste from the system leads to the lowest of the floor concrete basins in the lower storey, and from there out to the beach by a drain pipe.

As is usual in such cases, our tanks had to be filled and supplied many times, stocked and re-stocked, before they were seasoned and thoroughly cleaned, so that the water would remain perfectly pure in them, and the animals and plants live healthily. In fact, it was not until late in the summer that some of them began to be permanently established, and now during the winter we find that they are looking very healthy, and many small things are beginning to grow upon the glass and walls, forming a "self-sown" fauna and flora, so they ought to be in excellent condition during the coming season.

In order to defray the expense of a laboratory boy who would keep the place clean, and also with the view of excluding those who were not really interested or desirous of seeing the tanks, a small charge of 3d. each was made for admission to the Aquarium during the latter part of the summer after the tanks had been stocked. During the four weeks when the Aquarium was thus open, we had over 150 visitors, and the Treasurer received £1 17s. 10d. from this source. There is no reason why, with the additional interest which our museum specimens will give to the place, and under the charge of an energetic curator, who will at stated hours take round visitors and give short demonstrations, the Aquarium should not be a considerable attraction in Port Erin and yield a fair revenue. The Aquarium at the Biological Station in the small town of Arcachon, in the South of

France, has about 16,000 visitors each summer, which brings in about £320 to the funds of that institution.

The Curator.

In spring, the Committee appointed Mr. J. Henry Vanstone, of the Royal College of Science, South Kensington, resident Curator of the Biological Station, and Mr. Vanstone occupied the post continuously from April till September, when he was compelled to resign owing to family circumstances which required him to live near London. After Mr. Vanstone left, Mr. J. A. Clubb acted as Curator for a short time during the vacation, and then the station was left in the charge of the laboratory boy for the winter, but it is the intention of the Committee to proceed shortly to the appointment of a new Curator, who will commence his duties at Easter.

Mr. Vanstone during his tenure of the office drew up and sent weekly reports to the Director on the condition of the tanks, the work being done in the laboratory, the animals collected, the temperature of sea and air, the number of visitors, &c. From these reports I extract the following series of temperatures (Fahrenheit) which may be of value. They were all taken about 10 a.m. :—

Date	Air	Sea
April 11	48°	46°
12	45	47
13	52	48
14	48	48
15	50	49
17	46	46
18	50	48
19	56	51
20	60	52
21	62	51
22	62	50
24	60	55
April 25	56	50
26	54	50
27	53	50
28	54	50
29	50	48
May 1	53	48
2	54	48
3	57	48
4	55	49
5	66	49
6	60	51
8	58	50

Date		Air	Sea
May	9	65	49
	10	64	51
	11	63	53
	12	65	51
	13	64	51
	15	64	50
	16	60	50
	17	56	50
	18	68	52
	19	66	52
	22	60	51
	23	55	50
	24	58	51
	25	60	50
	26	60	52
	27	60	52
	29	60	51
	30	60	50
	31	60	51
June	1	66	58
	2	64	54
	3	65	55
	5	66	56
	6	66	56
	7	68	57
	8	70	57
	9	66	56
	10	66	57
	12	64	59
	13	66	59
	14	66	60
	15	70	61
	16	71	62
	17	70	62
	19	68	60
	20	68	58
	21, 22, 23, 24	Curator ill.	
	26	67	59

Date		Air	Sea
June	27	64	60
	28	65	59
	29	64	59
	30	70	61
July	1	70	61
	3	68	59
	4	69	59
	5	70	62
	6	71	60
	7	70	60
	8	72	62
[At 3 p.m., air 78°, sea 68°]			
	10	68	58
	11	68	58·5
	12	66	57
	13	66	58
	14	65	54
	15	59	55
	17	62	51
	18	62	51
	19	60	50
	20	64	51
	21	64	55
	22	61	59
	24	61	59
	25	60	59
	26	61	58
	27	62	68
	28	62	59
	29	62	59
Aug.	9	72	60
	11	70	61
	15	64	72
	28	63	61
	29	61	59
	30	60	59
	31	60	58
Sept.	1	60	59
	2	60	59
	4	61	58
	5	62	60

Date		Air	Sea	Date		Air	Sea
Sept.	6	63	59	Sept.	11	55	57
	7	60	59		12	59	58
	8	56	58		13	61	57
	9	54	56		14	59	58
	10	55	58				

These columns show how during the greater part of the summer, before the maximum has been reached, the temperature of the sea lags behind that of the air, while in September the air approximates to, or begins to be colder than, the sea.

The shore pools exposed at low tide to the sun become, of course, on some days very much warmer than any of the above records for the open water of the bay. On July 13th it was found that some of the pools in front of the laboratory varied during the day from 60° F. to 76° F., and on July 22nd from 59° F. to 76° F.

Fish Culture.

These temperatures show that, in summer at least, there is no reason why oyster culture should not be carried on at the Isle of Man. At the various places on the west coast of France, where successful oyster culture is now carried on, I found this summer that the temperature of the sea varied from 66° F. to 76° F. Lobster culture is another industry which might with advantage be tried at Port Erin, the narrow deep-water creeks near Bradda Head could readily be converted into vivaria for this purpose. The Lancashire Sea-Fisheries Committee have not yet erected a hatchery alongside the biological station. Unexpected difficulties have arisen, but with the growing feeling in favour of such applications of scientific knowledge and methods to the fishing industries, which is rapidly spreading amongst fishery experts, the general public, and in Parliament, there can be little doubt that sooner or later the plan will be carried out, and Port Erin will become an important centre for the propagation of young food fishes. In the initial stages of the work at the hatchery there is every probability that our tanks in the aquarium house will be of great service for experimental work. It may be of interest in this connection to note that during the past summer the following species of common fish have lived for longer or shorter periods in our tanks:—*Cottus scorpius* (Bullhead), *C. bubalis* (Father Lasher), *Trigla hirundo* (Sapphirine gurnard), *Agonus cataphractus* (Pogge), *Gobius minutus* (Goby), *Cyclopterus lumpus*, *Liparis montagui* (Sucker), *Lepadogaster bimaculatus* (two-spotted sucker), *L. gouanii*, *Blennius pholis* (Shanny), *Centronotus gunnellus* (Butter fish), *Gadus virens* (Saithe), *Motella cimbria* (Rockling), *Pleuronectes platessa* (Plaice), *Clupea harengus* (Herring), *Conger vulgaris* (Conger eel), *Syngnathus acus* (Pipe fish), and *Nerophis æquoreus*.

In May, Captain G. Dannevig, the Director of the well-known Norwegian fish-hatching establishment at Flödevig, near Arendal, paid a visit to Port Erin at the request of some of the Lancashire Sea Fishery Committee in order that he might judge of the suitability of the locality for fish culture. He expressed himself as thoroughly satisfied with the place, and in his evidence before the Select Committee of the House of Commons, on June 15th, he mentioned Port Erin as a most suitable place for the establishment of a hatchery.

Dredging Expeditions.

During the year 1893 various dredging expeditions in steamers have been arranged, partly under the auspices of the small Committee of the British Association, referred to in last report. The following is a brief account of the results of these expeditions:—

I. On January 29, 1893, the Committee had the use of the Lancashire sea-fisheries steamer "John Fell." Several hauls were taken about 7 miles to the west of Fleshwick (Isle of Man), then some further to the south between Port Erin and the Calf. Amongst other species obtained were *Cliona celata* (fine, in various conditions), *Sertularia tenella*, and a number of hydroids and polyzoa, *Sarcodictyon catenata, Porania pulvillus and Palmipes membranaceus, Astacilla gracilis, Inachus dorsettensis, Ascidia venosa* and *A. virginea, Capulus hungaricus, Venus casina*, and *Pectunculus glycimeris.*

II. On March 11-13 the work was again done from the steamer "John Fell." On the 11th the steamer left Douglas to examine the shoal lying to the north-east and south of the Bahama light (see chart, Plate I.). Here, along with various food-fishes and some commoner invertebrates, some very large specimens of *Tritonia hombergi* were trawled ; also the ascidians *Ascidia virginea, Didemnum gelatinosum* and *Polycyclus savignyi* (very large specimens), *Corystes cassivelaunus, Scaphander lignarius, Aglaophenia tubulifera, A. myriophyllum, Calycella fastigiata*, and *Sertularella gayi*, which is a new record to the district ; *Eudendrium rameum, Thuiaria articulata, Gonothyrœa gracilis* and other zoophytes, and various common polyzoa, some very abundant and luxuriant.

On the 13th, after trying again the same shoal as on the 11th, the steamer went to 'the top end of the Hole,' 26 miles east of St. Ann's Head, 30 fathoms. Here there is sand to the north and mud to the south, and some hauls were taken along the line of junction. Amongst other things the following nudibranchs were obtained : *Tritonia hombergi, Dendronotus arborescens* (up to 5 inches in length), *Eolis drummondi, Eolis rufibranchialis*, and *Eolis farrani*; also *Virgularia mirabilis*, and no less than twenty-five species of hydroid zoophytes and twenty-three species of polyzoa.

III. From March 29 to April 4 the Committee were working from Port Erin, and had the s.s. 'Lady Loch' hired for two of these days. One day was spent in dredging on the rocky bottom round the Calf and near the Chicken lighthouse, and in exploring the caves about Spanish Head and the Stack Rock. These caves can only be entered in a boat in calm weather at low tide; and the sides and roof are so closely covered with masses of bright red ascidians (*Polycarpa glomerata*), black and white sponges (*Pachymatisma johnstoni* and *Stelletta collingsi*), and tufts of *Tubularia indivisa*, that scarcely any rock is visible. Amongst the more noteworthy animals dredged round the Calf and obtained on the neighbouring shores were the rare calcareous sponge *Ute glabra*, *Corynactis viridis*, *Hyalinœcia* sp., *Depastrum cyathiforme*, *Lineus gesserensis*, *Dinophilus tœniatus* (breeding at Easter), fifteen species of hydroids, including *Aglaophenia tubulifera*, *Halecium tenellum*, *Lafoëa dumosa* form *robusta*, *L. fruticosa*, *Cuspidella costata* and *C. humilis;* the brachiopod *Crania anomala;* the crustacea *Xantho tuberculata*, *Ebalia tuberosa* and *E. tumefacta*, *Galathea dispersa* (one with a parasitic Bopyrian), *Spirontocaris spinus* (one with a parasitic Bopyrian), *Janira maculosa*, *Tritœta gibbosa*, *Amphithoe rubricata*, *Aora gracilis*, *Conilera cylindracea*, *Mœra othonis*, *Metopa* (? n. sp.), and others ; the mollusca *Spirialis retroversus*, *Rissoa cingulus*, var. *rupestris*, *Fissurella grœca*, *Emarginula fissura*, *Chiton lœvis*, *Pleurobranchus plumula*, *Lima elliptica* and *L. loscombii*, *Astarte sulcata* and *A. triangularis*, *Solecurtus antiquatus*, *Lyonsia norvegica*, *Pecten tigrinus* and *P. testœ*, *Kellia suborbicularis*, *Pandora inœquivalvis*, *Lamellaria perspicua*, *Circe minima* and *Thracia distorta*, the two last being new records to the district; the tunicata *Molgula citrina*, *Styela grossularia*, *Ascidia venosa*, *A. virginea*, and *A. plebeia*, *Botryllus schlosseri*, *B. violaceus*, *B. smaragdus*, *Distomum rubrum*, *Amaroucium proliferum*, *A. argus*, *Leptoclinum maculatum*, and *Didemnum gelatinosum*, *Botrylloides rubrum*, *B. leachii*, *B. albicans*; and the polyzoa *Chorizopora brogniartii*, *Cylindrœcium dilatatum*, *Smittia trispinosa*, *Diastopora suborbicularis*, *Ætea recta*, and *Alcyonidium mamillatum* which is new to the district.

IV. April 28 to May 1. During two of these days the Committee had the use of the Lancashire sea-fisheries steamer 'John Fell.' On one day dredging was carried on in shallow water along the shore about Fleshwick Bay to the north of Port Erin; while on the other day advantage was taken of the fine weather to run out to the deep water halfway to Ireland, and work inwards. Hauls were taken at the following localities:—

1. Fourteen miles north-west of Port Erin, 79 fathoms, mud; Found *Calocaris Macandreæ*, *Lipobranchius jeffreysii*, *Rissoa abyssicola*, *Nucula sulcata*, &c.

2. Ten miles north-west of Port Erin, 50 fathoms, mud: Found *Brissopsis lyrifera* (in quantity), &c.

3. Nine miles west of Contrary Head, 46 fathoms: Found *Cyclostrema millepunctatum*, *Rissoa soluta* and *R. cancellata*, *Eulima bilineata*, &c.

4. Six miles west of Contrary Head, 37 fathoms: *Thyone raphanus*, *Oscanius membranaceus*, *Alcyonidium mamillatum*, *Cellepora dichotoma*, and *Pedicellina gracilis*.

5. Four miles west of Dalby, 25 fathoms; bottom dead shells, &c.: Found *Forbesella tessellata*, *Stichaster roseus*, *Palmipes membranaceus*, *Diphasia pinaster*, *Eudendrium rameum*, *Scalpellum vulgare*, *Pecten maximus* and *P. opercularis* in great abundance.

Pecten maximus yielded to Mr. Thompson the new copepod *Lichomolgus maximus;* while in *P. opercularis* were found the amphipods *Leucothoe articulosa, Tritæta gibbosa*, and *Podocerus herdmani*, Walker.

6. Four miles west of Fleshwick, 20 fathoms: Found *Ophiocoma nigra* in enormous profusion, and other common species.

7. One mile off Bradda Head, 15 fathoms: Found *Amphidotus flavescens, Ute glabra, Sertularella rugosa, Coppinia arcta*, &c.

A good deal of shallow water and shore collecting was also done on this occasion, and all the compound ascidians noted under III. were got near Port St. Mary, with the addition of *Glossophorum sabulosum* and *G.* sp. (? n. sp.), both of them new to British seas, the genus only being known up to now from the French coast. A yellow variety of Giard's *Astellium spongiforme* was also obtained.

One of the most interesting finds on this expedition was certainly *Cyclostrema millepunctatum*, Friele, which was only previously known from one spot off the Lofoten Islands, in lat 69° 46′ N., long. 16° 15′ E., 649 fathoms. Our specimens, from 46 fathoms only, were collected by Mr. Leicester, identified by Dr. Chaster, and sent by him to Dr. A. M. Norman for confirmation by comparison with some of Friele's types in Dr. Norman's collection.

V. May 19-22. On one of these days the Committee again had the use of the sea-fisheries steamer 'John Fell.' The weather was rough, and it was only possible to work near the coast to the north of Port Erin, where hauls were taken at the following localities:—

1. South side of Fleshwick Bay, 13 fathoms: *Adamsia palliata* and *Eupagurus prideauxii, Pleurobranchus plumula*, and *Ascidia virginea*.

2. Opposite Fleshwick beach, 12 fathoms: *Palmipes membranaceus, Solaster papposus, Aporrhais pes-pelicani* (a very large number, all alive), *Lepadogaster bimaculatus.*

3. North side of Fleshwick Bay, 15 fathoms : *Solaster papposus, Plumularia pinnata, Eudendrium capillare, Palmicellaria skenei* (new to the district), *Scaphander lignarius, Ascidia virginea.*

4. Same line, a little further out : *Palmipes membranaceus, Aporrhais pes-pelicani, Eugyra glutinans.*

5. Across mouth of Port Erin Bay, from near Bradda Head to breakwater, bottom gravel and weeds : *Adamsia palliata, Eupagurus prideauxii, Ophioglypha albida* (spawning), *Membranipora imbellis, M. dumerilii, Mucronella ventricosa, M. variolosa, Stomatopora granulata, S. major, Lepralia pertusa, Schizoporella linearis.* Three varieties of the last species were found (1) var. with abortive cells having ovicells, (2) var. with avicularia on the top of blunt umbones, (3) var. approaching *crucifera*, but with a spine on the ovicell.

VI. June 17-19. The Committee hired the steam trawler 'Lady Loch' for June 18, and having favourable weather were able to work out to the depression between the Isle of Man and Ireland (see chart, Pl. II., and section). Two or three hauls were taken at each of the following :—

1. Six miles N.W. of Port Erin, 33 fathoms, sandy mud: Found *Brissopsis lyrifera, Alcyonidium gelatinosum, Porania pulvillus, Adamsia palliata, Palmipes membranaceus, Scalpellum vulgare* on *Antennularia.*

2. Eight miles N.W. of Port Erin, 40 fathoms, mud: Found *Calocaris macandreæ, Hyalinœcia tubicola,* &c.

3. Eleven miles N.W. of Port Erin, 50 fathoms, mud: *Sagartia herdmani* (on *Turritella* shells, see fig. 2, p. 22), *Panthalis oerstedi, Lipobranchius jeffreysii, Bougainvillea muscus.*

4. Thirteen miles N.W. of Port Erin, 60 fathoms, mud, bottom temperature 48° F., surface temperature 60° F.: Found *Calocaris macandreæ*, &c.

5. Five miles off Dalby, 30 fathoms, 'reamy' bottom (sand and mud mixed): Sole, turbot, and brill all spawning here. *Lima loscombii*, *Cerebratulus* (*? angulatus*), *Chætopterus* sp., *Thyone fusus* and *T. raphanus*, *Eurynome aspera*.

6. Four miles off Fleshwick, 23 fathoms: *Pecten opercularis* and *P. maximus* in quantity; *Molgula* sp., *Corella parallelogramma*, *Ascidia plebeia*, *Ascidiella venosa*, *Polycarpa comata*, *Suberites domuncula*.

7. A mile and a half off Bradda Head, 12-15 fathoms: *Styelopsis grossularia*, *Bowerbankia caudata*, *Eurynome aspera*, *Terebella nebulosa*, *Thyone raphanus*.

VII. On August 22nd dredging was conducted from Port Erin round the Calf Island from the hired steam-trawler 'Albatross' at the following spots:—

1. Off Halfway rock and Bay Fine, half a mile from shore, 15 fathoms, bottom broken shells and small gravel:—*Antennularia ramosa*, *Sertularia abietina*, *Aglaophenia myriophyllum*, *Cellularia fistulosa*, *Sarcodictyon catenata*, *Ascidia plebeia*, *A. mentula*, *Cynthia morus*, *Porania pulvillus*, *Galathea intermedia* with *Pleurocrypta intermedia*.

2. From off Kitterland to Halfway Rock, 17 fathoms, bottom stones and large shells:—*Cliona celata* (massive form), *Ascidia venosa*, *Cynthia morus*, *Ophiopholis bellis*.

3. Three-quarters of a mile north of Kitterland, 18 fathoms, bottom shell-sand and small gravel:—*Sarcodictyon catenata*, *Lepralia edax*, *Cellepora pumicosa*, *Echinocyamus pusillus*, *Ophiocoma nigra*, *Ascidia mentula*, *A. plebeia*, *Perophora listeri*, *Capulus hungaricus*, *Murex erinaceus*, *Xantho tuberculatus*, *Inachus dorsettensis*, *Ebalia cranchii*.

4. Off north corner of Calf Island, 17 fathoms, bottom stones and very many *Ophiocoma nigra* :—*Stichaster roseus*, *Ophiothryx pentaphyllum*, *Ocnus brunneus*, *Lineus longissimus*, *Cynthia morus*, &c.

5. South end of Calf Sound, 15 fathoms, large stones with *Sertularia abietina* and encrusting Polyzoa, and *Ciona intestinalis*.

6. North-west of Calf Island, 18 fathoms, bottom stones, with many *Ophiocoma nigra* :—Calcareous sponge, *Chætopterus* sp., *Thyone fusus*, *Ophiopholis bellis*, *Solaster papposus*, *Ascidiella scabra* and *Ciona intestinalis*.

7. N.W. of Calf Island, further out than last, 20 faths., bottom shells, stones and Echinoderm spines :—*Sarcodictyon catenata*, *Aglaophenia tubulipora*, *Spatangus purpureus*, *Aphrodite aculeata*, *Ciona intestinalis*, *Perophora listeri*, and *Pectunculus glycimeris*.

8. From off Kitterland to across Port Erin Bay, far out, bottom large shells:—*Perophora listeri*, *Ascidia mentula*, &c.

9. West of breakwater, one mile out, gravel and rotting weeds :—*Lyonsia norvegica* (alive), &c.

VIII. On September 11th some of the Committee dredged from a large rowing boat between Port Erin and the Calf Island :—Half a dozen hauls were taken about Aldrick and Bay Fine in 15 to 20 fathoms :—*Folliculina ampulla* (in quantity, alive), *Astrorhiza limicola*, *Antennularia ramosa* and other Hydroids, *Sarcodictyon catenata*, *Antedon rosacea*, *Halsydna gelatinosa*, *Terebella nebulosa*, *Amphiporus pulcher*, *Conilera cylindracea*, *Anthura gracilis* (new to the district), *Eurynome aspera*, *Galathea nexa* with *Pleurocrypta nexa*, n. sp., *Ascidia plebeia*, *Ascidiella venosa*, *A. virginea*, *Cynthia morus*, *Polycarpa pomaria*, *Corella parallelogramma*, *Doto fragilis*, *Velutina lævigata*, *Ostrea edulis* and *Syngnathus acus*.

ADDITIONS TO FAUNA.

On all these expeditions, in addition to the animals picked out and preserved at the time, surface and deeper gatherings with the tow-net were taken by Mr. I. C. Thompson; and samples of the bottom and of the 'dredge *débris*' were kept, and these were afterwards carefully examined by Mr. I. C. Thompson for copepoda, by Mr. A. O. Walker for amphipoda and isopoda, by Mr. A. Leicester for small mollusca, and by Dr. Chaster for foraminifera. The sponges collected have been identified by Dr. R. Hanitsch, and several other workers at the Port Erin Biological Station have assisted the Committee with particular sets of animals. The additions to our knowledge of the fauna during the year will now be given, akintg the groups in zoological order.

Fig. 1. Map of the L.M.B.C. District.

Dr. G. W. Chaster reports that amongst the FORAMINIFERA he has examined two are new to science, the one is a *Placopsilina* and the other an allied form which seems to require a new genus. They are from the central area at depths of 20-25 fathoms.

Amongst the Sponges examined by Dr. R. Hanitsch the following are specially worthy of note: *Ute glabra*, obtained near Port St. Mary (this is practically new to British seas, as it had only been found before at Guernsey); *Esperiopsis* (*Desmacidon*) *fruticosa*, dredged off Calf of Man, 40 to 50 fathoms; *Halichondria* (*Amphilectus ?*) *expansa*, off Garwick Head (previously known from Skye); *Suberites* sp. (?), some very large masses, dredged halfway between the Isle of Man and Lancashire, 20 fathoms; *Raspailia* sp. (new to the district), dredged off the Calf, 15 fathoms; *Stelletta collingsi*, from the Caves at Spanish Head, Port Erin; *Reniera rosea*, at Fleshwick and Perwick Bay (recorded by Bowerbank from Tenby and Sark only). In addition, Mr. Chopin, who was dredging at Port St. Mary in August, obtained *Dercitus bucklandi*, which is new to the Isle of Man.

We have found in the pools at Port Erin amongst other Hydroida the *Lafoea pygmæa* of Alder, and Miss Thornely has been able to prove that it is really a *Calycella*; while *Sertularella gayi* has been added as a new record to the district. In all eighty-nine species of Zoophytes have been recorded now in the L.M.B.C. district.

Fig. 2.—*Sagartia herdmani*, Haddon.

The small pale red anemone attached to *Turritella* shells (see fig. 2) which we dredge from the mud off Port Erin at depths of 50 to 70 fathoms has been identified by Prof. A. C. Haddon as *Sagartia herdmani*, a species described by himself a few years ago from specimens obtained off the west coast of Ireland during the cruise of the s.y. 'Argo.'

In regard to Turbellaria, Mr. F. W. Gamble while working at the Port Erin Biological Station last summer drew up a list of species found in the neighbourhood. This has been published in full in 'Trans. Biol. Soc., Liverpool,' vol. vii. pp. 148-174. The list contains records of twenty-eight species, representing twenty-three genera: of these the following five species are new to British seas:—*Promesostoma ovoideum*, *P. lenticulatum*, *Byrsophlebs intermedia*, *Plagiostoma sulphureum*, *Oligocladus sanguinolentus*. We also find at Port Erin the elongated pear-shaped opaque white cocoons of the Rhabdocœle *Fecampia* attached under stones in pools.

The Polyzoa collected on the various expeditions have been examined by Miss L. R. Thornely, who also worked at the Biological Station for a couple of weeks in August. She reports that amongst the many forms collected, amounting to 123 species and 14 varieties, four species at least are new records to the district, viz., *Alcyonidium mamillatum*, *Palmicellaria skenei*, *Crisia ramosa* and *Lepralia edax*, as well as five well-marked varities:—*Schizoporella linearis*, var. *hastata* and a var. like *crucifera*, *Membraniporella nitida* the Devonshire var., *Hippothoa flagellum* var. *vitrea*, and *H. divaricata* var. *carinata*.

The Copepoda obtained both by surface nets and also from the mud and other material from the dredge have yielded Mr. Thompson in all 136 species, of which eighteen are new records to British seas and eleven are new to science. These last are:—*Ameira attenuata*, *Cletodes monensis*, *Herdmania stylifera*, *Cyclops marinus*, *Hersilioides puffini*, *Jonesiella hyænæ*, *Laophonte spinosa*, *Lichomolgus maximus*, *Monstrilla longicornis*, *Stenhelia denticulata* and *S. hirsuta*. These new species are all described in full, and figured, in Mr. Thompson's 'Revised Report upon the Copepoda of Liverpool Bay,' just published (August, 1893) in 'Trans. Liverpool Biol. Soc.,' vol. vii., so it is perhaps unnecessary to give any further details here.

Since the publication of his report Mr. Thompson has also worked over a good deal of material, partly fish parasites and partly taken from the stomachs of the young fish examined by Mr. Corbin in the Fisheries laboratory at University College. He reports as follows :—

(*a*) Parasites—From the Cod—*Caligus rapax* and *C. curtus*. From the Hake—*Anchorella appendiculata*. From Flounder and from *Arnoglossus megastoma* — *Lepeoptheirus pectoralis*. From Sprat—*Lerneonema spratta*.

(*b*) From stomachs of young Plaice, chiefly from Morecambe Bay—most contained quantities of Harpacticidæ, chiefly *Jonesiella hyænæ* in quantity, also numbers of *Longipedia coronata* and *Canuella perplexa*; with these in most of the tubes were a few Cumacea and Amphipoda.

Three of the above Copepoda are new to the district, viz., *Lepeoptheirus pectoralis*, *Anchorella appendiculata*, and *Canuella perplexa*.

The Higher Crustacea have been examined, and to a large extent collected, by Mr. A. O. Walker, who has supplied the following lists and notes, which record only the more noteworthy additions to the local fauna :—

Schizopoda.

Erythrops elegans, G.O.S., 8 miles west of Fleshwick, 33 fathoms.

Mysidopsis gibbosa, G.O.S., Port Erin Harbour, in algæ.

Gastrosaccus sanctus, v. Ben., Port Erin Harbour, Nov. 1892 and Jan. 1893, (the most northerly record of this species),

Haplostylus normani, G.O.S., Port Erin Harbour, Jan. 1893, one male, colour dark brown (also a Southern, Mediterranean, form).

CUMACEA.

Diastylis biplicata, G.O.S., 8 miles west of Fleshwick, 33 fathoms, several specimens; an adult male measured only 5 mm. to end of telson.

ISOPODA.

Leptognathia laticaudata, G.O.S., Port Erin Harbour.

Paratanais batei, G.O.S., from *Pecten maximus* at Port Erin (along with another unidentified species of *Leptognathia*).

Astacilla gracilis, Goods., Port Erin and Rhos Bay.

Anthura gracilis, Montagu, off Aldrick, Port Erin, 20 fathoms, Sept. 11th, 1893.

AMPHIPODA.

Hyale nilssonii, Rath., shore, Port St. Mary, Isle of Man.

Perrierella audouiniana, Bate, from *Pecten maximus*, at Port Erin.

Hoplonyx similis, G.O.S., Laxey Bay, Isle of Man.

Harpinia crenulata, Boeck, 8 miles off Port Erin, 39 fathoms.

Ampelisca macrocephala, Lilljeb., off Port Erin, Aug., 1893, 10 to 20 fathoms, one large female.

Amphilochus melanops, n. sp., off Little Orme, 5 to 10 fathoms, rather common (see below, p. 27).

Monoculodes carinata, Bate, Port Erin Bay, July 21st, 1892.

Metopa borealis, G.O.S., Colwyn Bay and Menai Strait, 2½ fathoms, sandy bottom, not uncommon.

Metopa pusilla, G.O.S., Colwyn Bay, $2\frac{1}{2}$ fathoms.

Metopa bruzellii, Goës, off Little Orme, 5—10 fathoms.

Leucothoe spinicarpa, Abild., from *Ascidia mentula* off Clay Head, and from *Pecten* off Port Erin.

Synchelidium brevicarpum, Bate, Port Erin Harbour.

Paramphithoe monocuspis, G.O.S., off Puffin Id., &c. (probably an immature form of *P. bicuspis*).

Paramphithoe assimilis, G.O.S., Puffin Island, Little Orme, and Lancashire Coast.

Stenopleustes nodifer, Sars, Rhos Bay, 4 fathoms (not previously known South of Scotland).

Lilljeborgia kinahani, Bate, 3 miles west of Calf, 19 fathoms.

Laphystius sturionis, (Kröy.), (=*Darwinia compressa*, Bate), one specimen from under pectoral fin of cod sent from the Fisheries Laboratory, Liverpool.

Eusirus longipes, (Boeck), off Port Erin, Aug. 1893, 10 to 20 fathoms.

Melphidippa macra, Norm., 8 miles west of Fleshwick, 33 fathoms. (These show the perfect antennæ which were wanting in Dr. Norman's Shetland specimens*).

Maera longimana, Thomp., 3 miles west of Fleshwick, 20 fathoms.

Cheirocratus assimilis, Lillj., Port Erin Harbour, Jan. 1893.

Photis reinhardi, Kröy., off Little Orme; colour dark brown.

Megamphopus cornutus, Norm., 8 miles west of Fleshwick, 33 fathoms, and off Little Orme 5—10 fathoms. A comparison of specimens of this from Norway, Shetland, Cumbrae, and Isle of Man shows that the horn on the first epimere diminishes and disappears as the species goes south.

* British Association Report, 1868, p. 280.

Podocerus herdmani, A. O. Walker, off Port Erin, 20—35 fathoms (washed out of *Pecten maximus* and *P. opercularis*), and Laxey Bay (for diagnosis and figure see last Annual Report).

Podocerus isopus, A. O. Walker, Rhos Bay, low water, abundant.

Ericthonius difformis, M. Edw., Laxey Bay, 10 fathoms (colony of tubes attached to *Zostera*).

Siphonœcetes colletti, Boeck, Port Erin Harbour, off Garwick Head, and off Little Orme, 5—10 fathoms.

Seven of these Amphipoda, *Harpinia crenulata*, *Amphilochus melanops*, *Metopa bruzelii*, *Metopa pusilla*, *Paramphithoe monocuspis*, *Podocerus herdmani*, and *Siphonœcetes colletti*, have not been previously recorded in British seas.

In regard to the new species, *Amphilochus melanops*, Mr. Walker states:—

"This species is interesting from being very closely allied to *A. marionis*, Stebb., from Marion Island, from which it differs chiefly in its larger eyes, and in having the palm and hind margin of both gnathopods less convex. From *A. oculatus* (Hansen), from the west coast of Greenland, which it resembles in the eye, it differs in having no spiniform process to the anterior margin of the hand of the second gnathopod; and from *A. tenuimanus* (Boeck) it differs in the eye, which is described by Sars as being small, imperfectly developed, and light red; in the telson, which is much shorter, and in the armature of the outer plates of the maxillipedes, which are terminated by a single spine, exactly as in *A. marionis*, instead of two spines, as drawn by Sars. The mandibles have the molar tubercle intermediate in character between *Amphilochus* and *Gitanopsis*, Sars, to whose *Gitanopsis inermis* this species also has a great resemblance, but differs in the above character and in the length of the telson, which closely resembles that of *A. marionis*. The length of a female with ova is 2 mm.

'The occurrence of species so closely allied as those mentioned above in such widely separated regions as Marion Island in latitude 48°S. and the west coast of Greenland is very interesting, as also is the presence of well-developed eyes in *A. melanops* and *A. oculatus*, taken in from 5 to 25 fathoms; while in *A. marionis* and *A. tenuimanus*, taken in 100 to 200 fathoms, they are imperfect. It is very probable that it was this species (*A. melanops*) to which Mr. Stebbing referred* as having been sent to him by Mr. Robertson from the Clyde."

In regard to the MOLLUSCA a large number of species have been collected by the Committee; and Mr. Alfred Leicester, who has examined and identified them, has drawn up a list of seventy-eight species which have not before been found off the south coast of the Isle of Man, while thirty of them are new records for the district, these include the following :—*Lepton clarkiæ*, *Pecten testæ*, *Nucula sulcata*, *Kellia suborbicularis*, *Cardium minimum*, *Isocardia cor*, *Thracia distorta*, *Eulima intermedia*, *Odostomia lukisi*, *O. conoidea*, *Rissoa abyssicola*, *R. violacea*, *Cylichna umbilicata*, *Aclis gulsonæ*, *Utriculus hyalinus*, *Propylidium ancyloides*, *Cæcum trachea*, *Philine scabra*, *P. angulata*, *Bulla utriculus*, *Melampus myosotis*, *Trochus helicinus*, and *Cyclostrema millepunctatum*, the last being new to British seas. Some of these were found by Dr. Chaster.

We have also taken the two Brachiopods *Crania anomala* and *Terebratula caput-serpentis*, and the rare Cephalopod *Sepiola scandica*, (new record), as well as the more common *S. atlantica*. Mr. Walker has several times found *Loligo forbesii* at Colwyn Bay.

In regard to fishes, although most of the hauls on the

* 'Challenger' Report on Amphipoda, p. 746.

expeditions, having been taken with the naturalists' dredge, were not suitable for the capture of fish, still the Committee, partly through the work of Mr. P. F. J. Corbin, at the Fisheries Laboratory, University College, Liverpool, have collected records of 114 species of fish found in the district, and have added the following species, previously unknown—*Solea variegata, Gobius quadrimaculatus* and *Argentina sphyræna.*

In concluding this section it may be stated that the Committee have conducted eight dredging expeditions during 1893, and have explored a considerable amount of the Irish Sea around the Isle of Man, and especially to the south and west. They have collected and identified during the year over a thousand species of marine animals, of which thirty-eight are new records to the British fauna, two hundred and twenty four are new to the particular district (this part of the Irish Sea), and seventeen are new to science.

The Committee give with this report (1) a chart showing the area under investigation, with the zones of depths indicated and (2) a section from Ireland to Lancashire, through the Isle of Man, showing the marked difference in depth between the sea to the east and that to the west (see Pl. I). They are also preparing a larger and more detailed chart of the sea to the west and south of the Isle of Man, where most of their dredging has been carried on, in which the nature of the bottom and other particulars will be given; but they wish to make this chart more complete by the incorporation of further observations before publishing. It is hoped that this more detailed chart will appear in illustration of a future report.

The Sea Bottom.

The small Committee of the British Association, under whose auspices several of these expeditions have been carried out, was re-appointed* at the Nottingham meeting for another year, with a grant towards expenses of steamers. The application for the re-appointment of this Committee was supported by the Geological section, as well as by the Biological, on the ground that observations of geological importance might be accumulated by preserving samples of the various deposits brought up by the dredge. These samples will be sent, at the request of Sir Archibald Geikie, to form a series in the museum of the Geological survey at Jermyn Street, London. It is also of importance to determine if possible whether any of the finer muds in deep water are of glacial origin. We have not as yet brought up any stones with undoubted glacial striæ from these muds, but we propose to make use in the future of a circular dredge, with a large-meshed wire net, which will dig in more deeply and may possibly bring up some evidence either for or against the views of the modern glacialists that there were two successive stages in the movements of the ice which filled the Irish sea area—an earlier during which there was a convergence of ice from all sides towards the Isle of Man, and a later when the accumulated ice moved outwards from a central area to the east, south and west. The ice to the west of the Isle of Man would meet with little hindrance to its motion, and the deep gulley between the Isle of Man and Ireland may be the expression of the scour which this ice would produce.

There is one interesting deposit from the sea floor found in our district, and of which a specimen was exhibited before the Geological section at the recent British Association meeting. It takes the form of irregular calcareous

* The vacancy on the Committee caused by the sad and sudden death of our friend and colleague Mr. George Brook has been filled up by the appointment of Professor G. B. Howes, who visited Port Erin in July.

masses, cementing together the dead shells and sand grains which are lying on the bottom and making lumps like "clinkers." Hence the spot where it is found is called by the trawlers the "Blacksmith's Shop." It is about 25 miles S.S.W. of the Calf of Man (see Pl. I), in ordinary clear weather the Chicken Rock lighthouse just dipping and the Stack at Holyhead just rising above the water, and the depth is about 25 fathoms. We first heard of this interesting material from Mr. W. Beck, of Douglas, and he kindly sent a specimen to Mr. A. Leicester at Port Erin. Mr. Leicester found the following shells in the concretion :—*Pecten opercularis*, *Cyprina islandica*, *Venus lincta*, *Cardium echinatum*, *Nucula nucleus*, *Scrobicularia alba*, *Lucina borealis*, and *Turritella terebra*. We have obtained other specimens since, there is a fine lump in the Biological Station at Port Erin, and we have presented another piece to the Jermyn Street Museum in London. Mr. W. W. Watts, of the Geological survey, has made a careful examination by thin sections of the latter specimen, and he has kindly sent me the following notes in regard to it :—"The microscopic examination shows that it is practically a fine grained grit made up of the usual constituents of fragmental rocks cemented together, the cement being in greater quantity that the grains.

"These grains are chiefly chips of quartz, but I have also seen microcline, orthoclase felspar, plagioclase felspar, brown mica, a few grains of glauconite, and green and brown pseudomorphs, probably after grains of some ferro-magnesian mineral like augite, hornblende or even possibly olivine—which, it is impossible now to say, but I think most probably hornblende. There are one or two quite opaque grains and several clear grains containing a good deal of minute magnetite. The grains vary in size within small limits, the largest I have measured is 0·02 inch and the smallest 0·002 inch, but the average size would be about 0·004—0·005 inch in longest diameter. They are therefore minute grains, and as might be expected extremely angular, not one in a hundred showing rounded outlines. They are chiefly such grains as would come from the denudation of granitic rocks or sediments derived from them.

"The cement is carbonate of lime, with a small impurity of carbonate of iron, present chiefly in certain layers, but not there in any considerable quantity. The cement is clearly crystalline in immediate contact with the grains, and also where lining cracks and cavities. Elsewhere it is more opaque and is conspicuously crystalline. The section cuts across numerous shell fragments and a few polyzoa, and where there are any hollow structures as in the inside of Lamellibranchs or Gastropods they are filled up with a substance indistinguishable from the bulk of the concretion.

"The specimen shows no particular reason for the local deposit of cement, and the other constituents are doubtless the ordinary materials of the sea bed. I cannot find any evidence that the cementing is due to any organic agency, and the thoroughly well-developed crystals of carbonate of lime quite agree with this. It may be that the Carboniferous Limestone crops out on the sea bottom under the deposit, and if so there would very likely be submarine springs laden with carbonate of lime which might be precipitated there under less pressure or local loss of carbonic acid. It may be added that Mr. Clement Reid could not see in the specimen any identifiable shells of other than recent age."

Manx Natural History Society.

The Isle of Man Natural History and Antiquarian Society arranged to hold one of their Summer meetings at Port Erin for the purpose of visiting the Biological Station, and they invited the Hon. Director of the Station to give them an address on the occasion. The meeting was held on August 14th under the presidentship of Dr. Tellet. The Society arrived at midday, were received by some of the members of the L.M.B.C., and all had luncheon together at the Bellevue Hotel. At 2 p.m. the members and their friends, making a party of nearly 70, visited the laboratory, and the Director then gave an address on the "Objects and Methods of Marine Biology," with the view of defining the scope and nature of marine biology and its relation to the study of biology or natural history in general. He gave examples of the problems of wide theoretical importance still awaiting solution, and showed how much work of speciographic and distributional interest could be done by local scientific societies by means of sub-division and co-operation in work. The origin of land animals from marine ancestors was touched on, and some examples given of sea-animals now living on our coasts, which are becoming accustomed to breathe in air. Finally the subject of "bionomics," or the relation between animals and their environment was discussed, and cases given of protective and warning colouring, of mimicry, and of the characteristics of species having a definite utility and obvious connection with the habits or surroundings.

The remainder of the afternoon was spent in examining the specimens under microscopes in the laboratory, and in the tanks and aquaria, under the superintendence of the Hon. Director and the Curator.

Protective Colouring.

This is a subject which has been referred to in several of these annual reports, and a number of new examples have been described from our former laboratory at Puffin Island. There are two cases—(1) that of *Lamellaria perspicua*, and (2) that of *Virbius varians*—which we have had under observation during the summer at the Port Erin laboratory, and which may be of some interest to readers.

(1) The following note on the "mimicry" of *Lamellaria* appeared in the "Conchologist" for June 24th :—

"About twenty years ago Giard pointed out that the mollusc *Lamellaria perspicua* may be found associated with various compound Ascidians, and is then protectively coloured so as to form an excellent example of what he at that time called direct defensive mimicry.

"*Lamellaria perspicua* is not uncommon round the south end of the Isle of Man, and is frequently found under the circumstances described by Giard; but I met lately with such a marked case on the shore near the Biological Station at Port Erin, that it seems worthy of being placed on record. The mollusc was on a colony of *Leptoclinum maculatum*, in which it had eaten a large hole. It lay in this cavity so as to be flush with the general surface; and its dorsal integument was not only whitish with small darker marks which exactly reproduced the appearance of the *Leptoclinum* surface with the ascidiozooids scattered over it, but there were also two larger elliptical clear marks which looked like the large common cloacal apertures of the Ascidian colony. I did not notice the *Lamellaria* until I had accidentally partly dislodged it in detaching the *Leptoclinum* from a stone. I then pointed it out to a couple of naturalists who were with me, and we were all much struck with the difficulty in detecting it when *in situ* on the Ascidian.

"This is clearly a good case of protective colouring. Presumably the *Lamellaria* escapes the observation of its enemies through being mistaken for a part of the

Leptoclinum colony; and the *Leptoclinum* being crowded like a sponge with minute sharp-pointed spicules is, I suppose, avoided as inedible (if not actually noxious through some peculiar smell or taste) by carnivorous animals which might devour such things as the soft unprotected mollusc. But the presence of the spicules evidently does not protect the *Leptoclinum* from *Lamellaria*, so that we have, if the above interpretation is correct, the curious result that the *Lamellaria* profits by a protective characteristic of the *Leptoclinum* for which it has itself no respect, or to put it another way, the *Leptoclinum* is protected against enemies to some extent for the benefit of the *Lamellaria* which preys upon its vitals.

W. A. Herdman.

(2) It will be remembered that the colour variations of the small prawn *Virbius varians* whereby individuals resemble the green, the red, or the brown seaweeds they are associated with, or even sandy and gravel bottoms, were discussed and illustrated by a coloured plate in last year's report, and the question was raised as to whether, or to what extent, the adult animal could change its colour. We have had a number of specimens, of various colours, under observation in the laboratory during the year, and they have been kept in jars with various colours of seaweed and of background, and in very different amounts of light. These experiments have shown clearly that the adult animal *can* change its colouring very thoroughly, although not in a very short space of time. To take an example or two from my notes :—

I. One speckled-red and two brown specimens were put in a glass jar containing bright green sea-weeds (*Ulva* and *Enteromorpha*), on a sheet of white paper, in direct sunlight, on September 6th, at 9 a.m. At 8 p.m. all the brown and red colour had gone, the three specimens were all of a pale amber tint, and "washed-out" looking.

II. One reddish-brown specimen, dredged amongst red algæ on August 19th, was put that afternoon in a glass jar with green algæ (*Enteromorpha*) on a white background in the sun. On the morning of the 21st it was almost colourless, having merely a pale grey-green tint, and was quite inconspicuous. When examined in a watch glass under the microscope the integument was seen to be almost quite transparent, the pale grey-green muscles showing through distinctly, and the chromatophores or pigment spots being reduced to minute rounded, very rarely branched or stellate, dots which were all of a dark red-brown colour, but from their small size produced little effect upon the general tint of the body. When put back amongst the red weeds it was originally taken from this specimen now looked pale green and conspicuous.

III. One red, one brown, and two speckled-red specimens dredged amongst red and brown sea-weeds in Bay Fine were put on September 7th at 10 a.m. into a glass jar with green algæ, in the sun. At 8 p.m. the brown one was much paler, being a mixture of gamboge and pale neutral tints, while the other three had not undergone much change. On September 8th at 10 a.m. (i.e., after 24 hours in all) the brown one had become distinctly green and was quite inconspicuous, while the red and speckled ones, although not green, had become much less conspicuous by the whole body being very transparent, and the red markings very much paler than they had been—looking as if they had been almost washed out.

Of the four possible alternatives stated in our last report (p. 36) I now think that the 2nd, 3rd, and 4th are all parts of the true explanation of the state of affairs—that is, that there are no permanent varieties, but the young when they first settle down upon the sand or sea-weeds have, whatever the colour inherited from their parents may be, great adaptability, so that under the influence of their environment they soon assume a protective colouration; moreover in each generation the action of natural selection will eliminate those most markedly dissimilar to their environment and those which cannot so readily be modified, and this process will go on during the whole of life; further, the adaptability, or marked susceptibility to the influence of environment, is retained throughout adult life, so that, *e.g.*, a green *Virbius* from the *Zostera* put in a clump of *Halidrys* can change to a dark brown colour. The change in colour is, of course, due to changes in size, and in the arrangement of the contained pigment granules, of the chromatophores. In a reddish brown *Virbius* examined on September 6th the integument was seen under the microscope to be richly pigmented with very large stellate and elaborately branched chromatophores containing pigment of various colours, such as blue, yellow, red, brown and chocolate, the last three being the most conspicuous. When this specimen was examined again on September 7th, after the 24 hours in green sea-weeds, it was found that all the chromatophores were smaller and less branched, and that the blue and yellow ones were now the most conspicuous, the red and brown ones being mostly contracted down to little rounded dots. It would be interesting to determine whether here, as in some other cases of similar colour changes, the modification of the chromatophores is due to nerve action and is dependent upon sight, or is the result of the direct action of light upon the integument.

Swarms of Amphipods.

On several occasions during the past year the Biological Station has been invaded by countless numbers of common shore Amphipoda, chiefly *Orchestia gammarellus* (the shore hopper), accompanied by small black flies and some red mites (*Bdella longicornis*). This was notably the case on April 18th, and again on May 18th, but was noticed to a less degree on several other occasions. Once during the winter on entering the laboratory after it had been shut up for a few days we found the floor, tables, shelves, window ledges, and even dishes on the highest shelves, covered with great numbers of the dead Amphipods. On April 18th an unusually high tide occurred, and the curator and others

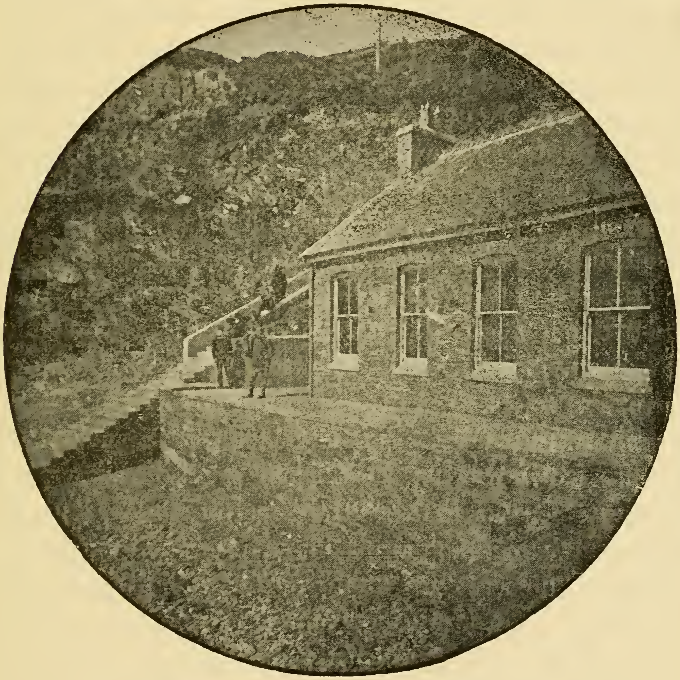


Fig. 3. The Laboratory at Biological Station, Port Erin.

noticed that the steps leading up from the beach were swarming with Amphipoda. On watching them it was found that the Amphipods were coming up in great numbers from high-water mark, that they jumped up the steps (see fig. 3), and even climbed the vertical concrete wall surrounding the station to a height of several feet.

Many of them were found about twelve feet (vertically) above the sea, having come nearly all the way on artificial ground (concrete steps and wall), and they were so abundant on the platform outside the laboratory door that it was impossible to put a foot down without treading on many. Specimens were kept and have been identified by Mr. A. O. Walker as *Orchestia gammarellus.* This species lives normally at or about high water mark, and it is abundant at Port Erin under stones at that level, but Mr. Walker has taken it on the one hand nearly at low water mark, and on the other hand under stones on grass, along with beetles, and we have found it near Port Erin far above high water mark at the side of the road. However, these last are probably exceptional cases, and there can be little doubt that the various Amphipod invasions we have sustained have been caused by the Orchestias being driven from their usual haunts by exceptionally high tides. On May 18th the high tide coincided with very heavy rain which may further have helped to cause the migration. But whether a panic arises on the flooding of their homes, or they lose their way on our new concrete, the fact remains that whereas the sea was only a couple of feet higher on these occasions than an ordinary high tide, the Amphipods ascended on the one occasion to about twelve and on the other to perhaps twenty feet above their usual level.

Other Faunistic Work.

In addition to the results of the various dredging expeditions given at pp. 13 to 29, a good deal of faunistic work has been carried on at Port Erin by shore-collecting at low tide, and by bringing in quantities of sea-weeds and materials from the shore pools and searching over these minutely in the laboratory. It is in this way that many of the smaller Mollusca, the Turbellarian and

Nemertine worms, and the smaller Polyzoa, &c., have been obtained.

To take these matters in zoological order :—Some mud sent from Port Erin by the Curator to Mr. Chopin, of Manchester, was examined by Mr. W. Chaffer, who has sent me through Mr. Chopin the following list of the Foraminifera he found, *Lagena striata*, *L. sulcata*, *L. squamosa*, *L. costata*, *L. obigerina*, *L. hexagona*, *L. lucida*, *L. marginata*, *L. gracilis*, *L. lævis*, *L. crinata*, *Nodosaria pyrula*, *N. scalaris*, *Biloculina depressa*, *B. ringens*, *Miliolina seminulum*, *Marginulina glabra*, *Nonionina* sp., *Bulimina pupoides*, *Spiroloculina depressa*, *Polymorphina striata-punctata*, and *Dentalina striata*.

We have obtained the anemone *Corynactis viridis* not only by dredging but also on the shore near Bradda Head at low tide, and we find that it lives well in our tanks. A marvellous place for sea anemones—and for many other things besides—is the group of rocks called the "Clets" on the south side of the Calf Sound. Few sights can give more pleasure to the naturalist than the spectacle revealed by a low spring tide on a fine summer morning. The variety and profusion of life is very astonishing. Mr. Beaumont during his visits to the Station in the summer of 1892 and in the spring of 1893 paid some attention to the Lucernarians, and he has since published a paper in the Trans. Biol. Soc , vol. VII., in which he shows that the species up to now found at Port Erin are *Depastrum cyathiforme*, *Haliclystus auricula*, and a second species of *Haliclystus*, possibly new.

Mr. Edward T. Browne, B.A. (Oxon.), from University College, London, worked again this year at Port Erin for some weeks in April, May, and June. He made a systematic examination of the plankton, or floating minute life, which is caught by means of the tow-net in the bay; and he specially studied the medusæ. Mr. Browne has sent me some notes upon his work, from which I extract the following brief particulars. Further details will be given in an independent L.M.B.C. Report upon the medusæ of our district, which Mr. Browne promises us after another visit to Port Erin during the coming season. The species which he has found so far are:—*Amphicodon (Corymorpha) fritillaria*, *Codonium (Sarsia) pulchellum*, *Cytæandra (Podocoryne) areolata*, *Euphysa aurata*, *Laodoce (Thaumantias) cruciata*, *Margellium (Lizzia) octopunctatum*, *Melicertidium (Stomobrachium) octocostatum*, *Tiaropsis (Thaumantias) multicirrata*, *Aurelia aurita*, *Cyanea capillata*, and several other species not yet determined. Nearly all these are new records to the L.M.B.C. district, and *Amphicodon fritillaria* has not previously been recorded for British seas.

Mr. Browne took tow-net gatherings on the average three days a week between April 28th and June 5th. He found:—PROTOZOA, three species nearly always present, *Ceratium tripos*, *C. fusus*, and *C. divergens*; *C. fusca* was not often taken. CTENOPHORA, *Pleurobrachia pileus* and *Lesueuria vitrea* (this is a new record for the L.M.B.C. district). ANNELIDA, *Terebella* and *Nerine* larvæ, *Tomopteris*, *Autolytus prolifer*, *Sagitta*, and *Actinotrocha*. CRUSTACEA, Nauplius and Metanauplius stages of *Balanus*; *Podon* and *Evadne*; many Copepoda not identified (great decrease of Copepoda when the sea is full of Diatoms); Zoea stage of *Porcellana*, Megalopa of *Pagurus*. And finally the Tunicate *Oikopleura*, many with ova at end of April, young stages at end of May.

Mr. G. W. Wood, who recorded several species of Hydroid Zoophytes new to the district in the third volume of our "Fauna," has now sent me notes of further work.

He obtained the specimens during a series of dredgings along the coasts of the northern parts of the Isle of Man, between Laxey and The Dhoon in the summers of 1890 and 1891, chiefly on the site of an old oyster bed, from which in the time of Edward Forbes (1838) oysters were brought to market. The supply of oysters has long since been exhausted, but various large mollusca are still abundant, such as *Pecten opercularis*, *Cyprina islandica* and *Mytilus edulis*. On these, Polyzoa and other encrusting colonies are abundant, and many Crustacea and some Echinodermata, such as *Solaster endeca*, *Palmipes membranaceus* and *Astropecten irregulare*, are brought up in the dredge. Mr. Wood's lists contain *Palmicellaria skenei*, *Scalpellum vulgare*, *Pisa gibbsii* and *Chiton hanleyi*, new to the district, and *Suberites ficus*, *Chalina oculata*, *Polymastia mammilaris*, *Flustra securifrons*, *Lichenopora verrucaria*, *Cardium nodosum* and *Tellina donacina*, all new to the Isle of Man. This does not exhaust Mr. Wood's work, as he has still undetermined material on hand. As is noted elsewhere Mr. Wood is presenting his collection of named and mounted Manx Invertebrata to the Aquarium at the Biological Station.

During his visit to Port Erin in April Mr. W. I. Beaumont worked for some time at the identification and variation of the Nemertida, while later in the summer Mr. J. Henry Vanstone, the Curator of the Station, also occupied some of his time with the determination of the Nemertines of the shore. Both these gentlemen have sent me reports upon their work, and I propose that these should be combined to form a joint report by Messrs. Beaumont and Vanstone, which will appear as a separate paper in the Transactions of the Biological Society, and later in the next volume of the "Fauna." Mr. Beaumont found eight species, as follows:—*Carinella annulata*, *Amphiporus* *lactifloreus*, *A. pulcher*, *Tetrastemma melanocephalum*, *T. candidum*, *T. dorsale*, *Nemertes neesii*, and *Lineus obscurus*. To these Mr. Vanstone was able to add seven others, viz., *Cephalothrix bioculata*, *Tetrastemma nigrum*, *T. immutabile*, *T. vermiculatum*, *T. robertianæ*, *Lineus longissimus* and *Cerebratulus angulatus (?)*. Nearly all of these 15 species are additions to our lists, only two of them having been previously recorded in vol. I. of the "Fauna." Several of the species live in abundance in the shingle, immediately in front of the Biological Station, along with the Oligochæte worm *Clitellio arenarius*. It was found that the best way of killing the Nemertines in an expanded condition was by means of either a 1 % solution of cocain or a saturated solution of ferrous sulphate.

Some parasitic Bopyridæ found on the bodies of *Galathea* at Port Erin have been examined by the Rev. T. R. R. Stebbing, who kindly sends me the following report in regard to them :—"The Bopyridæ appear to be (1) *Pleurocrypta galateæ*, Hesse, in *Galathea squamifera*, Leach ; (2) *Pleurocrypta intermedia*, Giard and Bonnier, in *Galathea intermedia*, Lilljeborg; (3) *Pleurocrypta nexa*, n. sp., in *Galathea nexa*, Embleton. They were all on the right side of the host's carapace, and all laden with eggs. The only authority I know of for *Pleurocrypta intermedia* is Giard and Bonnier, Bull. Sci. de la France et de la Belgique, t. xxii. p. 375, footnote, merely giving the name of the parasite and that of its host. On their principle that the same parasite does not inhabit two different species of host, the giving of the names would be sufficient for a preliminary description. On the same principle, therefore, it will be sufficient to announce *Pleurocrypta nexa* as a new species derived from *Galathea nexa*, Embleton. I send you, however, figures of the female and male of this species in dorsal view. The branchial plates on the pleon of the female have the edges crenulate, and are more or less pointed at the apex ; of the six pairs the first are least, and the last most, acute. The two last pairs of marsupial plates have very small setules on the hinder margin. The eyes of the female are very small and indistinct. . . . . In the very much smaller *Pleurocrypta intermedia* the eggs, as you will see on the slide (although they had not left the marsupium, but were taken from it), show a development equivalent to the 'first larval stage.' In all three specimens, as usual, the flattened back of the animal was pressed against the branchiæ of the host, while a vast quantity of eggs held together on the ventral side by the large and thin marsupial plates, distended the carapace of the host in a remarkable manner."

Mr. Chadwick, of Manchester, as a result of his work last year at the Station, has published an important paper on some points in the minute structure of the hæmal system of our Asterids. This summer he made some observations upon a species of *Synapta*, which is found to be not uncommon in the muddy shingle, near low tide, close to the Biological Station. During September we found that some of the common *Amphiura squamata* were swarming with the remarkable parasitic Orthonectid *Rhopalura*.

Dinophilus tæniatus appeared again this spring in considerable abundance, and was found to be breeding early in April. Our marine insects, which have been hitherto rather neglected, will, it may be hoped, receive adequate treatment in the future, as Prof. G. S. Brady and Prof. Miall have announced their intention of taking up this group of animals. We find the red sponge *Halichondria caruncula* at Port Erin very commonly has its oscula occupied by the Amphipod *Tritæta gibbosa*. The red compound ascidian *Distomum rubrum* from the Calf Sound is very constantly infested with a bright brick-red Caprellid.

Amongst the Opisthobranchiate Mollusca obtained at Port Erin during the year are:—*Elysia viridis*, var. *olivacea, Actæonia corrugata, Pleurobranchus plumula, Eolis coronata, E. angulata*, and *E. drummondi*; also *Cratena concinna* from Leasowe, near Liverpool, on Sertularians.

Some experiments were made during the summer at the laboratory with the gregarious Ascidian *Polycarpa glomerata* from the sugar-loaf caves, with the view of determining the functions of the atrial tentacles found in this and a few other species. Athough some results have been obtained, I hope to make the investigation more complete by further experiments before publishing an account.

The large buoy, which is moored at the entrance to the Bay, off the end of the broken breakwater, underwent its annual cleaning and tarring on May 26th. Fortunately Mr. E. T. Browne, who was then working at the Biological Station, was present on the occasion, and he found when the buoy was turned over that the flat bottom, about five feet in diameter, was completely covered with animals and sea-weeds, especially the former. The following were taken:—*Sycandra compressa* (very large), *S. ciliata* (fine clusters), *Antedon rosacea* (a dozen), *Eucratea chelata, Scrupocellaria reptans, Caprella linearis, Eolis coronata, Mytilus edulis, Ciona intestinalis* and *Ascidiella scabra* (up to 5 cm. in length).

It is interesting to get here such forms as *Antedon*, the Polyzoa and the Ascidians which are usually found in 10 to 20 fathoms off Port Erin. All the specimens taken were characterized by their fine and luxuriant growth, and all must have become attached since the cleaning of the previous summer.

THE SUGAR-LOAF CAVES.

These caves, like the "Clets" in the Calf Sound, are most attractive to the naturalist who loves to see a profusion of animals flourishing under their natural conditions. The following note of a visit to them appeared in *Nature* for May 4th, 1893 :—

"During the Easter vacation the Port Erin Biological Station has been full. The L.M.B.C. organized a dredging expedition, and the steamer 'Lady Loch' was hired for some days, during which a trip was made to the deep water lying west of the Isle of Man, and the shallower ground round the Calf Island and off Spanish Head was also explored. On one of the days the calm sea and low tide enabled the wonderful caves at the Sugar-loaf rock, near

Fig. 4. Sugar-loaf Rock, near Spanish Head.

Spanish Head (see fig. 4), to be visited in a boat from the steamer. The exposed sides, parts of the roof, and as far down as can be seen in the clear water are closely covered with rounded red Ascidians adhering together in masses, black and white sponges, and tufts of *Tubularia*, forming altogether a most striking sight. The sponges are mostly *Pachymatisma johnstoni*, and the Ascidians are Alder's *Polycarpa glomerata*, a somewhat variable species, solitary specimens of which have been sometimes referred to *Styela rustica* (a species which probably does not occur at all in British seas). When touched these ascidians emit forcibly tiny jets of sea water from the branchial and atrial apertures, and this with their colour has gained for them the local name of the "red-currant squirters of the Sugar-loaf cave."

Publications.

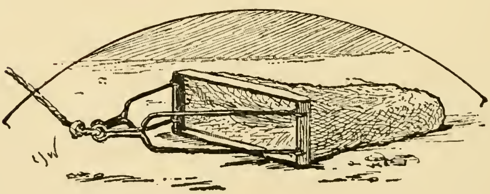
No new volume of the "Fauna" of Liverpool Bay has been issued during the past year, but several L.M.B.C. papers have been published and copies printed off and stored away to form part of Vol. IV., which will probably be completed in a year or so. These papers are :—Mr. I. C. Thompson's "Revised Report on the Copepoda," a lengthy paper illustrated by 21 plates, and giving an account and a figure of every species found up to now in the district; Mr. F. W. Gamble's Report on the Turbellaria of the L.M.B.C. district, illustrated by three plates; Mr. W. I. Beaumont's Note on Lucernarians found at Port Erin; and Mr. H. C. Chadwick's account of the hæmal and water-vascular systems of some of our star fishes, with four plates.

Amongst future papers which will probably be laid before the Biological Society this session as an outcome of work at Port Erin are :—On *Synapta* by Mr. Chadwick, on the Medusæ by Mr. Browne, Revised Report on the Amphipoda and Isopoda by Mr. Walker, on the Nemertida by Messrs. Beaumont and Vanstone, and possibly a Report on the Fishes by Prof. Herdman and Mr. Corbin.

Finally, it may interest some to know that at a recent visit paid to the Station in December we found the place in excellent order, it having been kept well aired and cleaned, and the tanks well looked after by the laboratory boy, William Bridson. In one tank we found vast swarms of Copepoda had made their appearance: Mr. Thompson identified them as *Harpacticus fulvus*. Swarms of Copepoda made their appearance suddenly in June in an aquarium at University College, and they proved on examination to be *Idya furcata*. In another tank at Port Erin we found that a common anemone had a few days before produced upwards of 50 young ones. There is every prospect that when we re-open the station at Easter, with a resident curator, the tanks will be thoroughly "established" and in excellent condition for more complete stocking.

In addition to the speciographic investigations and the bionomical work—such as the relations between the structure and colours of animals and their surroundings and habits—which have occupied a good deal of our attention both at Puffin Island and at Port Erin there is another allied subject well worthy of careful observation, and that is the association of species together, and an enquiry into the causes thereof. The distribution of every species is no doubt determined by definite factors which we may hope some time to ascertain by observation and experiment; some of these factors are known to be the temperature and the salinity of the water and the nature of the bottom, others are doubtless the presence or absence of other organisms—both plants and animals—which serve as food, act as enemies, or influence their neighbours in other more obscure and subtle ways difficult to determine. Edward Forbes wrote long ago, "Geology and Zoology will gain as much by inquiring how our marine animals are associated together as by investigating genera and species, though the former subject has as yet been but little attended to in comparison with the latter." Things are a little better now. The teachings of Darwin in regard to the inter-relations of species have told upon the work of the last quarter of a century, but we still require much accurate knowledge in regard to the factors which limit the existence of a species, and I trust that we may be able to do something at the Port Erin Biological Station towards supplying this want.

The usual statement of the Hon. Treasurer, and the lists of subscriptions and donations is appended to this Report.



The Dredge.

APPENDIX A.

LIST OF PRESENTS TO THE STATION.

A new L.M.B.C. flag	Mrs. Harvey-Gibson
Balfour's Embryology, 2 vols.	Prof. Weiss
Day's British Fishes, 2 vols. ...	Mr. J. Vicars
Gosse's Marine Zoology.........	Mr. A. O. Walker
Monograph on the Ostracoda	Prof. G. S. Brady
A Hartnach Microscope	Prof. R. J. Harvey-Gibson
Various Zoological Books	Prof. R. J. Harvey-Gibson
Dredge and Rope..................	Mr. W. J. Halls
Sets of Sieves, &c.	Mr. R. D. Darbishire

APPENDIX B.

SUBSCRIPTIONS and DONATIONS.

	Subscriptions.			Donations.		
	£	s.	d.	£	s.	d.
Banks, Prof. W. Mitchell, 28, Rodney-st.	2	2	0		—	
Barlow, Rev. T. S., Bishop's Court, I. of Man	0	10	6		—	
Beaumont, W. I., Cambridge	1	1	0		—	
Bickersteth, Dr., 2, Rodney-street... ...	2	2	0		—	
Boulnois, H. P., 7, Devonshire-road, Prince's Park	1	1	0		--	
Brown, Prof. J. Campbell, University College, Liverpool	1	1	0		—	
Browne, Edward T., B.A., 14, Uxbridge road, Shepherd's Bush, London ...	1	1	0		—	
Burton, Major, Fryars, Beaumaris... ...	2	2	0		—	
Caine, Nath., 10, Orange-court, Castle-street	1	1	0		—	

Cash, William, 38, Elmfield Terrace, Halifax	1	1	0		—	
Caton, Dr., 31, Rodney-street		—		1	1	0
Chadwick, H. C., 2, Market-place, Chorlton-cum-Hardy, Manchester	0	10	0		—	
Clague, Dr., Castletown, Isle of Man ...	1	1	0		—	
Clague, Thomas, Bellevue Hotel, Port Erin	1	1	0		—	
Comber, Thomas, J.P., Leighton, Parkgate	1	1	0		—	
Crellin, John C., J.P., Ballachurry, Andreas, Isle of Man	1	1	0		—	
Dawkins, Professor W. Boyd, Owens College, Manchester	1	1	0		—	
Denny, Prof., Firth College, Sheffield ...	1	1	0		—	
Derby, Earl of, Knowsley	5	0	0		—	
Dumergue, A. F., 79, Salisbury road, Wavertree	1	1	0			
Gair, H. W., Smithdown-road, Wavertree...	2	2	0			
Gamble, Col. David, C.B., Windlehurst					—	
St. Helens	2	0	0		—	
Gaskell, Frank, Woolton Wood, ...	1	1	0		—	
Gaskell, Holbrook, J.P., Woolton Wood,	1	1	0		—	
Gell, James S., High Bailiff of Castletown...	1	1	0		—	
Gibbons, Fredk., 19, Ranelagh-street ...	1	1	0		—	
Gibson, R. J. Harvey, 41, Sydenham-avenue	1	1	0		—	
Gifford, J., Whitehouse terrace, Edinburgh	1	0	0		—	
Glynn, Dr., 62, Rodney-street	1	1	0		—	
Halls, W. J , 35, Lord-street	1	1	0		—	
Henderson, W. G., Liverpool Union Bank	1	1	0		—	
Herdman, Prof., University College. L'pool.	2	2	0		—	
Holder, Thos., 1, Clarendon-buildings Tithebarn-street	1	1	0		—	
Holland, Walter, Mossley Hill-road ...	2	2	0		—	
Holt, George, J.P. Sudley, Mossley Hill ...	1	0	0		—	
Howes, Prof. G. B., Royal College of Science, South Kensington, London...	1	1	0		—	
Isle of Man Natural History and Antiquarian Society	1	1	0		—	

	£	s.	d.	£	s.	d.
Jones, C. W., J.P., Field House, Wavertree	5	0	0		—	
Kermode, P. M. C., Hill-side, Ramsey ...	1	1	0		—	
Leicester, Alfred, Priory Gardens, Weld-rd., Birkdale	1	1	0		—	
Lomas, J., Amery-grove, Birkenhead ...	1	1	0		—	
Macfie, Robert, Airds	1	1	0		—	
Meyer, Dr. Kuno, University College, L'pool	0	5	0		—	
Mitchell, J., 156, Thicketford-road, Tonge, Bolton...				0	2	6
Marshall, Prof. A. Milnes (the late), Owens College, Manchester	1	1	0		—	
Meade-King, H. W., J.P., Sandfield Park, West Derby	1	1	0		—	
Meade-King, R. R., 4, Oldhall-street ...	0	10	0		—	
Melly, W. R., 90, Chatham-street... ...	1	1	0		—	
Miall, Prof., Yorkshire College, Leeds ...	1	1	0		—	
Monks, F. W., Brooklands, Warrington ...	1	1	0		—	
Muspratt, E. K., Seaforth Hall	5	0	0		—	
Mylchreest, J., White House, Kirk Michael. Isle of Man	1	1	0		—	
Newton, John, M.R.C.S., 44, Rodney-street	0	10	6		—	
Odgers, Rev. J. E., Horton, Bowden ...	1	1	0		—	
Poole, Sir James, Tower Buildings ...	2	2	0		—	
Potter, Prof. M. C., Durham University ...	1	1	0		—	
Rathbone, R. R., Glan-y-Menai, Anglesey	2	2	0		—	
Rathbone, S. G., Croxteth-drive, Sefton-park	2	2	0		—	
Rathbone, Mrs. Theo., Backwood, Neston	1	1	0		—	
Rathbone, Miss May, Backwood, Neston ...	1	1	0		—	
Rathbone, W., M.P., Greenbank, Allerton	2	2	0		—	
Roberts, Isaac, F.R.S., Tunbridge-wells ...	1	1	0			
Shepheard, T., Kingsley Lodge, Chester ...	1	1	0		—	
Simpson, J. Hope, Annandale, Aigburth-drive	2	2	0		—	
Smith, A. T., junr., 24, King-street ...	1	1	0		—	
Stevenson, W. A., Ballakreighan, Castletown, Isle of Man	1	1	0		—	

Stevenson, W. B., Balladoole, Castletown, Isle of Man	1	1	0		—	
Stewart, W. J., City Magistrates Office ...	1	1	0		—	
Thompson, Isaac C., 19, Waverley-road Sefton park	2	2	0		—	
Thornely, James, Baycliff, Woolton ...	1	1	0		—	
Thornely, The Misses, Baycliff, Woolton ...	1	0	0		—	
Toll, J. M., 340, Walton Breck-road ...	1	1	0		—	
Tomlin, B., 59, Liverpool-road, Chester ...	0	5	0		—	
Talbot, Rev. T. U., 4, Osborne terrace, Douglas, Isle of Man	1	1	0		—	
Vicars, John, 8, St. Alban's-square, Bootle	2	2	0		—	
Walker, Alfred O., Nant-y-glyn, Colwyn Bay	3	3	0		—	
Walker, Horace, South Lodge, Princes-park	1	1	0		—	
Walpole Spencer, LL.D., His Excellency The Governor, Isle of Man	2	2	0		—	
Walters, Rev. Frank, B.A., King William College, Isle of Man	1	1	0		—	
Wareing, W. R., Charlesbye, Ormskirk ...	1	1	0		—	
Watson, A. T., Tapton-crescent, Sheffield	1	1	0		—	
Weiss, Prof. F. E., Owen's College, Manchester	1	1	0		—	
Westminster, Duke of, Eaton Hall ...	5	0	0		—	
Wiglesworth, Dr., Rainhill...	1	1	0		—	
	115	15	0	1	3	6
Arrears unpaid	4	4	0		—	
	111	11	0	1	3	6

THE LIVERPOOL MARINE BIOLOGY COMMITTEE,

Dr. IN ACCOUNT WITH ISAAC C. THOMPSON, HON. TREASURER. **Cr.**

1893	£	s.	d.
To Balance due Treasurer, 1892	2	4	8
,, Expenses of Dredging Expeditions	19	11	8
,, Rent of Port Erin Biological Station and Aquarium	15	0	0
,, Tanks and Pumps for Aquarium	16	6	6
,, Apparatus, Furniture, Books, &c., at Port Erin Biological Station	8	14	3
,, Printing, Dobb & Co. (Fauna Reports, vol. iii., &c)	64	18	4
,, Do. Marples & Co.	2	11	0
,, Engraving Plates, Vaus and Crampton	3	8	0
,, Postages, Carriage of Apparatus, &c.	6	4	1
,, Sundries	5	13	3
,, Salary to Curator and laboratory boy	38	9	1
	£183	0	10
By Balance due Treasurer	46	14	2

1893	£	s.	d.
By Subscriptions and Donations	£112	14	6
,, Dividend, British Workman's Public House Co., Ltd., Shares	5	18	0
,, Sale of Reports	7	3	9
,, Sale of Cutter "Morning Star"	6	0	0
,, Bank Interest	1	8	7
,, Sale of Museum Specimens	1	4	0
,, Admissions to Aquarium (Port Erin)	1	17	10
,, Balance due Treasurer	46	14	2
	£183	0	10

Endowment Fund Investment :—

	£	s.	d.
Brit. Workman's Public House Co.'s Shares	105	11	0
Cash in Union Bank	75	0	0
	£180	11	5

ISAAC C. THOMPSON,

HON. TREASURER.

LIVERPOOL, *December 30th*, 1893.

Audited and found correct,

ALFRED LEICESTER.

L.M.B.C. NOTICES.

The public are admitted by ticket to inspect the Aquarium from 12 to 1 and from 6 to 6-30 p.m. daily, when the Curator will be, as far as possible, in attendance to give information. Tickets of admission, price sixpence each, to be obtained at the Biological Station or at the Bellevue Hotel. The various tanks are intended to be illustrative of the marine life of the Isle of Man. It is intended also that short lectures on the subject should be given from time to time by Prof. Herdman, F.R.S., the Hon. Director of the Station, or by other members of the Committee.

Applications to be allowed to work at the Biological Station, or for specimens (living or preserved) for Museums, Laboratory work, and Aquaria, should be addressed to Professor Herdman, F.R.S., University College, Liverpool.

Subscriptions and donations should be sent to Mr. I. C. Thompson, F.L.S., 19, Waverley Road, Liverpool.

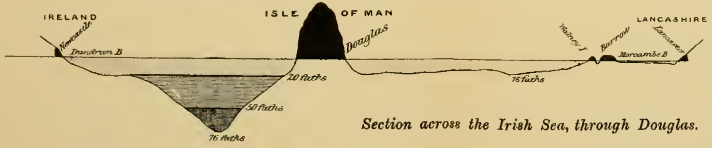
The L.M.B. Committee are publishing their Reports upon the Fauna and Flora of Liverpool Bay in a series of 8vo volumes at intervals of about three years. Of these there have appeared :—

Vol. I. (372 pp., 12 plates), 1886, price 8/6.
Vol. II. (240 pp., 12 plates), 1889, price 7/6.
Vol. III. (400 pp., 24 plates), 1892, price 10/6.

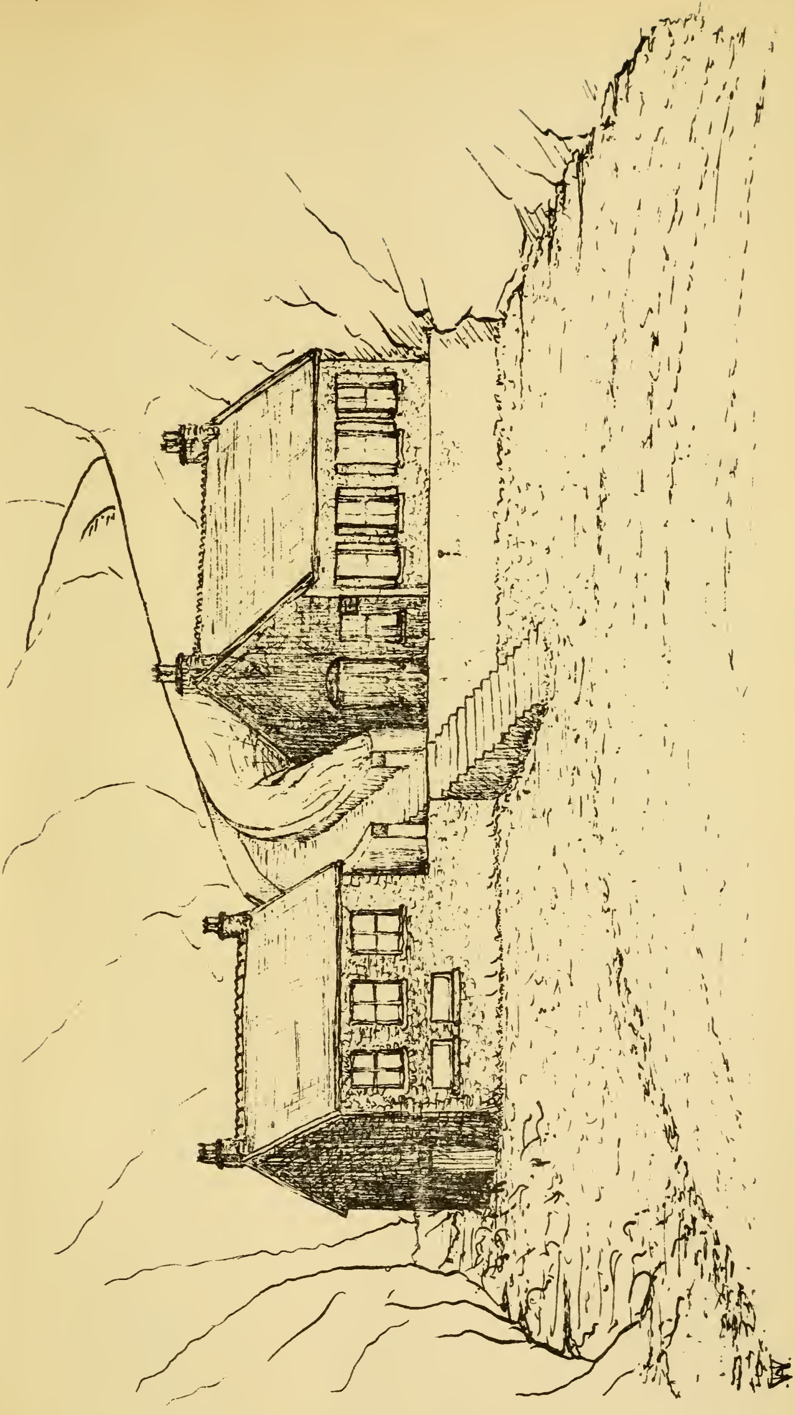
Copies of these may be ordered from the Liverpool Marine Biology Committee, University College, Liverpool, or from the Hon. Sec., 4, Lord Street, Liverpool.

ISAAC C. THOMPSON,
Hon. Sec. and Treas.

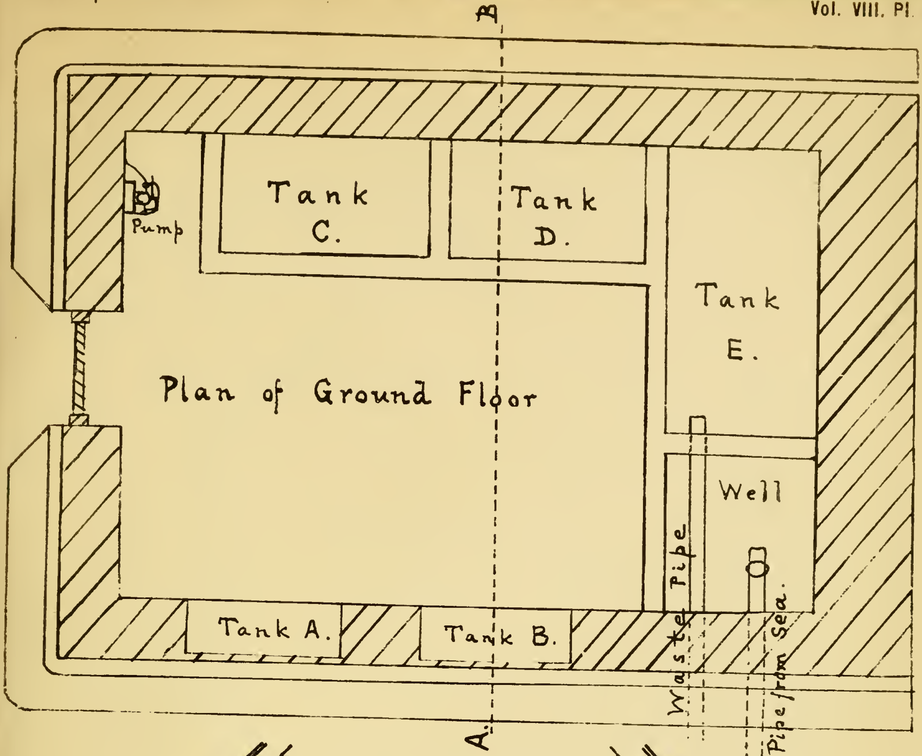
Chart showing the area under investigation.

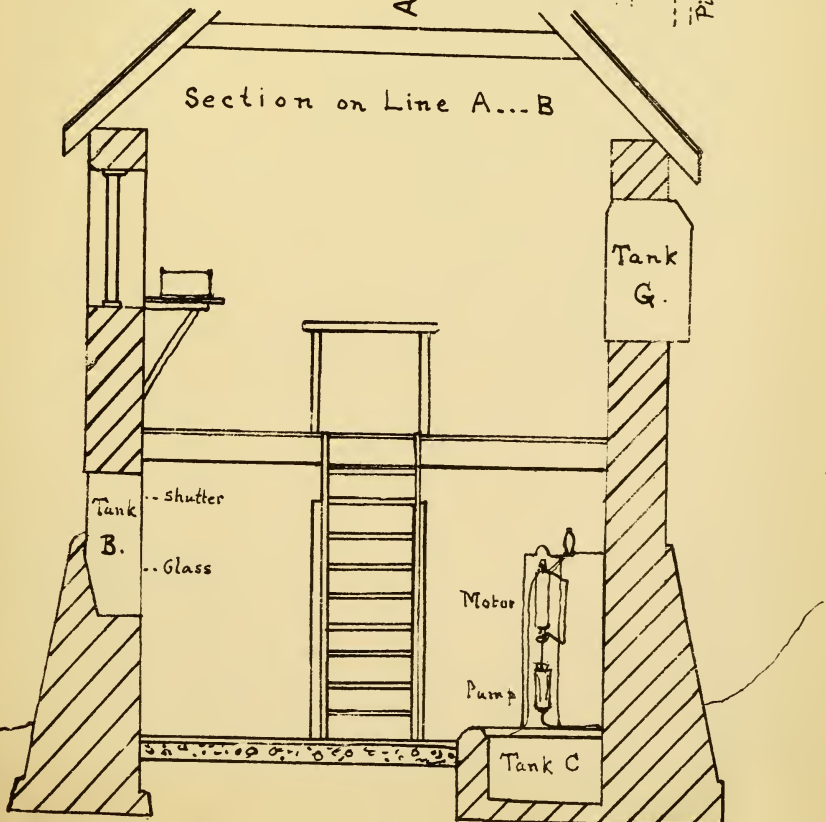


Section across the Irish Sea, through Douglas.

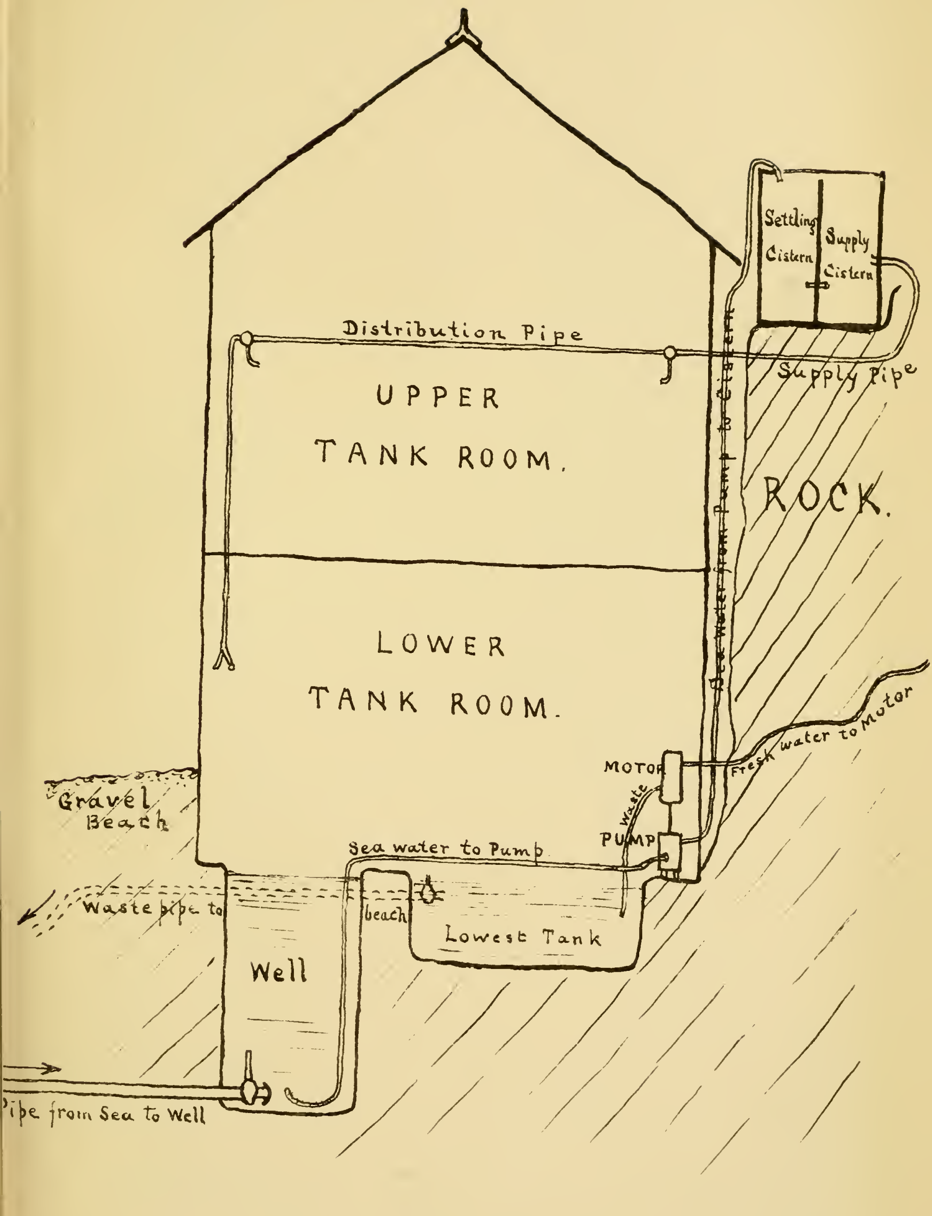


BIOLOGICAL STATION AND AQUARIUM AT PORT ERIN

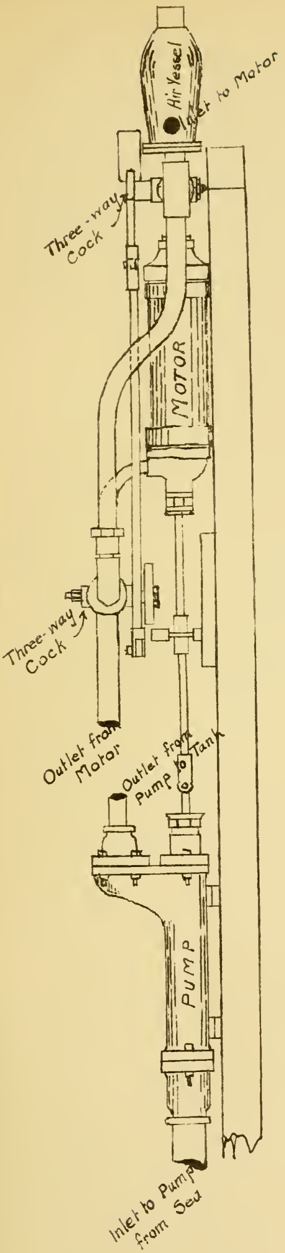

B
Tank C.
Tank D.
Pump
Tank E.
Plan of Ground Floor
Well
Waste Pipe
Pipe from Sea.
Tank A.
Tank B.
A.


Section on Line A...B
Tank G.
Tank B.
Shutter
Glass
Motor
Pump
Tank C

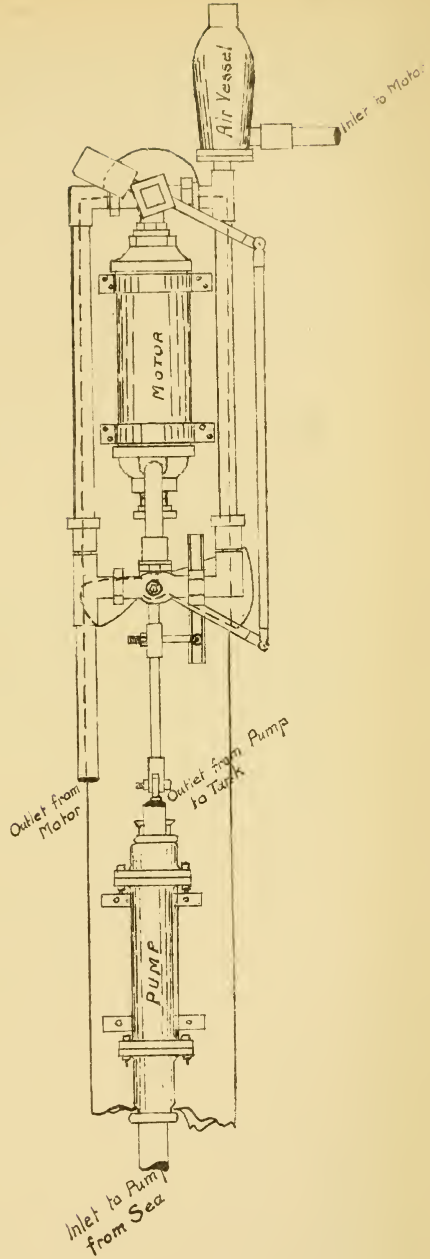
W.H., del.



L.M.B.C. AQUARIUM–PIPES.



SIDE ELEVATION.



FRONT ELEVATION.

/.H., May, 1893

AUTOMATIC PUMP AT PORT ERIN.

Explanation of the Plates.

Plate I. Chart showing the area of the Irish Sea under investigation, and a section across the Irish Sea, through Douglas (this plate is from the report to the British Association at the Nottingham Meeting).

Plate II. Sketch of the Biological Station and Aquarium at Port Erin.

Plate III. Plan and Section of the Aquarium house, as arranged by Mr. G. W. Herdman, B.Sc.

Plate IV. Diagram of the arrangement of the pipes in the Aquarium House.

Plate V. The automatic pump at Port Erin, arranged by G. W. Herdman, B.Sc.

[WORK FROM THE PORT ERIN BIOLOGICAL STATION.]

REPORT upon the NEMERTINES found in the neighbourhood of PORT ERIN, ISLE OF MAN.

By J. Henry Vanstone and W. I. Beaumont.

[Read January 26th, 1894.]

In the first volume of the "Fauna of Liverpool Bay," several species of Nemertines were recorded for the district, but since that time no additions have been made to this division of the Fauna of the Irish Sea. In the present list are noted those genera and species which have come under our notice, during the spring and summer of this year, at Port Erin and in its immediate neighbourhood. The list is far from being a complete one, and there is no doubt that this interesting class of worms will be found to be well represented on the Manx coast.

The habitat of the group is varied. Some, like *Nemertes neesii*, are found under stones at high tide mark, others only at mid and low tide among the tufts of *Corallina officinalis*, while others again love the deeper waters and are only captured by means of the dredge. On the east shore of the Calf Island is a group of rocks ("The Clets,") forming at low water an excellent hunting ground for many marine animals, and especially in respect to the Nemertines, which abound there in the masses of *Crisia* and *Tubularia*.

Owing to their great power of contractility, these worms are difficult to kill in an extended and normal condition. Authors have recommended various methods, such as the use of corrosive sublimate or chloral hydrate, but the results obtained are very uncertain. A one per cent solution of cocain, however, answers well in most cases, and in the absence of this drug, a saturated solution of ferrous sulphate may be used. The worms are dropped into the solution and in about ten minutes will be found thoroughly anæsthetised in an extended condition without any extrusion of the proboscis. They are then transferred, through 50 % and 70 %, to 90 % alcohol.

Order I.—PROTONEMERTINI, Bürger.

Family CARINELLIDÆ.

Carinella annulata, Montagu.

Under this species must be placed a nemertine recorded in Report I, and again in the Sixth Annual Report, as *C. linearis*. It is described as being "of a brick-red colour with white bands," and these are the characters of *C. annulata*, and not of *C. linearis* which is pure milk-white without any bands. This species has been dredged in 23 fathoms, S.E. of Port St. Mary, and in 20 fathoms, W. of Fleshwick Bay. A specimen about 3 cm. long, coloured in the manner characteristic of this species, was found in July, 1892, under a stone at low tide at Port St. Mary by Mr. Beaumont.

Order II.—MESONEMERTINI, Bürger.

Family CEPHALOTHRICIDÆ, M'Intosh.

Cephalothrix bioculata, Oersted.

Several specimens were taken during August in the coralline pools between Traie Vane and Traie Veg to the north of the Biological Station. The average length was about one centimetre. The colour in each case was of a pale orange with the characteristic reddish snout.

Order III.—METANEMERTINI, Bürger.

Family AMPHIPORIDÆ, Hubrecht.

Amphiporus lactifloreus, M'Intosh.

Average length, 5 centimetres. Colour creamy white with conspicuous red brain. This species is very abundant in the shingle under Ulva-covered stones, a short distance from the Laboratory, and is generally associated with *Lineus obscurus* and the Oligochaete *Clitellio arenarius*. On being placed in a dish of sea-water with some sand and shingle, *A. lactifloreus* forms a sandy mucous tube which lies on the top of the shingle. Mr. Beaumont also found this species under stones on the limestone reefs at Poyllvaaish in Bay-ny-Carrickey.

Amphiporus pulcher (?), O. F. Müller. Oersted.

A specimen about 1½ inch long dredged in 10 fathoms, S.E of Kitterland (between Spanish Head and the Burrow), on April 1st, 1893, was doubtfully referred at the time to this species.*

Family TETRASTEMMIDÆ, Hubrecht.

Tetrastemma dorsale, Abildgaard.

Average length 3 cm. Colour brown, with yellow median dorsal line and transverse bands. Found in the laminarian zone on the destroyed breakwater and on the north side of the Bay. The easily recognised reddish brown speckled variety of this species occurred plentifully last year in dishes containing material dredged in the vicinity of Port Erin.

Tetrastemma nigrum, Riches.

Average length 9 mm. Found on *Codium* in a mid-tide pool at Traie Veg, Port Erin Bay. The body is rounded, and the head, in this species, not well defined. The colour on the ventral surface is yellow, while the dorsal surface is quite black.

* In the absence of information as to the structure of the proboscis and the position of the side organs of this specimen it is impossible to determine whether it should be referred to *Amphiporus pulcher*, or to the recently described species *Amphiporus dissimulans*, Riches (Jour. of Mar. Biol. Ass., Vol. II, new series, p. 10).

Tetrastemma immutabile, Riches.

Average length 5 mm. Found among the masses of zoophytes at "The Clets." The body is rounded and of a pale yellow with a dark brown dorsal band running the whole length of the body.

Tetrastemma candidum, O. F. Müller.

Average length 1 cm. Fairly common in Port Erin Bay. The colour-varieties met with are the pale yellow and the yellowish green. Some examples had well developed gonads in April.

Tetrastemma melanocephalum, Johnston.

Mr. Beaumont obtained a specimen from Poyllvaaish in April, and Mr. Vanstone has since collected several of a green variety in the coralline pools near Spaldrick Bay, Port Erin. This variety was 5 cm. in length, and lived for several weeks in captivity.

Tetrastemma vermiculatum, De Quatrefages.

Average length, 2 cm. Found at "The Clets" among tufts of *Crisia eburnea*. The colour was pale orange with a white dorsal line. The anterior and posterior eyes on either side were united by a band of dark pigment.

Tetrastemma robertianæ, M'Intosh.

Length, 2 cm. One specimen was found during July, 1893, in company with *Amphiporus lactifloreus*. The yellowish body bears on its upper surface a median white line and two lateral brown stripes, which take their origin in a transverse pigment band behind the posterior pair of eyes.

Family NEMERTIDÆ, Hubrecht.

Nemertes neesii, Oersted.

Average length 7—8 cm. This species is very common under stones and amongst gravel, from high to low-water mark on the south side of the Bay, and also at low-water off Traie Veg. The colour is usually brown on the dorsal surface, and flesh coloured on the ventral surface. A very pale variety was obtained from "The Clets," having the dorsum of a flesh tint with scattered brown granules.

Order IV.—HETERONEMERTINI, Bürger.

Family Lineidæ, M'Intosh.

Lineus obscurus, Desor (= *L. gesserensis*, auct.).

Average length 7 cm. This is by far the most abundant species of Nemertine at Port Erin and also at Poyllvaaish, and is found under stones along with *Amphiporus lactifloreus*. The colour varieties met with are the dark olive green and the dark red, with pale ventral surfaces, and the pale green form with red at anterior end as figured by M'Intosh. The head is wider than the body, and the whitish lateral cephalic fissures are very conspicuous. Near the jetty, flesh-coloured and dark green varieties occur averaging in length from 2 to 3 centimetres. *Lineus obscurus* lives well in captivity, seeking the waterline, where it ensheaths itself in a transparent mucous investment. Some individuals had well developed gonads in April.

Lineus longissimus, Sowerby (= *L. marinus*, auct.).

The length varies from a few centimetres to 2 or 3 feet. It is found in low tide pools and in deep water all round the coast. The three pale longitudinal bands on the dorsal surface are usually very distinct, but in an individual from Traie Veg, the dorsum was very black, and the bands hardly noticeable.

Cerebratulus angulatus (?), O. F. Müller.

In April, 1893, a large pale nemertine was dredged off Dalby, depth 25 fathoms. It broke up into many pieces before it was got to the laboratory, but from the description given of its appearance and mode of swimming, it was, most probably, referable to this genus and species.

[WORK FROM THE PORT ERIN BIOLOGICAL STATION.]

SUPPLEMENTARY REPORT upon the HYDROID ZOOPHYTES of the L.M.B.C. DISTRICT.

By Miss Laura Roscoe Thornely.

With Plate IX.

[Read February 9th, 1894.]

Editorial Note.

The first volume of the Fauna of Liverpool Bay, published in 1886, contained a report upon the Hydroida, drawn up by Mr. W. R. Melly, Dr. Sibley Hicks and myself, in which were recorded 63 species. Since then a certain amount of work upon the Zoophytes of the district has been done by Mr. W. J. Halls and by Mr. G. W. Wood, and the additions to our list made by these gentlemen, and by Miss Thornely, have been noted from time to time in the annual reports. But by far the greater part of the work in this group since 1886 has been done by Miss L. R. Thornely who has worked carefully through all the mass of material brought home by the various dredging and other collecting expeditions and has identified and mounted the species new and old. Miss Thornely's work has been carried on to some extent in the Zoological Laboratory of the College, where she has arranged the Hydroida and the Polyzoa in the "Local Collection"; and she has also studied the living material at the Port Erin Biological Station. The success of her work will be seen from the numerous entries in the carefully compiled table of geographical distribution in the district which follows, from the fact that the total number of species has been raised from 63 in 1886 to 87 in 1893, and from the accompanying plate (Pl. IX.)

which records the discovery of several interesting novelties and the transference of a species of *Lafoëa* to another genus (*Calycella pigmæa*).

W.A.H.
Ed., L.M.B.C. Repts.

In the last report on the Hydroid Zoophytes, in 1886, 63 species were recorded as having been found in Liverpool Bay. Two species, *Thuiaria thuja* and *Aglaophenia pennatula*, might have been added from Mr. Charles H. Brown's list given in "The Handbook for Southport," edited by Dr. E. D. McNicoll, 1861.

Since then (1886) four species:—*Tubularia attenuata*, *Campanularia raridentata*, *Halecium muricatum*, and *Sertularella tenella* have been recorded by Mr. G. W. Wood in Volume III of the Fauna of Liverpool Bay; and eighteen I have identified from material sent to me from time to time after dredging trips and shore collections had been made, these are:—*Coryne van-benedeni*, *Hydranthea margarica*, *Bougainvillia ramosa*, *Obelia plicata*, *Campanularia fragilis*, *Gonothyræa gracilis*, *G. hyalina*, *Lafoëa fruticosa*, *Calycella fastigiata*, *C. pigmæa*, *Cuspidella grandis*, *C. costata*, *C. humilis*, *Sertularella gayi*, *S. fusiformis*, *Aglaophenia tubulifera*, *Plumularia frutescens*, and *P. echinulata*. To these the following 12 (*Eudendrium rameum*, *Bimeria vestita*, *Tubularia larynx*, *Obelia geniculata*, *Opercularella lacerata*, *Filellum serpens*, *Diphasia pinaster*, *Thuiaria articulata*, *Aglaophenia myriophyllum*, *Plumularia setacea*, *P. catharina*, and *P. similis*) may be added as new to the L.M.B.C. although they have already been reported in "Fauna" Vol. I., as having been found in the district by earlier collectors. This makes 36 additional species in all (and there is also the variety *Lafoea dumosa* var. *robusta*) which are new to us since 1886, and so the total record is now brought up to 87 species and 1 variety.

I have arranged these in the following table so as to show their distribution in the district, as has been done in previous reports on other groups, so that here I need only mention those that seem to call for special remark.

In the first place, we have found several that are rare:—two species *Hydranthea margarica*, (found growing on *Flustra foliacea*, the habitat which Hincks gives), and *Campanularia fragilis*, have only been found at Ilfracombe before; two others *Obelia plicata* and *Gonothyræa hyalina* are only known from the Shetland Islands; *Calycella pigmæa*, only at Tynemouth, and *Gonothyræa gracilis*, only at Connemara; while several have only been found before in the South, such as *Bougainvillea muscus* (Torquay) *Campanularia raridentata* (Swanage, Brixham, Torquay), *Plumularia setacea* (Cornwall), and *Campanularia caliculata* (Ramsgate, Cork).

Secondly, the following species have presented some noteworthy points of structure, or have shown some previously unrecorded character :—

Obelia geniculata, Linnaeus.

Specimens of this luxuriantly branched (Hincks says they are sometimes sparingly branched) were found lately at the Isle of Man. The branches, or in their place, two extra pedicels, bearing calycles, rise from the axils of the ordinary pedicels. Tendrils like those on *Campanularia angulata* were fairly common on these specimens, as I have also seen them on *Campanularia flexuosa* and *Obelia plicata*.

Gonothyræa hyalina, Hincks (Pl. IX, fig. 1).

This species has not been recorded by us until now, as although I have examined a good many specimens of it I have always wanted to see more before saying that I believed it to be a *Gonothyræa*, which Hincks only thought probable from the shape of the gonotheca. I have now found one specimen with gonothecæ bearing extra-capsular medusæform sporosacs, the character distinguishing the genus *Gonothyræa*, thus placing the matter beyond doubt. These specimens are all more the height of *G. lovéni*, but the number and shape of the castellations round the rim of the calycle do not accord with those of that commoner form.

Calycella pigmæa, Alder (Pl. IX, fig. 2).

In this species, lately transferred from the genus *Lafoea* to that of *Calycella*, as I found it to have an operculum which the *Lafoeas* have not, I have now found gonothecæ, which are said to be unknown by Hincks. They many of them bear extra-capsular gonophores which resemble, as does the whole colony, those of *Calycella syringa* in miniature.

Calycella syringa, Linn. (Pl. IX, figs. 3 and 4).

Hincks speaks of a sheath covering, as I understand, the calycle of old specimens of *Calycella syringa*, and having a serrated border which stands above and around the operculum. I have seen this (as in fig. 4), and also in some cases several series of these castellations encircling the calycle one below another at varying distances apart (as in fig. 3). In some cases I have seen three such sets of castellations. I think it possible that these are really old, worn-out opercula, new ones having developed inside them. Lengthening of the calycle by growth would carry these up. The single sheath with a serrated border (fig. 4) would be the first stage.

Filellum serpens, Hassall (Pl. IX, fig. 5).

Most of our specimens of this form have a chitinous crust in which the creeping stem is immersed, (fig. 5). Professor Sir Wyville Thomson speaks of this, but Hincks could not find it. One of our specimens creeping over an ascidian, however, is without this crust.

Halecium tenellum, Hincks (Pl. IX, figs. 6 and 7).

Hincks speaks of the gonothecæ of this species being borne on the side of the calycle. I have found them so (see fig. 7) and on the stolon, but also and most frequently protruding from hydrothecæ in place of polypes, (as shown in fig. 6).

Plumularia echinulata, Lamarck (Pl. IX, figs. 8, 9 & 10).

I have hesitated over the specimens finally placed under this name. They have the internodes of the stem narrowing towards the base (see fig. 8), the right number of nematophores in well preserved specimens, and other characters of *P. echinulata*, but they have also, as in *P. similis*, the branchlets set forward on the stem, never less than two joints between the calycles (fig. 8), and the gonothecæ often without spines (fig. 10), and obscurely lobed; even when spinose (fig. 9) they are always more the shape of Hinck's figures of *P. similis* than of those of *P. echinulata*.

Table showing the distribution of the species of zoophytes in the L.M.B.C. District.	Lancashire Coast, Barrow to Crosby.	Mersey Estuary.	Hilbre Island & Cheshire Coast.	Welsh Coast, Rhyl to Penmaenmawr	Puffin Island, Menai Straits and Anglesea.	Isle of Man.	Central Area.
Clava multicornis		×	×			×	
C. leptostyla	×						
Hydractinia echinata	×	×	×	×			
Coryne van-benedeni					×	×	×
C. pusilla		×	×		×	×	
Eudendrium rameum	×	×			×		×
E. ramosum	×	×			×	×	×
E. capillare				×	×	×	×
Hydranthea margarica							×

TABLE SHOWING THE DISTRIBUTION OF THE SPECIES OF ZOOPHYTES IN THE L.M.B.C. DISTRICT.	Lancashire Coast, Barrow to Crosby.	Mersey Estuary.	Hilbre Island & Cheshire Coast.	Welsh Coast, Rhyl to Penmaenmawr	Puffin Island, Menai Straits and Anglesea.	Isle of Man.	Central Area.
Garveia nutans	×		×	×	×		
Bimeria vestita	×						×
Bougainvillia muscus			×			×	×
B. ramosa		×			×		
Tubularia indivisa	×	×	×	×	×	×	×
T. coronata	×	×	×			×	
T. attenuata						×	
T. simplex						×	
T. britannica					×		
Tubularia larynx	×					×	
Ectopleura dumortierii						×	
Corymorpha nutans		×				×	
Clytia johnstoni		×	×		×	×	×
Obelia geniculata	×	×	×		×	×	×
O. gelatinosa	×	×	×		×	×	
O. longissima		×	×	×	×	×	×
O. dichotoma	×	×	×	×	×	×	×
O. plicata		×	×		×	×	
O. flabellata			×	×	×	×	
Campanularia volubilis.........	×	×	×		×	×	×
C. hincksii		×			×	×	×
C. fragilis						×	
C. caliculata						×	
C. verticillata	×	×	×		×	×	×
C. flexuosa		×			×	×	×
C. angulata					×	×	
C. neglecta..........				×	×	×	
C. raridentata						×	
Gonothyræa lovèni			×		×	×	
G. gracilis					×	×	×
G. hyalina					×	×	
Opercularella lacerata		×			×	×	×
Lafoea dumosa	×	×	×	×	×	×	×
do., var. *robusta*						×	
L. fruticosa..................						×	

TABLE SHOWING THE DISTRIBUTION OF THE SPECIES OF ZOOPHYTES IN THE L.M.B.C. DISTRICT.	Lancashire Coast, Barrow to Crosby.	Mersey Estuary.	Hilbre Island & Cheshire Coast.	Welsh Coast, Rhyl to Penmaenmawr	Puffin Island, Menai Straits and Anglesea.	Isle of Man.	Central Area.
Calycella syringa	×	×	×		×	×	×
C. fastigiata...............						×	×
C. pigmæa..................						×	
Cuspidella grandis						×	
C. costata						×	
C. humilis				×	×	×	
Filellum serpens		×	×		×	×	×
Coppinia arcta		×	×	×	×	×	×
Halecium halecinum............	×	×	×	×	×	×	×
H. beanii	×	×	×		×	×	×
H. tenellum	×				×	×	×
H. muricatum						×	
Sertularella polyzonias	×	×	×	×	×	×	×
S. rugosa		×	×		×	×	×
S. gayi							×
S. tenella						×	
S. fusiformis						×	
Diphasia rosacea	×	×	×		×	×	×
D. attenuata			×		×	×	×
D. pinaster		×			×	×	
D. tamarisca	×		×		×	×	×
D. fallax	×			×			
Sertularia pumila		×	×	×	×	×	
S. gracilis					×		
S. operculata	×	×	×		×	×	×
S. filicula	×	×	×			×	×
S. abietina	×	×	×	×	×	×	×
S. argentea	×	×	×		×	×	×
S. cupressina............	×	×	×		×	×	×
Hydrallmania falcata	×	×	×	×	×	×	×
Thuiaria articulata		×	×			×	×
T. thuia	×						
Antennularia antennina	×	×	×		×	×	×
A. ramosa	×	×	×		×	×	×

TABLE SHOWING THE DISTRIBUTION OF THE SPECIES OF ZOOPHYTES IN THE L.M.B.C. DISTRICT.	Lancashire Coast, Barrow to Crosby.	Mersey Estuary.	Hilbre Island & Cheshire Coast.	Welsh Coast, Rhyl to Penmaenmawr	Puffin Island, Menai Straits and Anglesea.	Isle of Man.	Central Area.
Aglaophenia pluma	×	×		×	×	×	
A. myriophyllum ...	×	×				×	×
A. tubulifera					×	×	×
A. pennatula	×						
Plumularia pinnata						×	
P. frutescens	×						×
P. setacea	×	×	×		×	×	×
P. catharina					×	×	
P. echinulata					×	×	
P. similis						×	×

EXPLANATION OF PLATE IX.

Fig. 1. *Gonothyraea hyalina*, showing extra-capsular gonophores on the gonotheca, and castellations on the hydrotheca.

Fig. 2. *Calycella pigmaea*, showing operculum and gonophore.

Fig. 3. *Calycella syringa*, with double row of castellations.

Fig. 4. *Calycella syringa*, showing the castellations as Hincks describes them.

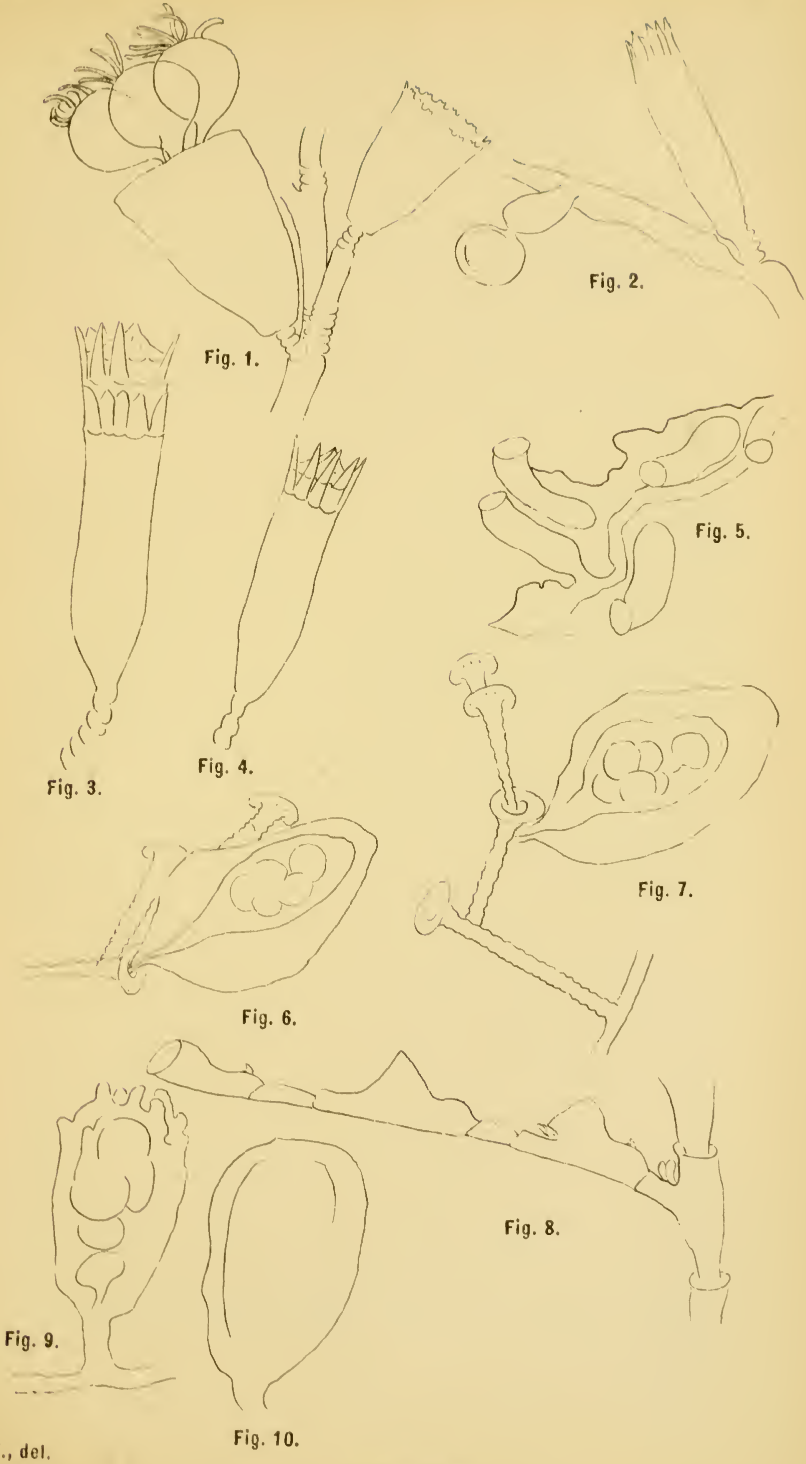
Fig. 5. *Filellum serpens*, hydrothecæ and stolon embedded in a chitinous crust.

Fig. 6. *Halecium tenellum*, with gonotheca protruding from orifice of hydrotheca.

Fig. 7. *Halecium tenellum*, with gonotheca growing on side of hydrotheca.

Fig. 8. *Plumularia echinulata*, showing two joints between the hydrothecæ, and other characters.

Figs. 9 and 10. *Plumularia echinulata*, spinose and plain gonothecæ.



L. R. T., del.

HYDROIDA.

[From Trans. Biol. Soc. L'pool. Vol. VIII.]

REVISION of the GENERIC NOMENCLATURE and CLASSIFICATION in Bowerbank's "BRITISH SPONGIADÆ."

By R. Hanitsch, Ph.D.,
DEMONSTRATOR OF ZOOLOGY IN UNIVERSITY COLLEGE, LIVERPOOL.

[Read 11th May, 1894.]

No Spongologist is likely to expect an apology for the present paper. Whilst the faithfulness of the illustrations and the correctness—in general—of the descriptive part in Bowerbank's "British Spongiadæ" is such that this Monograph will remain indispensable to students for time to come, yet his generic nomenclature and classification are incomprehensible and have never been accepted. What Bowerbank understood by a genus will remain a mystery. One out of numerous instances is sufficient: his genus *Hymeniacidon* has had to be broken up into no less than fifteen different genera, including amongst them the following: *Halichondria*, *Esperella*, *Clathria*, *Suberites*, *Dercitus* and perhaps even *Halisarca*.

Therefore I have made an attempt in this paper to assign all species described in Bowerbank's Monograph to their proper genera, as the latter are accepted at present, thus continuing and supplementing what Oscar Schmidt (*15*, p. 76) began in 1870. Whilst thus I shall be responsible for the correctness of the generic names, I do not wish to be equally so for the specific names. Many of Bowerbank's species will, in time to come, be found synonymous with others described by himself or by other authors. This, I think, applies chiefly to the still numerous species of *Halichondria*, *Reniera* and *Hymeniacidon*.

But only he who is fortunate enough to have access to the type specimens can attempt to revise the specific nomenclature, and, even then, his success may be doubtful, as so many of the type specimens are preserved in the dried condition.

This paper consists of two parts, the first containing the revision of the generic nomenclature. It is meant to be used with the plates in the third and fourth volumes of the Monograph. The left of the two columns gives Bowerbank's nomenclature, the right the revised nomenclature, beginning with the first plate in the third volume and ending with the last plate in the fourth volume. The numbers of the plates in the third volume are simply indicated by Roman numbers, but those in the fourth volume by Roman numbers preceded by "4."

The second part of the paper contains the classified list of all species described by Bowerbank, with their revised generic names only. References to the plates in the two volumes are given in each case, so that, by referring back to the first part of the present paper, the old name is easily ascertained. In many cases references are added to other works in which Bowerbank's species have been redescribed, or which otherwise bear upon the subject.

I have thought it useful to give the generic definitions of all Monaxonida, because they have been compiled from various authors. I have to acknowledge my indebtedness to Ridley and Dendy's "Challenger" Report (*14*) and perhaps still more to Topsent's recent writings (*18*, *19*, *20*). Many of the generic definitions are literally, or almost so, copied from those sources. Thus also the classification of Halichondrina is taken from Topsent's latest paper (*20*). Valuable aid was also obtained from von Lendenfeld (*11*, *13*) and Vosmaer's works (*22*).

But I have not deemed it necessary to give the generic definitions in the other groups of Sponges, as for the Calcarea I have exclusively followed Dendy (*2*, *3*, *4*), for the Tetractinellida, Sollas (*17*), and for the Hexaceratina and Monoceratina, von Lendenfeld (*12*). The definitions of the genera of these groups will be found in the works of these respective authors.

PART I.

	Bowerbank's Nomenclature.	Revised Nomenclature.
Pl. I.	Grantia compressa	Sycon compressum, auctt.
II.	Grantia ciliata	Sycon coronatum, E. & S.
	Grantia ensata	Ute glabra, O.S.
	Grantia tessellata	Sycon elegans, B.
III.	Leucosolenia botryoides	Leucosolenia botryoides, E. & S.
	Leucosolenia contorta	Leucosolenia contorta, B.
	Leucosolenia coriacea	Leucosolenia coriacea, Fl.
IV.	Leucosolenia lacunosa	Leucosolenia lacunosa, Johnst.
V.	Leuconia nivea	Leucandra nivea, Grant.
	Leuconia fistulosa	Leucandra fistulosa, Johnst.
VI.	Leuconia pumila	Leucandra pumila, B.
	Leucogypsia Gossei	Leucandra gossei, B.
VII.	Geodia Zetlandica	Cydonium mülleri, Fleming.
VIII.	Pachymatisma Johnstonia	Pachymatisma johnstonia, B.
	Ecionemia ponderosa	Stryphnus ponderosus, B.
IX.	Ecionemia compressa	Pœcillastra compressa, B.
	Polymastia ornata	Polymastia ornata, B.
X.	Polymastia bulbosa	Polymastia bulbosa, B.
	Polymastia robusta	Polymastia robusta, B.
XI.	Polymastia brevis	Quasillina brevis, B.
	Polymastia spinula	Polymastia spinula, B.
	Polymastia radiosa	Polymastia radiosa, B.
XII.	Polymastia mammillaris	Polymastia mammillaris, B.
XIII.	Halyphysema ramulosa	(no sponge).
	Ciocalypta penicillus	Ciocalypta penicillus, B.
XIV.	Tethea cranium	Craniella cranium, auctt.
	Isodictya infundibuliformis	Tragosia infundibuliformis, J.
XV.	Tethea Collingsii	Stelletta collingsi, B.
	Tethea Schmidtii	Stelletta collingsi, B.

	Tethea Lyncurium	Tethya lyncurium, Lin.
	Tethea spinularia	? Polymastia spinularia, B.
	Halicnemia patera	Halicnemia patera, B.
XVI.	Dictyocylindrus ventilabrum	Raspailia ventilabrum, B.
	Dictyocylindrus ramosus	Raspailia ramosa, Mont.
XVII.	Dictyocylindrus hispidus	Raspailia hispida, Mont.
XVIII.	Dictyocylindrus fascicularis	Axinella fascicularis, B.
XIX.	Dictyocylindrus stuposus	Axinella stuposa, Mont.
	Dictyocylindrus Howsei	Raspailia howsei, B.
	Dictyocylindrus virgultosa	Raspailia virgultosa, B.
	Dictyocylindrus pumilus	Raspailia pumila, B.
XX.	Dictyocylindrus rugosus	Axinella rugosa, B.
	Dictyocylindrus radiosus	Raspailia radiosa, B.
XXI.	Dictyocylindrus pumilus	Raspailia pumila, B.
	Dictyocylindrus aculeatus	Raspailia aculeata, B.
	Phakellia robusta	Phakellia robusta, B.
XXII.	Phakellia ventilabrum	Phakellia ventilabrum, Johnst.
XXIII.	Microciona fictitia	Plumohalichondria fictitia, B.
	Microciona lævis	Microciona lævis, B.
	Microciona fallax	Microciona fallax, B.
	Microciona armata	Microciona armata, B.
XXIV.	Microciona spinulenta	Pocillon spinulentum, B.
	Microciona plumosa	Stylostichon plumosum, Mont.
	Microciona atrasanguinea	Microciona atrasanguinea, B.
XXV.	Microciona ambigua	Stylostichon ambiguum, B.
XXVI.	Hymeraphia vermiculata	Axinella vermiculata, B.
	Hymeraphia clavata	Hymeraphia clavata, B.
XXVII.	Hymeraphia verticillata	Hymeraphia verticillata, B.
	Hymeraphia stellifera	Acarnus stelliferus, B.
XXVIII.	Hymedesmia radiata	Hymeraphia radiata, B.
	Hymedesmia stellata	Hymedesmia stellata, B.
XXIX.	Hymedesmia Zetlandica	Clathrissa zetlandica, B.
	Hymedesmia radiata	Hymeraphia radiata, B.
XXX.	Hymeniacidon Thomasii	Halichondria thomasi, B.
	Hymeniacidon coccinea	Halichondria coccinea, B.
	Hymeniacidon Brettii	Halichondria bretti, B.
	Hymeniacidon fragilis	Halichondria fragilis, B.
XXXI.	Hymeniacidon reticulatus	Halichondria reticulata, B.
	Hymeniacidon fallaciosus	Halichondria fallaciosa, B.
	Hymeniacidon albescens	Halichondria albescens, J.
	Hymeniacidon perarmatus	Clathrissa perarmata, B.
XXXII.	Hymeniacidon caruncula	Hymeniacidon carunculum, B.

	Hymeniacidon sanguinea	Hymeniacidon sanguineum, G.
	Hymeniacidon lactea	Halichondria lactea, B.
	Hymeniacidon membrana	Halichondria membrana, B.
XXXIII.	Hymeniacidon mammeata	Hymeniacidon mammeatum, B.
	Hymeniacidon consimilis	Hymeniacidon consimile, B.
	Hymeniacidon macilenta	Esperella macilenta, B.
	Hymeniacidon variantia	Desmacella variantia, B.
	Hymeniacidon fallax	Hymeniacidon fallax, B.
	Hymeniacidon viridans	Hymeniacidon viridans, B.
XXXIV.	Hymeniacidon perlevis	Hymeniacidon perleve, M.
	Hymeniacidon crustula	Suberites crustula, B.
	Hymeniacidon aurea	Hymeniacidon aureum, M.
	Hymeniacidon pachyderma	Hymeniacidon pachydermum, B.
	Hymeniacidon armatura	Spanioplon armaturum, B.
XXXV.	Hymeniacidon virgultosa	Suberites virgultosus, J.
XXXVI.	Hymeniacidon suberea	Suberites domuncula, Olivi.
	Hymeniacidon carnosa	Suberites carnosus, J.
	Hymeniacidon ficus	Suberites ficus, J.
XXXVII.	Hymeniacidon sulphurea	Suberites sulphureus, Bean.
	Hymeniacidon paupertas	Hymeraphia paupertas, B.
	Hymeniacidon subclavata	Esperella subclavata, B.
	Raphiodesma floreum	Esperella florea, B.
	Hymeniacidon clavigera	Clathria clavigera, B.
XXXVIII.	Hymeniacidon Dujardinii	Dendoryx dujardini, B.
	Hymeniacidon celata	Cliona celata, Grant.
	Hymeniacidon gelatinosa	? Hymeniacidon gelatinosum, B.
	Hymeniacidon Bucklandi	Dercitus bucklandi, B.
XXXIX.	Halichondria panicea	Halichondria panicea, Pallas.
XL.	Halichondria panicea	Halichondria panicea, Pallas.
XLI.	Halichondria glabra	Halichondria glabra, B.
	Halichondria augulata	Gellius angulatus, B.
	Halichondria caduca	Halichondria caduca, B.
	Halichondria inconspicua	Halichondria inconspicua, B.
	Halichondria incerta	Halichondria incerta, B.
	Halichondria coalita	Halichondria coalita, Gr.
XLII.	Halichondria distorta	Halichondria distorta, B.
XLIII.	Halichondria corrugata	Biemma corrugata, B.
	Halichondria forcipis	Forcepia forcipis, B.
	Halichondria subdola	Axinella subdola, B.
XLIV.	Halichondria Thompsoni	Esperiopsis thompsoni, B.
	Isodictya simplex	Reniera simplex, B.
	Halichondria incrustans	Dendoryx incrustans, Esper.

	Halichondria candida	Dendoryx candida, B
	Halichondria irregularis	Myxilla irregularis, B.
XLV.	Halichondria Dickiei	Dendoryx dickiei, B.
	Halichondria granulata	Myxilla granulata, B.
	Halichondria scandens	Pocillon scandens, B.
	Halichondria albula	Yvesia albula, B.
	Halichondria nigricans	Iophon nigricans, B.
	Hymeniacidon variantia	Desmacella variantia, B.
XLVI.	Halichondria Pattersoni	Dendoryx pattersoni, B.
	Halichondria Hyndmani	Pocillon hyndmani. B.
	Halichondria pulchella	Dendoryx pulchella, B.
	Halichondria Ingalli	Dendoryx ingalli, B.
	Halichondria Batei	Dendoryx batei, B.
XLVII.	Halichondria inornatus	Biemma inornata, B.
	Halichondria simplex	Hymeniacidon simplex, B.
	Raphiodesma lingua	Esperella lingua, B.
XLVIII.	Isodictya cinerea	Reniera cinerea, Grant.
	Isodictya Peachii	Reniera peachi, B.
	Isodictya permollis	Reniera permollis, B.
	Isodictya simulo	Reniera bowerbanki, Norman.
	Isodictya varians	Reniera varians, B.
XLIX.	Isodictya elegans	Reniera elegans, B.
	Isodictya parasitica	Reniera parasitica, B.
	Isodictya Mcandrewii	Reniera macandrewi, B.
	Isodictya rosea	Reniera rosea, B.
	Isodictya indefinita	Reniera indefinita, B.
L.	Isodictya anomala	Reniera anomala, B.
	Isodictya densa	Reniera densa, B.
	Isodictya pallida	Reniera pallida, B.
	Isodictya jugosa	Gellius jugosus, B.
	Isodictya Gregorii	Reniera gregori, B.
	Isodictya simplex	Reniera simplex, B.
LI.	Isodictya indistincta	Reniera indistincta, B.
	Isodictya simulans	Reniera simulans, Johnst.
	Isodictya mammeata	Reniera mammeata, B.
	Isodictya fallax	Gellius fallax, B.
LII.	Isodictya palmata	Homœodictya palmata, Johnst.
LIII.	Isodictya ramusculus	Reniera ramuscula, B.
	Isodictya pocillum	Reniera pocillum, B.
	Isodictya clava	Reniera clava, B.
	Isodictya dichotoma	Reniera dichotoma, B.
	Isodictya fistulosa	Reniera fistulosa, B.

LIV.	Isodictya infundibuliformis	Tragosia infundibuliformis, J.
LV.	Isodictya dissimilis	Tragosia polypoides, O. S.
	Isodictya paupera	Esperiopsis paupera, B.
	Isodictya uniformis	Stylotella uniformis, B.
LVI.	Isodictya Normani	Esperiopsis normani, B.
	Isodictya pygmea	Reniera pygmea, B.
	Isodictya Clarkei	Esperiopsis clarkei, B.
	Isodictya fucorum	Esperiopsis fucorum, Johnst.
	Isodictya Alderi	Esperiopsis alderi, B.
LVII.	Isodictya Barleei	Tragosia barleei, B.
	Isodictya Beanii	Clathria beani, B.
	Isodictya fimbriata	Dendoryx fimbriata, B.
	Isodictya Edwardii	Esperiopsis edwardi, B.
	Isodictya lobata	Esperella lobata, Mont.
	Isodictya gracilis	Esperiopsis gracilis, B.
	Isodictya lurida	Dendoryx lurida, B.
LIX.	Spongilla fluviatilis	Ephydatia fluviatilis, Pallas.
LX.	Spongilla lacustris	Euspongilla lacustris, auctt.
LXI.	Desmacidon fruticosa	Desmacidon fruticosum, Mont.
LXII.	Desmacidon Jeffreysii	Oceanapia robusta, B.
LXIII.	Desmacidon Peachii	Desmacella peachi, B.
	Desmacidon ægagropila	Esperella ægagropila, Johnst.
LXIV.	Raphyrus Griffithsii	Cliona celata, Grant.
LXV.	Ophlitaspongia seriata	Ophlitaspongia seriata, Grant.
	Spongionella pulchella	Leiosella pulchella, Sowerby.
LXVI.	Chalina oculata	Chalina oculata, Pallas.
LXVII.	Chalina cervicornis	Chalina cervicornis, Pallas.
	Chalina gracilenta	Pachychalina gracilenta, B.
	Chalina limbata	Pachychalina limbata, Mont.
LXVIII.	Chalina Flemingii	Chalina flemingi, B.
	Chalina Montaguii	Pachychalina montagui, Fl.
	Chalina Grantii	Pachychalina granti, B.
LXIX.	Dysidea fragilis	Spongelia fragilis, M. var. irregularis.
LXX.	Ophlitaspongia papilla	Ophlitaspongia papilla, B.
	Halichondria farinaria	Suberites farinarius, B.
	Verongia Zetlandica	Aplysina zetlandica, B.
	Diplodemia vesicula	Diplodemia vesicula, B.
LXXI.	Hymeniacidon foliatus	Suberites foliatus, B.
	Desmacidon constrictus	Esperella constricta, B.
LXXII.	Hymeniacidon firmus	Halichondria firma, B.
	Hymeniacidon radiosa	Hymeniacidon radiosum, B.

	Hymeniacidon placentula	Pœcillastra compressa, B.
	Hymeniacidon plumiger	Hymeniacidon plumigerum, B.
	Polymastia conigera	Polymastia conigera, B.
LXXIII.	Halichondria foliata	Esperiopsis foliata, B.
	Halichondria edusa	Halichondria edusa, B.
	Halichondria regularis	Halichondria regularis, B.
	Halichondria Couchii	Gellius couchi, B.
	Microciona simplicima	Tedania simplicissima, B.
LXXIV.	Halichondria falcula	Hamacantha falcula, B.
	Halichondria mutula	Esperiopsis mutula, B.
	Halichondria expansa	Dendoryx expansa, B.
	Halichondria ambigua	Halichondria ambigua, B.
	Hymeniacidon tegeticula	Halichondria tegeticula, B.
LXXV.	Isodictya laciniosa	Clathria laciniosa, B.
LXXVI.	Isodictya obscura	Reniera obscura, B.
	Isodictya imitata	Esperiopsis imitata, B.
	Isodictya coriacea	Plocamia coriacea, B.
	Raphiodesma sordida	Esperella sordida, B.
LXXVII.	Raphiodesma lingua	Esperella lingua, B.
LXXVIII.	Isodictya Ingalli	Reniera ingalli, B.
	Desmacidon columella	Stylotella columella, B.
LXXIX.	Hymeraphia coronula	Hymeraphia coronula, B.
	Hymedesmia inflata	Pytheas inflatus, B.
	Hymedesmia occulta	Desmacidon occultum, B.
LXXX.	Hymedesmia simplicima	Suberites simplicissimus, B.
	Hymeraphia simplex	Hymeraphia simplex, B.
LXXXI.	Normania crassa	Pœcillastra compressa, B.
LXXXII.	Isodictya lurida	Dendoryx lurida, B.
	Desmacidon copiosa	Esperella copiosa, B.
	Desmacidon cavernula	Desmacella cavernula, B.
	Ecionemia coactura	Stelletta coactura, B.
	Microciona fictitia	Plumohalichondria fictitia, B.
LXXXIII.	Microciona jecusculum	Myxilla jecusculum, B.
	Microciona fraudator	Plumohalichondria fraudator, B.
	Chalina inornata	Stylotella inornata, B.
	Tethea spinosa	Lissomyxilla spinosa, B.
	Desmacidon ægagropila	Esperella ægagropila, Johnst.
LXXXIV.	Dictyocylindrus rectangulus	Raspailia rectangula, B.
LXXXV.	Isodictya filamenta	Reniera filamenta, B.
	Isodictya luteosa	Reniera luteosa, B.
	Isodictya invalida	Hymeniacidon invalidum, B.
	Hymeniacidon medius	Hymeniacidon medium, B.

	Desmacidon incognitus	Stylotella incognita, B.
LXXXVI.	Ciocalypta Leei	Ciocalypta penicillus, B.
	Spongilla Parfitti	Ephydatia parfitti, C.
	Spongilla sceptrifera	Ephydatia sceptrifera, B.
LXXXVII.	Hymedesmia indistincta	Hymeraphia indistincta, B.
	Isodictya obscura	Reniera obscura, B.
LXXXVIII.	Isodictya varians	Reniera varians, B.
LXXXIX.	Desmacidon pannosus	Stylotella pannosa, B.
	Isodictya incerta	Reniera incerta, B.
	Tethea cranium	Craniella cranium, auctt.
	Microciona Kentii	Plumohalichondria kenti, B.
	Desmacidon similaris	Esperella similaris, B.
XC.	Raphiodesma simplissima	Stylotella simplicissima, B.
	Isodictya dubia	Esperiopsis dubia, B.
	Desmacidon rotalis	Esperella rotalis, B.
XCI.	Isodictya rugosa	Dendoryx rugosa, B.
	Leuconia Somesii	Leucandra somesi, B.
	Halichondria McIntoshii	Halichondria macintoshi, B.
	Dysidea coriacea	Spongelia fragilis, M. var. irregularis.
XCII.	Isodictya tumulosa	Dendoryx tumulosa, B.
	Battersbyia Bucklandi	Dercitus bucklandi, B.
	Hymeniacidon Aldousii	Hymeniacidon aldousi, B.
4, I.	Hymedesmia pansa	Myxilla pansa, B.
	Hymedesmia tenuicula	Suberites tenuiculus, B.
4, II.	Hymedesmia pilata	Myxilla pilata, B.
	Hymedesmia pulchella	Myxilla pulchella, B.
4, III.	Hymeniacidon Hillieri	Hymeniacidon hillieri, B.
	Hymeniacidon solidus	Halichondria solida, B.
4, IV.	Isodictya scitula	Esperiopsis scitula, B.
	Hymeniacidon virgulatus	Hymeniacidon virgulatum, B.
	Hymeniacidon callosus	Hymeniacidon callosum, B.
	Hymeniacidon armiger	Yvesia armigera, B.
4, V.	Halichondria virgea	Dendoryx virgea, B.
	Halichondria Robertsoni	Dendoryx robertsoni, B.
4, VI.	Halichondria condensa	Halichondria condensa, B.
	Halichondria cylindracea	Desmacidon cylindraceum, B.
4, VII.	Halichondria coralloides	Halichondria coralloides, B.
	Halichondria flabellifera	Lissodendoryx flabellifera, B.
4, VIII.	Isodictya ferula	Reniera ferula, B.
	Isodictya crassa	Reniera crassa, B.
4, IX.	Isodictya scitula	Esperiopsis scitula, B.

	Isodictya perplexa	Reniera perplexa, B.
4, X.	Isodictya involuta	? Hymeniacidon involutum, B.
	Isodictya paupercula	? Desmacidon pauperculum, B.
4, XI.	Microciona tumulosa	Halichondria tumulosa, B.
	Isodictya trunca	Clathrissa trunca, B.
4, XII.	Isodictya hispida	Esperiopsis hispida, B.
	Isodictya nodosa	Hymeniacidon nodosum, B.
4, XIII.	Isodictya pertenuis	Hymeniacidon pertenue, B.
	Hymedesmia Peachii	Myxilla peachi, B.
4, XIV.	Isodictya deformis	Esperiopsis deformis, B.
	Isodictya collina	Esperiopsis collina, B.
4, XV.	Hymeniacidon tenebrosus	Suberites tenebrosus, B.
	Isodictya funalis	Esperiopsis funalis, B.
4, XVI.	Isodictya inæqualis	Dendoryx inæqualis, B.
	Isodictya implicita	Jophon implicitum, B.
4, XVII.	Raphiodesma intermedium	Esperella intermedia, B.
	Raphiodesma fallaciosum	Esperella fallaciosa, B.

PART II.

Classified List of the British Sponges described by Bowerbank.

Phylum PORIFERA.

Class I. CALCAREA, Gray.

1. Order. HOMOCŒLA, Poléjaeff.

Leucosolenia botryoides, Ellis & Sol., III, (Hæckel, *6*, p. 65).

,, *contorta*, B., III, (Hæckel, *6*, p. 91).

,, *coriacea*, Fleming, III, (Hæckel, *6*, p. 24).

,, *lacunosa*, Johnst., IV, (Hæckel, *6*, p. 70).

2. Order. HETEROCŒLA, Poléjaeff.

Sycon compressum, auctt., I, (Hæckel, *6*, p. 360).

,, *coronatum*, Ellis & Sol., II, (Hæckel, *6*, p. 304).

,, *elegans*, B., II, (Hæckel, *6*, p. 338).

Ute glabra, O. Schmidt, II, (Hæckel, *6*, p. 349).

Leucandra fistulosa, Johnst., V, (Hæckel, *6*, p. 197).

,, *gossei*, B., VI, (Hæckel, *6*, p. 177).

Leucandra nivea, Grant, V, (Hæckel, *6*, p. 211).
„ *pumila*, B., VI, (Hæckel, *6*, p. 148).
„ *somesi*, B., XCI.

Class II. SILICEA, Gray.

Sub-class I. TRIAXONIA, Schulze.

1. Order HEXACTINELLIDA, Schmidt.

None.

2. Order HEXACERATINA, Lendenfeld.

Halisarca dujardini, Johnston. (Schulze, *16*.)

NOTE. Bowerbank (see Vol. II, p. 225) never seemed to believe in the existence of *Halisarca dujardini*, as described by Johnston. It is difficult to imagine that B. never met with that sponge. For some time I thought that his *Hymeniacidon dujardini*, XXXVIII and *H. gelatinosa*, XXXVIII might have been certain spiculiferous sponge remains overgrown by *Halisarca*. But since Topsent (*18*, p. 99) describes the former of the two sponges under the name *Dendoryx dujardini*, B., my supposition could be true only with regard to *Hymeniacidon gelatinosa*. Norman enumerates *H. dujardini* in the Appendix to Vol. IV, p. 238.

Sub-class II. TETRAXONIA, Schulze.

a. Order TETRACTINELLIDA, Marshall.

1. Sub-order: CHORISTIDA, Sollas.

Craniella cranium, auctt., XIV and LXXXIX. (Sollas, *17*, p. 51.)

Pœcillastra compressa, B., IX, LXXII and LXXXI. (Sollas, *17*, p. 98.)

Dercitus bucklandi, B., XXXVIII and XCII. (Sollas, *17*, p. 108).

Stelletta coactura, B., LXXXII. (Sollas, *17*, p. 184).
„ *collingsi*, B., XV. (Sollas, *17*, p. 185).

Stryphnus ponderosus, B., VIII. (Sollas, *17*, p. 193).
Pachymatisma johnstonia, B., VIII. (Sollas, *17*, p. 242.)
Cydonium mülleri, Fleming, VII. (Sollas, *17*, p. 254.)

2. Sub-order: LITHISTIDA, O. Schmidt.

None.

b. Order MONAXONIDA, Ridley and Dendy.

With uniaxial megascleres.

1. Sub-order HALICHONDRINA, Vosmaer.

Typically non-corticate; skeleton usually reticulate; megascleres usually either oxea or styli.

Family I. HAPLOSCLERIDÆ, Topsent (*20*).

Skeleton simple; megascleres typically diactinal; microscleres rarely present, never chelæ.

a. Sub-family CHALININÆ, Ridley and Dendy.

Skeleton fibrous. Megascleres oxea or strongyla, completely enveloped by a sheath of spongin. Microscleres, if present, toxa.

Genus *Chalina*, Grant.

Fibres typically with a single axial series of spicules. No microscleres.

Chalina cervicornis, Pallas, LXVII.
,, *flemingi*, B., LXVII.
,, *oculata*, Pallas, LXVI.

Genus *Pachychalina*, O. Schmidt.

Fibres typically with numerous spicules, arranged polyserially. No microscleres.

Pachychalina gracilenta, B., LXVII.
,, *granti*, B., LXVIII.
,, *limbata*, Mont., LXVII. (Grentzenberg, *5*, p. 30.)
,, *montagui*, Fleming, LXVIII. (Hanitsch, *8*, p. 201.)

b. Sub-family RENIERINÆ, Ridley and Dendy.

Skeleton confused or regular. Spongin may be present, but never completely enveloping the spicules. Microscleres rarely present.

Genus *Halichondria*, Fleming.

Skeleton confused, never regularly reticulate. Megascleres oxea or strongyla. Spongin scarcely appreciable. No microscleres.

Halichondria albescens, Johnst., XXXI.
,, *ambigua*, B., LXXIV.
,, *bretti*, B., XXX.
,, *caduca*, B., XLI. (Ridley & Dendy, *14*, p. 3.)
,, *coalita*, Grant, XLI.
,, *coccinea*, B., XXX.
,, *condensa*, B., 4, VI.
,, *coralloides*, B., 4, VII.
,, *distorta*, B., XLII.
,, *edusa*, B., LXXIII.
,, *fallaciosa*, B., XXXI.
,, *firma*, B., LXXII.
,, *fragilis*, B., XXX.
,, *glabra*, B., XLI.
,, *incerta*, B., XLI.
,, *inconspicua*, B., XLI.
,, *lactea*, B., XXXII.
,, *macintoshi*, B., XCI.
,, *membrana*, B., XXXII.
,, *panicea*, Pallas, XXXIX. (Grentzenberg, *5*, p. 11.)
,, *regularis*, B., LXXIII.
,, *reticulata*, B., XXXI.
,, *solida*, B., 4, III.
,, *tegeticula*, B., LXXIV.

Halichondria thomasi, B., XXX.
,, *tumulosa*, B., 4, XI.

Genus *Reniera*, Nardo.

Skeleton composed of definite, rectangular (sometimes triangular or polygonal), typically unispicular meshes. Spicules short oxea or strongyla, usually united together at the ends only by spongin. No microscleres.

NOTE. Some of the spicules of one species, viz., *R. anomala*, are inflated in the centre.

Reniera anomala, B., L.
,, *bowerbanki*, Norman, XLVIII.
,, *cinerea*, Grant, XLVIII.
,, *clava*, B., LIII.
,, *crassa*, B., 4, VIII.
,, *densa*, B., L.
,, *dichotoma*, B., LIII.
,, *elegans*, B., XLIX. (Topsent, *18*, p. 70.)
,, *ferula*, B., 4, VIII.
,, *filamenta*, B., LXXXV.
,, *fistulosa*, B., LIII.
,, *gregori*, B., L.
,, *incerta*, B., LXXXIX.
,, *indefinita*, B., XLIX.
,, *indistincta*, B., LI. (Topsent, *18*, p. 69.)
,, *ingalli*, B., LXXVIII.
,, *luteosa*, B., LXXXV.
,, *mammeata*, B., LI.
,, *macandrewi*, B., XLIX.
,, *obscura*, B., LXXVI and LXXXVII.
,, *pallida*, B., L.
,, *parasitica*, B., XLIX.
,, *peachi*, B., XLVIII.
,, *permollis*, B., XLVIII.
,, *perplexa*, B., 4, IX.

Reniera pocillum, B., LIII.
,, *pygmea*, B., LVI.
,, *ramuscula*, B., LIII.
,, *rosea*, B., XLIX.
,, *simplex*, B., XLIV and L.
,, *simulans*, Johnston, LI.
,, *varians*, B., XLVIII and LXXXVIII.

Genus *Gellius*, Gray.

Skeleton formed of a more or less regular network, never of fibres. Megascleres diactinal. Microscleres sigmata and (or) toxa.

NOTE. Bowerbank omitted to describe and figure the sigmata amongst the microscleres of *Gellius angulatus*. Ridley and Dendy (*14*, p. 44) who examined the type specimens in the British Museum, discovered that spicule, and referred the sponge to the genus *Gellius*.

Gellius angulatus, B., XLI. (Topsent, *18*, p. 76.)
,, *couchi*, B., LXXIII.
,, *fallax*, B., LI.
,, *jugosus*, B., L.

c. Sub-family SPONGILLINÆ.

Fresh water Sponges.

Genus *Euspongilla*, Vejdowsky.

Megascleres smooth or spined. Gemmules covered with small spined spicules.

Euspongilla lacustris, autt., LX. (Weltner, *23*, p. 12; *24*, p. 260.)

Genus *Ephydatia*, Lamouroux.

Megascleres smooth or spined. Gemmules covered with amphidiscs the edges of which are indented.

Ephydatia fluviatilis, Pallas, LIX. (Weltner, *24*, p. 245.
,, *parfitti*, Carter, LXXXVI,
,, *sceptrifera*, B., LXXXVI.

d. Sub-family GELLIODINÆ.

None.

e. Sub-family PHLŒODICTYINÆ, Ridley and Dendy.

Massive Sponges with a thick rind and fistulous appendages. Skeleton of the choanosome consisting of spiculous fibres. Megascleres oxea. Microscleres (if present) sigmata.

Genus *Oceanapia*, Norman.

With microscleres.

Oceanapia robusta, B., LXII. (Ridley and Dendy, *14*, p. 36.)

Family II. PŒCILOSCLERIDÆ, Topsent.

Skeleton more complicated. Megascleres typically monactinal. Usually with microscleres, typically chelæ.

a. Sub-family ESPERELLINÆ, Ridley and Dendy.

Skeleton fibres not echinated. Megascleres of the ectosome not differing essentially from those of the choanosome.

Genus *Stylotella*, Lendenfeld.

Skeleton reticulate. Primary fibres multispiculous. Megascleres chiefly styli. No microscleres.

NOTE. Topsent, (*18*, p. 135) established the genus *Stylinos* for the undermentioned forms (except *S. inornata*), but dropped it again (*20*, p. 6) on finding that *Stylotella*, Lendenfeld, was identical with and prior to it.

Stylotella columella, B., LXXVIII. (Topsent, *18*, p. 136.)

,, *incognita*, B., LXXXV.

,, *inornata*, B., LXXXIII.

,, *pannosa*, B., LXXXIX.

,, *simplicissima*, B., XC.

,, *uniformis*, B., LV.

Genus *Desmacella*, Schmidt.

Skeleton fibrous. Megascleres tylostyli or styli, or both. Microscleres sigmata and (or) toxa, occasionally trichodragmata.

Desmacella cavernula, B., LXXXII. (Topsent, *18*, p. 84).
,, *peachi*, B., LXIII. (Topsent, *18*, p. 84.)
,, *variantia*, B., XXXIII and XLV.

Genus *Biemma*, Gray.

Sponges allied to *Desmacella*, but with the aspect and structure of *Halichondria*. Megascleres: tylostyles. Microscleres: sigmata.

Biemma corrugata, B., XLIII. (Topsent, *18*, p. 81.)
,, *inornata*, B., XLVII. (Topsent, *18*, p. 80.)

Genus *Esperiopsis*, Carter.

External form amorphous or symmetrical. Megascleres monactinal. Microscleres isochelæ, with or without sigmata.

Esperiopsis alderi, B., LVI.
,, *clarkei*, B., LVI.
,, *collina*, B., 4, XIV.
,, *deformis*, B., 4, XIV.
,, *dubia*, B., XC.
,, *edwardi*, B., LVIII. (Ridley and Dendy, *14*, p. 78.)
,, *foliata*, B., LXXIII. (Carter, *1*, p. 310.)
,, *fucorum*, Johnst., LVI.
,, *funalis*, B., 4, XV.
,, *gracilis*, B., LVIII.
,, *hispida*, B., 4, XII.
,, *imitata*, B., LXXVI.
,, *mutula*, B., LXXIV.
,, *normani*, B., LVI.
,, *paupera*, B., LV.

Esperiopsis scitula, B., 4, IV and 4, IX.
,, *thompsoni*, B., XLIV.

Genus *Esperella*, Vosmaer.

External form amorphous or symmetrical. Megascleres monactinal. Microscleres palmate anisochelæ, to which others may be added.

Esperella ægagropila, Johnst., LXIII and LXXXIII.
,, *constricta*, B., LXXI.
,, *copiosa*, B., LXXXII.
,, *fallaciosa*, B., 4, XVII.
,, *florea*, B., XXXVII. (Hanitsch, *8*, p. 202.)
,, *intermedia*, B., 4, XVII.
,, *lingua*, B., XLVII and LXXVII. (Topsent, *18*, p. 88.)
,, *lobata*, Mont., LVIII.
,, *macilenta*, B., XXXIII.
,, *rotalis*, B., XC.
,, *similaris*, B., LXXXIX.
,, *sordida*, B., LXXVI. (Hanitsch, *9*, p. 214.)
,, *subclavata*, B., XXXVII.

Genus *Hamacantha*, Gray.

Megascleres usually styli. Microscleres typically diancistra, with or without sigmata, toxa and trichodragmata.

Hamacantha falcula, B., LXXIV.

Genus *Desmacidon*, Bowerbank.

Megascleres diactinal. Microscleres isochelæ and, usually, sigmata.

Desmacidon cylindraceum, B., 4, VI.
,, *fruticosum*, Mont., LXI. (Ridley and Dendy, *14*, p. 104.)
,, *occultum*, B., LXXIX.
? ,, *pauperculum*, B., 4, X.

Genus *Homœodictya*, Ehlers.

Usually lobate or palmate. Fibres rich in spongin.

Megascleres diactinal. Microscleres characteristic fimbriated isochelæ.

Homœodictya palmata, Johnston, LII. (Ridley and Dendy, *14*, p. 108.)

b. Sub-family DENDORICINÆ, Topsent.

Skeleton fibres not echinated. The megascleres of the ectosome are usually of a different type of those of the choanosome, generally diactinal.

Genus *Dendoryx*, Gray.

Skeleton reticulate. Megascleres of the ectosome usually diactinal, mostly smooth, in a few cases spined on the ends. Megascleres of the choanosome monactinal, always spined. Microscleres: usually isochelæ, rarely anisochelæ or no chelæ at all. Sigmata may be present.

NOTE. As the genus *Dendoryx*, defined as above, includes a great variety of forms, I think it useful to arrange the species according to the character of the ectosomal megascleres, and of the microscleres. According to Vosmaer (*22*, p. 359), *D. dickiei* and *D. lurida* are identical. But he apparently overlooked what Bowerbank says in regard to the former species (Vol. II, p. 254): "The vast quanity and great size of many of the anchorate spicula is a very remarkable feature in this sponge." The corresponding spicule in *D. lurida* is considerably smaller. Still these two species, as possessing hastate diactinals (and thus forming Vosmaer's genus *Hastatus*), stand much nearer to each other than they do to *D. rugosa*.

1. Ectosomal megascleres diactinal, smooth:

a. with isochelæ and sigmata:

Dendoryx inaequalis, B., 4, XVI.

" *incrustans*, Esper, XLIV. (Hanitsch, *8*, p. 204.)

,, *robertsoni*, B., 4, V.

b. with isochelæ only:

Dendoryx dickiei, B. XLV.

,, *lurida*, B., LVIII and LXXXII.

,, *rugosa*, B., XCI.

c. with anisochelæ and sigmata:

Dendoryx ingalli, B., XLVI.

d. without microscleres:

Dendoryx dujardini, B., XXXVIII. (Topsent, *18*, p. 99).

2. Ectosomal megascleres monactinal, smooth:

a. with isochelæ only:

Dendoryx batei, B., XLVI.

,, *fimbriata*, B., LVIII.

,, *virgea*, B., 4, V.

3. Ectosomal megascleres diactinal, terminally spined:

a. with anisochelæ only:

Dendoryx expansa, B., LXXIV.

,, *pattersoni*, B., XLVI. (Ridley and Dendy, *14*, p. 117.)

b. with sigmata only:

Dendoryx pulchella, B., XLVI.

4. Ectosomal megascleres monactinal, terminally or entirely spined:

a. with isochelæ and sigmata:

Dendoryx tumulosa, B., XCII.

b. with sigmata only:

Dendoryx candida, B., XLIV.

Genus *Iophon*, Gray.

Soft, crumbling sponges, of dark colour. Megascleres of the ectosome diactinal, those of the choanosome spined styli. Microsceleres anisochelæ and bipocilli.

Iophon nigricans, B., XLV. (Topsent, *18*, p. 98.)

,, *implicatum*, B., 4, XVI.

NOTE. Ridley and Dendy (*14*, p. 117) include *Halichondria pattersoni*, B., under the present genus. This must be an oversight, as that species possesses no bipocilli. Its right place seems to be under *Dendoryx*. Topsent (*18*, 34) places *J. implicata* in his new genus *Pocillon*. I do not follow him, as Bowerbank leaves it uncertain whether there are really "defensive spicules" in that sponge.

Genus *Lissodendoryx*, Topsent (*18*, p. 97.)

Sponges having the main skeleton composed of smooth styli, but else with the characters of *Dendoryx*.

Lissodendoryx flabellifera, B., 4, VII.

Genus *Tedania*, Gray.

Megascleres of the ectosome diactinal, those of the choanosome monactinal, both smooth. Microscleres raphides.

Tedania simplicissima, B., LXXIII.

Genus *Forcepia*, Carter.

Megascleres of the ectosome diactinal, those of the choanosome monactinal, both smooth. Characteristic microsclere a labis, with or without isochelæ or anisochelæ.

Forcepia forcipis, B., XLIII.

Genus *Yvesia*, Topsent (*18*, p. 102).

Megascleres of the ectosome generally monactinal, but often also diactinal, always spined, Megascleres of the choanosome smooth, normally diactinal. Microscleres isochelæ and (or) sigmata, or absent altogether.

Yvesia armigera, B., 4, IV.

" *albula*, B., XLV.

c. Sub-family ECTYONINÆ, Ridley and Dendy.

Skeleton fibres echinated, generally by spined spicules.

Genus *Myxilla*, Schmidt.

Megascleres of the choanosome monactinal, spined, forming a reticulate skeleton echinated by spined styli. Megascleres of the ectosome smooth diactinals. Microscleres isochelæ, with or without sigmata and toxa.

Myxilla granulata, B., XLV.
,, *irregularis*, B., XLIV.
,, *jecusculum*, B., LXXXIII. (Carter, *1*, p. 237.)
,, *pansa*, B., 4, I.
,, *peachi*, B., 4, XIII. (Topsent, *18*, p. 109.)
,, *pilata*, B., 4, II.
,, *pulchella*, B., 4, II.

Genus *Pocillon*, Topsent (*19*, p. xxxiv).

Agreeing with *Myxilla* in structure, but having bipocilli in addition. Differing from *Iophon* only by the possession of echinating spined styli.

Pocillon hyndmani, B., XLVI. (Hanitsch, *9*, p. 217.)
,, *scandens*, B., XLV.
,, *spinulentum*, B., XXIV.

Genus *Lissomyxilla*, n.g.

Skeleton fibres of the choanosome formed of smooth monactinals, echinated by spined styli. Megascleres of the ectosome smooth diactinals or monactinals. Microscleres (isochelæ, etc.,) may be present.

NOTE. I have ventured to make this new genus for a form which I could bring under no existing genus. It differs from *Myxilla* only by the smooth styli of the choanosome, and stands to *Myxilla* in the same relationship as *Lissodendoryx*, Topsent, to *Dendoryx*, Gray. Topsent (*18*, p. 108) speaks of the possibility, of a genus of the above character having to be created sometime. I have left the definition of the new genus wider than was really necessitated by the only known species of it, so that allied forms may be more easily included under it. The present species has monactinals in the ectosome, and possesses no microscleres.

Lissomyxilla spinosa, B., LXXXIII.

Genus *Plumohalichondria*, Carter.

Main skeleton formed of plume-like columns, containing smooth diactinal spicules, echinated by spined styli. Dermal skeleton with smooth diactinal spicules and spined styli. Microscleres isochelæ.

Plumohalichondria fictitia, B., XXIII and LXXXII.
,, *fraudator*, B., LXXXIII.
,, *kenti*, B., LXXXIX.

Genus *Stylostichon*, Topsent (*18*, p. 111).

Main skeleton formed of plume-like columns, containing spined styli, echinated by spined styli. Dermal skeleton with smooth diactinal spicules. Microscleres isochelæ.

Stylostichon ambiguum, B., XXV.
,, *plumosum*, Mont., XXIV. (Ridley and Dendy, *14*, p. 145.)

Genus *Microciona*, Bowerbank.

Main skeleton formed of short plume-like columns, containg basally spined styli, echinated by entirely spined styli. Dermal skeleton with smooth styli. Microscleres may be present: isochelæ, with or without toxa and sigmata.

NOTE. *M. lævis* differs from the three other species by having smooth styli in the skeleton columns.

Microciona armata, B., XXIII.
,, *atrasanguinea*, B., XXIV. (Hanitsch, *8*, p. 207.)
,, *fallax*, B., XXIII.
,, *lævis*, B., XXIII.

Genus *Hymeraphia*, Bowerbank.

Sponges thin, encrusting. Main skeleton formed of isolated monactinals, spined at least at their bases, arising vertically from the basal membrane, with accessory shorter, generally entirely spined monactinals. Megascleres of the ectosome of varying character. No microscleres (?)

NOTE. Topsent (*18*, p. 109) places *H. radiata* under the genus *Myxilla*.

Hymeraphia clavata, B., XXVI.
,, *coronula*, B., LXXIX.
,, *indistincta*, B., LXXXVII.
,, *paupertas*, B., XXXVII.
,, *radiata*, B., XXVIII and XXIX. (Topsent, *18*, p. 109).
,, *simplex*, B., LXXX.
,, *verticillata*, B., XXVII. (Carter, *1*, p. 321.)

Genus *Raspaila*, Nardo.

Sponges typically whip-like, with a dense central axis of spiculo-fibre containing much spongin, from which loose tufts of spicules radiate to the surface. Megascleres usually monactinal. Echinating spined styli always present. No microscleres.

NOTE. Topsent (*20*, p. 13) states that some species of *Raspailia* possess asters, referring apparently to *Dictyocylindrus stuposus*, B., *D. fascicularis*, B., and similar forms. I prefer to include the same under *Axinella*, as they do not possess echinating spined styli. *Spongia rigida*, Montagu, described by me (*8*, p. 213) under the name *Raspailia rigida*, M., would now also come under *Axinella*.

Raspailia aculeata, B., XXI.
,, *hispida*, Mont., XVII.
,, *howsei*, B., XIX.
,, *pumila*, B., XIX and XXI.
,, *radiosa*, B., XX.

Raspailia ramosa, Mont., XVI.
,, *rectangula*, B., LXXXIV.
,, *ventilabrum*, B., XVI. (Hanitsch, *8*, p. 212.)
,, *virgultosa*, B., XIX.

Genus *Acarnus*, Gray.

Megascleres of the ectosome diactinal (tylota); those of the choanosome monactinal (smooth styli). Accessory megascleres of the choanosome cladotyles, characteristic of the genus. Microscleres isochelæ and toxa.

Acarnus stelliferus, B., XXVII.

Genus *Pytheas*, Topsent (*18*, p. 110).

Megascleres of the ectosome usually spined styli, lying tangentially. Skeleton of the choanosome formed of bundles of smooth diactinals, echinated by spined styli. Isochelæ usually present.

Pytheas inflatus, B., LXXIX.

Genus *Spanioplon*, Topsent (*18*, p. 116).

Chief megascleres of the choanosome smooth monactinals, few in number as compared with the megascleres of the ectosome, smooth diactinals. With accessory small spined spicules (microxea, microstyles, or tylostyles). Microscleres (isochelæ and sigmata) rarely present.

Spanioplon armaturum, B., XXXIV.

Genus *Clathria*, O. Schmidt.

Main skeleton formed of well-developed horny fibres cored with smooth styli, echinated by spined styli. No special dermal skeleton. Microscleres isochelæ and (or) toxa, sometimes absent.

Clathria beani, LVIII.
,, *clavigera*, B., XXXVII,
,, *laciniosa*, B., LXXV.

Genus *Clathrissa*, Lendenfeld, emend. (*11*, p. 217).

Main skeleton formed of dense bundles of diactinals, with very little spongin, echinated by spined styli. With or without dermal crust of oxea. Chelæ may be present.

NOTE. The orginal diagnosis runs: "Desmacidonidæ with a skeleton composed of dense bundles of slender oxea, with very litttle spongin; echinated by spined styli." I have altered the diagnosis slightly in order to include the undermentioned species. Topsent created a new genus (*Leptosia*) for Bowerbank's *Hymedesmia zetlandica*, but I think we can include that species under the present genus.

Clathrissa perarmata, B., XXXI.
,, *trunca*, B., 4, XI.
,, *zetlandica*, B., XXIX.

Genus *Ophlitaspongia*, Bowerbank.

Skeleton formed of horny fibres, not cored by spicules, but echinated by smooth styli. Microscleres toxa.

Ophlitaspongia papilla, B., LXX.
,, *seriata*, Grant, LXV.

Genus *Diplodemia*, Bowerbank.

Skeleton formed of horny fibres containing smooth oxea and echinated by smooth oxea. No microscleres.

Diplodemia vesicula, B., LXX.

Genus *Plocamia*, O. Schmidt.

Characteristic megascleres dumb-bell shaped spicules, spined. Chief megascleres styli or subtylostyli, often spined at their bases, sometimes accompanied by shorter and more completely spined spicules. Ectosome sometimes with diactinals. Microscleres: isochelæ and, usually, toxa.

NOTE. Topsent (*20*, p. 17) includes this genus under his new sub-family *Bubarinæ*. But as that sub-family is at present not yet quite satisfactorily defined, we may be allowed to leave *Plocamia* amongt the *Ectyoninæ*. The type of Topsent's new sub-family is *Bubaris*, Gray. But as the same is supposed to include such greatly differing forms as *Hymeraphia vermiculata*, B. and *H. verticillata*, B. (which I refer to *Axinella* and *Hymeraphia* respectively), I have not thought it advisable, to make use of that genus.

Plocamia coriacea, B., LXXVI. (Ridley and Dendy, *14*, p. 158; Topsent, *18*, p. 117.)

Family III. AXINELLIDÆ, Ridley and Dendy.

Skeleton typically consisting of ascending axes of fibres from which arise subsidiary fibres radiating to the surface, but may be reticulate. Megascleres chiefly monactinals to which diactinals may be added. Microscleres rarely present; if present, raphides, microxea, cladostrongyla or asters.

Genus *Hymeniacidon*, Bowerbank.

Sponge massive. Skeleton reticulate. Megascleres monactinal. No microscleres.

NOTE. In regard to *? H. gelatinosum* see *Halisarca*.

Hymeniacidon aldousii, B., XCII.
,, *aureum*, Mont., XXXIV.
,, *callosum*, B., 4, IV.
,, *carunculum*, B., XXXII. (Ridley and Dendy, *14*, p. 167.)
,, *consimile*, B., XXXIII.
,, *fallax*, B., XXXIII.
? ,, *gelatinosum*, B., XXXVIII.
,, *hillieri*, B., 4, III.
,, *invalidum*, B., LXXXV.
? ,, *involutum*, B., 4, X.
,, *mammeatum*, B., XXXIII.
,, *medium*, B., LXXXV.
,, *nodosum*, B., 4, XII.
,, *pachydermum*, B., XXXIV.
,, *perleve*, Mont., XXXIV.

Hymeniacidon pertenue, B., 4, XIII.
,, *plumigerum*, B., LXXII.
,, *radiosum*, B., LXXII.
,, *sanguineum*, Grant, XXXII.
,, *simplex*, B., XLVII.
,, *virgulatum*, B., 4, IV.
,, *viridans*, B., XXXIII.

Genus *Phakellia*, Bowerbank.

Sponge fan—or funnel—shaped. Skeleton somewhat reticulate. Megascleres styli and often oxea, generally slender and twisted. No microscleres.

NOTE. O. Schmidt, and Ridley and Dendy regard *Ph. robusta* as identical with, or, at the most, only as a variety of *Ph. ventilabrum*. I prefer to keep the two forms separate.

Phakellia robusta, B., XXI.
,, *ventilabrum*, Johnston, XXII. (Ridley and Dendy, *14*, p. 170.)

Genus *Tragosia*, Gray.

Sponge fan—or funnel—shaped, or branching and anastomosing. Skeleton pretty regularly reticulate. Megascleres styli and often oxea, not twisted and stouter than in *Phakellia*. No microscleres.

Tragosia barleei, B., LVII.
,, *infundibuliformis*, Johnst., XIV and LIV. (Carter, *1*, p. 240.)
,, *polypoides*, O. Schmidt, LV.

Genus *Ciocalypta*, Bowerbank.

Sponge massive or ramose. Megascleres stylote and sometimes oxeote. From a central skeleton are given off pillars of spiculo-fibre at about right angles, spreading out and supporting the dermal membrane, leaving large sub-dermal spaces. No microscleres.

Ciocalypta penicillus, B., XIII and LXXXVI. (Ridley and Dendy, *14*, p. 173.)

Genus *Axinella*, Schmidt.

Sponge generally ramose. Skeleton fibre plumose. Megascleres stylote, sometimes oxeote. Sometimes stellate microscleres.

NOTE. *A. vermiculata*, B., is possibly identical with *A. erecta*, Carter. See Ridley and Dendy, *14*, p. 182.

Axinella fascicularis, B., XVIII.
,, *rugosa*, B., XX and XXI.
,, *stuposa*, Mont., XIX. (Topsent, *18*, p. 123.)
,, *subdola*, B., XLIII.
,, *vermiculata*, B., XXVI.

2. Sub-order CLAVULINA, Vosmaer.

Sponges typically with cortex, radiating skeleton, tylostylote megascleres and no spongin. Microscleres rarely present, never chelæ or sigmata.

Family I. SUBERITIDÆ, Vosmaer.

No microscleres, except occasionally centrotylote microstrongyles.

Genus *Suberites*, Nardo.

Massive or stipitate, without mammiform projections. Usually with special dermal crust of radiating spicules. Megascleres typically tylostyles. Microscleres: occasionally centrotylote microstrongyles.

Suberites carnosus, Johnst., XXXVI. (Ridley and Dendy, *14*, p. 197.)
,, *crustula*, B., XXXIV.
,, *domuncula*, Olivi, XXXVI.
,, *farinarius*, B., LXX.
,, *ficus*, Johnst., XXXVI.
,, *foliatus*, B., LXXI.
,, *simplicissimus*, B., LXXX.

Suberites sulphureus, Bean, XXXVII.
,, *tenebrosus*, B., 4, XV.
,, *tenuiculus*, B., 4, I.
,, *virgultosus*, Johnst., XXXV.

Genus *Polymastia*, Bowerbank.

With mammiform projections. Megascleres tylostyli or styli. No microscleres.

NOTE. I include here *P.* (*Tethea*) *spinularia*, B. Oscar Schmidt referred this species to his *Radiella*. However the figure given by Bowerbank shows no special resemblance to the symmetrical structure of *Radiella* (nor of *Trichostemma* and *Halicnemia*). Still I have some doubt in regard to the systematic position of this species, as it contains oxea in addition to the tylostyles, and as its mammiform projections are very short.

Polymastia bulbosa, B., X.
,, *conigera*, B. LXXII.
,, *mammillaris*, B., XII. (Vosmaer, *21*, p. 14; Hanitsch, *7*, p. 166.)
,, *ornata*, B., IX.
,, *radiosa*, B., XI.
,, *robusta*, B., X. (Ridley and Dendy, *14*, p. 210.)
,, *spinula*, B., XI.
? ,, *spinularia*, B., XV.

Genus *Quasillina*, Norman.

"Sponge corticate, stipitate, with oval body, bearing a single osculum at the summit, and short stalk. In the cortex primary skeleton fibres ascend in parallel lines from the base, crossed at right angles by secondary ones. Spicules, large and small styli." Ridley and Dendy, *14*, p. 225.

Quasillina brevis, B., XI. (Ridley and Dendy, *14*, p. 226; Vosmaer, *21*, p. 20.)

Genus *Halicnemia*, Bowerbank.

Sponge symmetrical, flat discoid, with marginal fringe of long spicules. Megascleres tylostyli. Microscleres (?); spined centrotylotes.

NOTE. I am not sure whether the small spined centrotylote spicules which Bowerbank describes in *H. patera* (but no figures) are to be regarded as microscleres. Vosmaer fused this genus with *Polymastia*, but, as I think, without sufficient reason. Nor can, according to Hansen (*10*, p. 8), *Halicnemia* be fused with *Radiella*, as Marenzeller had done.

Halicnemia patera, B., XV.

Genus *Cliona*, Grant.

Boring Suberitidæ. Megascleres tylostyles. No microscleres.

Cliona celata, Grant, XXXVIII and LXIV. (Hanitsch, *8*, p. 216.)

Family II. TETHYIDÆ, Vosmaer.

The ectosome is usually a well developed cortex with distinct fibrous layer. Megascleres styli or tylostyli, radially arranged. Microscleres, when present, spherasters or microrrhabds.

NOTE. I include under this family also the genus *Hymedesmia*, B., as represented by *H. stellata*, B., although this is a thin encrusting sponge without cortex. An encrusting sponge very similar to *H. stellata*, but possessing oxyasters instead of chiasters was dredged last year in Liverpool Bay, for which I propose the provisional name *H. acuto-stellata*. Its spiculation, but not its mode of growth, reminds one strongly of *Axinella stuposa*. Thus *Hymedesmia* ought perhaps be included under the Axinellidæ.

Genus *Tethya*, Lamarck.

Sponge of a more or less spherical form. Megascleres styli. Microscleres spherasters.

Tethya lyncurium, Lin., XV.

Genus *Hymedesmia*, Bowerbank.

Thin, encrusting. Megascleres tylostyles. Microscleres asters.

Hymedesmia stellata, B., XXVIII.

c. Order. MONOCERATINA, Lendenfeld.

Family I. SPONGIDÆ, Schulze.

Leiosella pulchella, Sowerby, LXV. (Lendenfeld, *12*, p. 211).

Aplysina zetlandica, B., LXX. (Lendenfeld, *12*, p. 403.)

Family II. SPONGELIDÆ, Vosmaer.

Spongelia fragilis, Mont., var. *irregularis*, LXIX and XCI. (Lendenfeld, *12*, p. 662.)

LITERATURE.

1. CARTER, H. J. Descriptions and figures of Deep-Sea Sponges and their spicules, from the Atlantic Ocean, dredged up on board H.M.S. 'Porcupine' chiefly in 1869. Ann. Mag. Nat. Hist., 1876.

2. DENDY, A. A Monograph of the Victorian Sponges. Part I. The Organisation and Classification of the Calcarea Homocœla, with descriptions of the Victoria Species. Tr. R. Soc. Victoria, III, part I, 1891.

3. ———— Synopsis of the Australian Calcarea Heterocœla, with a proposed classification of the group and descriptions of some new genera and species. Proc. R. Society of Victoria (N.S.), V, 1893, pp. 69—116.

4. ———— Studies on the Comparative Anatomy of Sponges. V. Observations on the Structure and Classification of the Calcarea Heterocœla. Q. J. Micr. Science (N.S.), No. 138, 1893, pp. 159—257.

5. Grentzenberg, Max. Die Spongienfauna der Ostsee. Inaugural—Dissertation. Kiel, 1891.

6. Hæckel, E. Die Kalkschwämme: eine Monographie. 3 Bde. Berlin, 1872. [References apply to Band II only.]

7. Hanitsch, R. Second Report on the Porifera of the L.M.B.C. District. Proc. Liverpool Biol. Soc., Vol. III, pp. 155—173.

8. ———— Third Report on the Porifera of the L.M.B.C. District. Trans. Liverpool Biol. Soc., Vol. IV, pp. 192—238.

9. ———— Notes on some Sponges collected by Professor Herdman off the West Coast of Ireland from the 'Argo.' Trans. Liverpool Biol. Soc., Vol. V, pp. 213—222,

10. Hansen, G. Armauer. Spongiadæ. In: The Norwegian North-Atlantic Expedition, 1876—1878. Christiania, 1885.

11. Lendenfeld, R. von. Descriptive Catalogue of the Sponges in the Australian Museum, Sydney. 1888.

12. ———— A Monograph of the Horny Sponges. 1889.

13. ———— Das System der Spongien. Abhandl. d. Senckenb. naturf. Gesellschaft, Frankfurt a. M., 1890.

14. Ridley, Stuart O. and Dendy, Arthur. Report on the Monaxonida collected by H.M.S. 'Challenger' during the years 1873—76.

15. Schmidt, Oscar. Grundzüge einer Spongien-Fauna des Atlantischen Gebietes. Leipzig, 1870.

16. Schulze, F. E. Untersuchungen über den Bau und die Entwicklung der Spongien. II. Die Gattung *Halisarca*. Zeitschr. wiss. Zool., Bd. XXVIII, 1877, pp. 1—48.

17. Sollas, W. J. Report on the Tetractinellida collected by H.M.S. 'Challenger' during the years 1873—76.

18. Topsent, E. Contribution à l'étude des Spongiaires de l'Atlantique Nord. Résultats des Campagnes scientifiques, etc., fasc. II.

19. ——— Nouvelle série de diagnoses d'Eponges de Roscoff et des Banyuls. Arch. zool. exp. et. gén. (3), T. I, 1893, pp. XXXIII—XLVIII.

20. ——— Une Réforme dans la classification des *Halichondrina*. Mém. Soc. Zool. France, VII, 1894, pp. 5—27.

21. Vosmaer, G. C. J. The Sponges of the 'Willem Barents' Expedition 1880 and 1881. Bijdr. Dierkunde, Aflev. 2, 1885.

22. ——— Spongien (Porifera). Bronn's Klassen und Ordnungen des Thierreichs. 1887.

23. Weltner, W. Ueber die Autorenbezeichnung von *Spongilla erinaceus*. Ges. naturf. Freunde, Berlin, 1893, No. I.

24. ——— Spongillidenstudien. II. Ueber den Bau der Gemmulæ einheimischer Spongilliden. Arch. f. Naturg. 1893, pp. 245—284.

[From Trans. Biol. Soc., L'pool. Vol. IX.]

EIGHTH ANNUAL REPORT of the LIVERPOOL MARINE BIOLOGY COMMITTEE and their BIOLOGICAL STATION at PORT ERIN.

By W. A. Herdman, D.Sc., F.R.S.

DERBY PROFESSOR OF NATURAL HISTORY IN UNIVERSITY COLLEGE, LIVERPOOL; CHAIRMAN OF THE LIVERPOOL MARINE BIOLOGY COMMITTEE, AND DIRECTOR OF THE PORT ERIN STATION.

[Read 9th November, 1894.]

The work at Port Erin continues to flourish, and the investigation of the Irish Sea generally is increasing in scope. The laboratory has been well used during vacation times; there have been a considerable number of dredging expeditions, and several new lines of investigation have been started which promise well. As there is much to report upon, I shall pass at once to the usual statistical statements without further introduction; and for information in regard to the foundation and equipment of the Biological Station, and as to the aims and methods of the Committee, reference must be made to former reports.* As usual, I am indebted to several of my colleagues on the Committee and to workers at the Station for kind help which they have given me in the preparation of this annual record.

Station Record.

The following naturalists have worked at the Station during the past year:—

DATE.	NAME.	WORK.
March.	I. C. Thompson...	Copepoda.
—	W. A. Herdman	Tunicata.
—	C. H. Hurst	Collecting.

* Copies of the Sixth Report (56 pp. and 6 plates), in stiff boards, and containing an account of the opening of the Station at Port Erin in 1892 by Governor Walpole, can still be had, price one shilling each, on application to the Hon. Treasurer.

—	W. I. Beaumont	Nemertida.
—	F. W. Gamble	Turbellaria.
—	E. T. Browne	Medusæ.
—	Alfred Leicester	Mollusca.
—	F. E. Weiss	Algæ.
—	T. Hick	Algæ.
April.	F. E. Weiss	Algæ.
—	E. T. Browne	Medusæ.
—	W. I. Beaumont	Nemertida.
May.	E. T. Browne	Medusæ.
—	H. C. Chadwick...	Synapta, &c.
—	W. A. Herdman	Tunicata.
—	I. C. Thompson	Copepoda.
June.	T. S. Lea.	Photographing Algæ.
—	Miss L. R. Thornely	Polyzoa.
—	Miss R. Alcock	Tunicata.
July.	I. C. Thompson	Copepoda.
—	A. O. Walker	Amphipoda.
—	W. A. Herdman	Tunicata.
—	W. E. Ritter, California	Tunicata.
–	A. Leicester	Mollusca.
August.	R. Hanitsch	Sponges.
—	W. A. Herdman...	Tunicata.
—	I. C. Thompson...	Copepoda.
—	Alf. Leicester	Mollusca.
—	T. S. Lea	Photographing Algæ.
—	Arnold T. Watson	Annelids.
—	P. M. C. Kermode	General.
—	G. W. Wood	General.
—	J. D. F. Gilchrist	Opisthobranchiata.
—	W. J. Halls	General.
September.	W. A. Herdman	General.
—	R. Hanitsch	Sponges.
—	J. D. F. Gilchrist	Opisthobranchiata.
—	W. J. Halls	General.
—	I. C. Thompson	Copepoda.
—	F. T. Paul	General.
—	G. B. Howes	General.
—	R. J. Harvey Gibson	Algæ.
—	Arnold T. Watson	Annelids

Although this list is a somewhat shorter one than that in last year's record, still several of the workers stayed for long periods, and so the amount of work carried on in the laboratory this year has probably been greater than in any previous year. Some of this work will be referred to later on in the report.

Besides these workers, there were many visitors both to the Laboratory and also to the Aquarium, which seems increasing in popularity. During the season several demonstrations on the animals living in the tanks were given by the Director, and in September a special meeting of the Isle of Man Natural History Society was held at the Biological Station, when the Director gave an address on "The Exploration of Our Coasts."

The Aquarium.

A full account of the arrangement of the tanks and pipes in the Aquarium-house was given in the last report. Several minor additions and improvements have been made during this year. High stands for small aquaria and glass vessels have been erected in front of the windows. The long table has been fitted with a leaden covering, with upturned edges and waste pipe, so that water spilled or leaking from aquaria may run off without wetting the wood. New wall cases and shelving have been added in the upper room for the reception of the collection of Manks Marine Invertebrates (Echinoderms, Zoophytes, Crustacea, and Mollusca) kindly presented by Mr. G. W. Wood, and other similar dried or "spirit" specimens collected in the neighbourhood. In this way the walls of the room are becoming covered with collections which form an interesting little museum of local marine zoology, and are a useful addition to the living animals in the tanks when explaining the results of our dredging investigations to visitors.

The water motor and pump are not as satisfactory as could be wished, but with a few alterations, which are now contemplated, and which can be easily carried out, we have reason to believe that the apparatus will work better. Even without the pump we have, however, the sea-water brought fresh every tide into our building by means of the pipe from the beach and our deep well, so that it is no difficult matter to keep the tanks supplied.

The Aquarium was in excellent condition during August and part of September, under the care of Dr. Hanitsch, and was open daily to visitors. The greatest number of visitors in one day was twenty-nine. With a permanent Curator, who will have fixed hours for going round with visitors and demonstrating the contents of the tanks, this department of the Biological Station will probably undergo considerable development, may form a not inconsiderable source of revenue to the institution, and will prove an additional resource and attraction to the visitors to Port Erin.

Amongst the more interesting or rarer animals which lived in the Aquarium during the summer were :—*Synapta inhærens*, *Porania pulvillus*, *Asterina gibbosa*, *Brissopsis lyrifera*, *Panthalis oerstedi*, *Calocaris macandeæ* (several individuals of this deep-sea prawn lived for some weeks; they were partly covered with fine colonies of the rare Polyzoon *Triticella boeckii*), *Ebalia tuberosa*, *Sarcodictyon catenata* (both red and yellow varieties), *Alcyonium digitatum*, *Scalpellum vulgare*.

One specimen of *Aurelia aurita* lived in a tank for over five weeks, but diminished steadily in size during the time. At the end it was about half of its original diameter, but still quite active and apparently healthy. The tank given up to Shrimps, Prawns, and Mysids proved a success, and was a great source of interest to visitors on account of the lively scenes that took place when the animals were fed. There were always a number of the ordinary shore animals, usually some beautiful vessels of brilliant anemones from the Calf Sound, sometimes jars of Copepoda and other surface organisms, while Hermit crabs, the sea-mouse, a few flat fish, brittle stars, and sea-urchins were always interesting to watch, and could readily be made to lend themselves to purposes of instruction.

Besides its distinct use to the general public, our Aquarium has another function. Several of the naturalists at work this year have made more or less use of it, and it has been felt to be a distinct aid in making several interesting original observations, such as those on *Panthalis* described further on. A number of animals spawned during spring or summer in the tanks, and an *Actinia mesembryanthemum* produced in March about 50 young anemones, which scattered themselves over the tank and throve well.

Temperature of the Sea.

As we have had no permanent resident Curator during the year, the sea temperatures have not been taken with regularity, but several of the naturalists working, who have been interested in the matter, and notably Mr. E. T. Browne in the earlier part of the summer, and Dr. Hanitsch, who acted as temporary Curator during the later part of the season, have kept daily records during the period of their stay. These are entered in the diary at the Station, and they show that, as in the case of last year's series, but not quite so markedly, the temperatures of the sea-water in gradually rising as the spring and summer advance lag slightly behind the inincreasing temperatures of the air. This summer the highest temperature (62° F., on August 21st) was ten degrees lower than the highest of last year (72° F., on August 15th), but the latter is probably to be regarded as an exceptional occurrence, in an exceptionally hot summer. It is interesting to notice that in a few of the observations taken by Mr. Browne in April, the water out in the Bay, at a depth of 3 fathoms, was about 5° F. below the surface temperature at the same time (afternoon).

Nothing has yet been done in the direction of fish hatching and lobster culture, for both of which important industries Port Erin is so eminently suitable. There are unfortunate parliamentary restrictions which at present prevent the Lancashire Sea-Fisheries Committee from spending money in this direction, upon what, from their point of view, is foreign soil. The Manks Legislature is, however, now stirring in the matter of their coast fisheries. A bill has been promoted, has passed through the House of Keys, and was lately promulgated, conferring powers, to make fishery bye-laws and other necessary regulations, upon a committee. It remains to be seen whether this committee will content itself with "restrictive" legislation, or will supplement that by the at least equally important and necessary "productive" work which leads to the encouragement and advance of fish culture and the stocking of beds and banks. Such direct action in aid of the fishing industries cannot be much longer delayed, and I am now of opinion that our Station at Port Erin should, during the coming season, be utilised for experimental work on fish hatching. Even if we cannot obtain any assistance from the Lancashire Committee, and if the Insular Government find they are unable to aid in fish production, still our L. M. B. Committee might establish one or two hatching boxes in spring, test the quality of the water by an actual experiment in hatching, and show what can be done even on a very small scale and with very limited resources.

Dredging Expeditions.

During the year 1894 the following dredging expeditions in steamers have been arranged, partly with the help of the small Committee of the British Association alluded to in former reports. This B. A. Committee reported to the Oxford meeting of the Association, and was then re-appointed for another year, with the addition of Professor Weiss to cover the Marine Flora, and of Mr. Clement Reid to aid in working out the Geology of the floor of the sea :—

I. March 20-25th. At Easter the Committee spent some days in shore-collecting at the southern end of the Isle of Man, and hired the steam trawler "Lady Loch" for two days' dredging. On the first day the floor of the sea to the north of Port Erin from Fleshwick to Contrary Head at Peel was worked at twelve stations within four miles of the coast, and at depths from 10 to 20 fathoms. On the second day nine stations off the west of the Calf Island at depths from 20 to 25 fathoms were dredged.

March 24th. 1. West of Fleshwick Bay, a quarter mile off shore, 13 fathoms; bottom fine sand and broken shells, with* *Cliona celata*, *Gemellaria loricata*, *Canda reptans*, *Ophiura ciliaris*, *Galathea intermedia*, *Portunus arcuatus*, *Aporrhais pes-pelicani*, *Trochus magus*, *Ascidia virginea*.

2. West of Fleshwick, further north, half a mile off

* The few species picked out for mention in each haul are not to be regarded as the rarest forms observed. In some cases they are the commonest. They are the forms which at the time seemed to us the most conspicuous and characteristic of the haul—the most noteworthy inhabitants of the ground.

shore, 15 fathoms; bottom small gravel and shells, with *Cycloporus papillosa*, *Hyas coarctatus*, *Stenorhynchus tenuirostris*, *Venus fasciata*, *Lissocardium norvegicum*.

3. West of Fleshwick, further north, half a mile off shore, 15 fathoms; bottom large shells, a little gravel, with *Pecten tigrinus*, *Venus casina*, many common crabs.

4. One mile north of Fleshwick, half a mile off shore, 14 fathoms; bottom much fine gravel, with *Pecten maximus*, *Trochus magus*, *Antedon rosacea*.

5. Off the Cronk, a mile off shore, 14 fathoms; bottom small gravel and some *Melobesia*, with *Tellina crassa* (alive), *Thracia prætenuis*.

6. One mile further north, a mile off shore, 10 fathoms; bottom Nullipores (*Melobesia* and *Lithothamnion*), with compound ascidians.

7. West from South Barrule, a mile off shore, 12 fathoms; bottom Nullipores, with *Antedon rosacea*.

8. Off Niarbyl Point a mile out (several hauls), 12 fathoms; rough hard ground, with *Antedon rosacea*, *Echinocardium flavescens*.

9. Off Glen Meay, 4 miles out, 20 fathoms; bottom "reamy" (sand and mud), with *Ophiopholis aculeata*, *Porania pulvillus*.

10. Off Glen Meay, half a mile further north, 21 fathoms, with many *Pecten opercularis*, *Cucumaria hyndmani*, *Ebalia tuberosa*, *Cellaria fistulosa*, *Scalpellum vulgare*.

11. West of Contrary Head, 4 miles off, 18 fathoms; bottom Melobesia and stones, with *Eugyra glutinans*.

12. West of Contrary Head, 1½ miles off, 13 fathoms; bottom muddy sand with some stones and many ophiuroids, with *Cliona celata* (massive form), *Astarte sulcata*, *Pecten maximus*.

II. March 25th. 1. Off Aldrick (south of Port Erin), a mile out, 18 fathoms; bottom dead shells, shell sand, and echinoderm spines, with *Spatangus purpureus*, *Echinocyamus pusillus*, *Porania pulvillus*, *Henricia sanguinolenta*, *Murex erinaceus*, *Xantho tuberculatus*.

2. Off Kitterland, $1\frac{1}{2}$ miles out, 18 fathoms; bottom dead shells, with *Ascidia mentula*, *Cynthia morus*.

3. North-west of Calf Sound, 2 to 3 miles off, 19 fathoms; bottom sand and shells, with *Palmipes placenta*, *Luidea ciliaris*, *Stichaster roseus*, *Thyone fusus and T. raphanus*, *Cellaria fistulosa*, *Ascidia plebeia*, *Polycarpa comata*.

4. North-west of Calf Island, 3 miles off, 20 fathoms; bottom sand and shell fragments, with *Pectunculus glycimeris*, *Modiola modiolus*, *Pecten maximus*.

5. North-west of Burrow Rock, 3 to 4 miles off, 22 fathoms; bottom shells, with *Pectunculus glycimeris*, *Lissocardium norvegicum*, *Pecten maximus*.

6. North-west of Chicken Rock, 5 miles off, 25 fathoms; bottom dead shells and some sand, with *Sarcodictyon catenata*, *Chætopterus* sp., *Ebalia tuberosa*, *Ascidia plebeia*.

7. One-and-a-half miles off Bradda Head, 18 fathoms; bottom large shells and broken fragments, with *Asterias rubens* (very large*), *Porania pulvillus*, *Ciona intestinalis*.

8. Two to three miles N.W. of Bradda Head, 21 fathoms; bottom muddy sand, with many ophiuroids, *Cucumaria hyndmani*.

9. Four miles N.W. of Bradda Head, 23-25 fathoms (several hauls); bottom sandy mud, many ophiuroids.

* The specimens we dredge are very much larger than those we find on the rocks of the neighbouring shore. Are there two varieties in the species, a smaller shore and a larger deep-water form, or do the individuals move outwards from the shore as they grow older?

III. May 27th. The Committee hired the steam trawler "Lady Loch," and dredged the following localities:—

1. South-east of Calf Sound, a mile from Kitterland, 20 fathoms; bottom subangular gravel (? glacial material), many ophiuroids and *Buccinum undatum*, a few large shells, *Mytilus edulis*, and *Venus casina*.

2. South-east of Calf Sound, half a mile further out, 19 fathoms; some coarse sand and broken shells, with the subangular gravel (stones much incrusted), *Spatangus purpureus*, many encrusting polyzoa, *Venus*, *Trochus*, *Pecten*, *Serpula*, *Echinus*, and *Lithothamnion* fragments.

3. South-east of Calf Sound, further on, 2 miles from Kitterland, 20 fathoms; bottom white shelly (calcareous) sand, mainly organic, lamellibranch and gastropod shells, echinoderm spines and plates, *Cellaria fistulosa* and *Cellepora pumicosa*, *Pectunculus glycimeris*, Zoophytes.

4. South-east of Spanish Head, 2½ miles off, 20 fathoms; bottom sand and broken shells; a few small stones—Triassic sandstone, slate, and pebble of felsite. Annelids, *Phyllophorus drummondi*.

5. South-east of Spanish Head, 3 miles off, 22 fathoms; bottom more shelly (fragments large), and a few small pieces of slaty rocks.

6. Off the Chasms, half a mile out, 17 fathoms; bottom muddy sand with much *Lithothamnion* and *Melobesia*, a few shells and small stones, small sub-angular fragments of slate, grit, Carboniferous limestone (with *Productus*), and pebbles of coarse sandstone.

7. Off the Chasms, a mile out, 19 fathoms; bottom mud and small gravel (subangular grit and granite), *Echinocardium cordatum* and *Echinus* remains, and some shells.

8. Off the Chasms, 2 miles out, 21 fathoms; mixed bottom, sandy mud, small subangular stones and shell fragments; with *Pagurus prideauxii* and *Adamsia palliata*.

9. South-east of the Old Mines, near Perwick Bay, quarter mile to a mile off shore, 15 to 18 fathoms (two hauls); bottom Nullipore and gravel (angular grit, slate, vein-quartz); a few shell fragments with *Ebalia tuberosa*, *Hyas coarctatus*.

10. Off mouth of Perwick Bay, half a mile off, 12 fathoms; bottom small gravel.

IV. July 8th. The Committee had the use of the Lancashire Sea Fisheries steamer "John Fell," and dredged at the following localities:—

1. West of Dalby, 5 miles out, 30 fathoms; bottom sandy mud, with *Antennularia ramosa*, *Ophiura ciliaris* and *O. albida*, *Pecten opercularis* and *P. pusio*, *Turritella terebra*, *Scalpellum vulgare*, *Hyas coarctatus*, *Eupagurus thompsoni*, *Eudorella nana*, *Gammaropsis* (? n. sp.), both the latter new to Britain, *Ascidia virginea*, and *Eugyra glutinans*.

2. Six-and-a-half miles west of Contrary Head (Peel) 38 fathoms; bottom fine mud, with *Brissopsis lyrifera*, *Lipobranchius jeffreysii*, *Eudorella nana*.

3. Seven-and-a-half miles west of Niarbyl Point, 45 fathoms; bottom fine mud, with *Calocaris macandreæ*, *Gonoplax rhomboides*, *Harpinia lævis* (new to Britain), *Panthalis oerstedi*, and fragments of a small *Lumbriconereis*.

4. Five-and-a-half miles west of Glen Meay, 34 fathoms; bottom mud, many *Turritella terebra* with *Sagartia herdmani*.

5. Four-and-a-half miles west of the Cronk, 22 fathoms; bottom broken shells and small stones, with many ophiuroids, *Stichaster roseus*, *Ebalia tuberosa*, *Eurynome aspera*, *Atelecyclus septemdentatus*, many encrusting polyzoa (twelve species identified), including *Barentsia nodosa*, hydroids (fifteen species identified), including *Dicoryne*

conferta, new to the district: also the cumacean *Campylaspis macrophthalma*, new to Britain.

V. August 19th. The Committee hired the steam trawler "Lady Loch," and dredged at the following localities:—

1. North of Calf, close in, 14 fathoms, gravel, with *Clavelina lepadiformis*, *Asterias glacialis*, many ophiuroids.

2. One-and-a-half miles north of Kitterland, 19 fathoms; stones and mud, with *Antennularia antennina* and *A. ramosa*, *Sarcodictyon catenata*, *Chætopterus* sp., *Stichaster roseus*, *Porania pulvillus*, *Ebalia tuberosa*, *Xantho tuberculatus*, *Ascidia mentula*, *A. plebeia*, *Corella parallelogramma*, *Perophora listeri*, *Forbesella tessellata*, and *Cynthia morus*.

3. Two miles west of Bradda, 23 fathoms; *Munida bamffica*, *Ascidia mentula*, *Cynthia morus*.

4. Mouth of Port Erin Bay (with small trawl), much seaweed, with *Ascidia albida* (*scabra*), several common species, such as *Pagurus bernhardus* and shrimps, some young plaice and lemon sole.

VI. August 25th. In hired steam trawler "Albatross."

1. Two miles north of the Calf, 22 fathoms; sand and Pectunculus shells and Zoophytes, with *Alcyonium digitatum*, *Sarcodictyon catenata* (yellow variety), *Campanularia verticillata*, *Chætopterus* sp.

2. Seven miles off outer end of Calf Id., 30 fathoms; dead Pectens and a few stones (up to 3 lbs.), in a little mud, with Zoophytes, *Cellaria fistulosa*, *Echinocardium flavescens*, *Echinocyamus pusillus*, *Lyonsia norvegica*.

3. Eight to nine miles west of Port Erin, 35 fathoms; bottom "reamy," with *Spatangus purpureus*, *Phascolosoma vulgare*.

4. A mile further out, 48 fathoms; mud, (containing some stones and dead shells), with *Calocaris macandreæ*,

with *Triticella boeckii, Panthalis oerstedi,* and *Brissopsis lyrifera.*

5. Twelve miles off, 51 fathoms; same mud and fauna.

6. Four miles west of Chicken Rock, 38 fathoms; "reamy" and shells, *Eumenis jeffreysii, Thyone fusus, Xantho tuberculatus, Lima elliptica, Pecten pusio.*

7. Three miles west of Chicken Rock, 29 fathoms; large dead shells, *Crania anomala, Trochus millegranus, Corbula gibba, Dentalium entale.*

8. One-and-a-half miles west of Chicken Rock, 26 fathoms; shells, sand, and gravel (general colour yellowish brown), several hauls, much material, *Solaster endeca,* many ophiuroids, *Ebalia tuberosa, Galathea, Aphrodite aculeata, Dentalium entale, Anomia ephippium, Pectunculus glycimeris, Venus casina,* and *V. gallina, Astarte sulcata, Murex erinaceus, Polycarpa comata, Ascidia mentula,* and *A. plebeia, Corella parallelogramma.*

9. One mile off Calf, 25 fathoms; large stones, with fine colonies of *Sertularia abietina, Cynthia morus, Saxicava rugosa* burrowing in the limestone.

10. Mouth of Port Erin Bay (small trawl); algæ, with common species of *Stenorhynchus, Pagurus, Pandalus, Crangon, Hydractinia, Natica, Lacuna.*

VII. September 30th. In hired steam trawler "Lady Loch."

1. Five hauls were taken from 7½ to 11 miles N.W. Bradda Head, 47 to 60 fathoms; mud, with *Turritella* shells, *Brissopsis lyrifera, Panthalis oerstedi, Calocaris macandreæ,* and *Triticella boeckii.* Several of the *Calocaris* were females with eggs on the abdominal appendages.

2. From 8 in to 5 miles west of Dalby and Niarbyl, about 20 fathoms; *Sarcodictyon catenata, Porania pulvillus, Palmipes placenta* (a 6 rayed specimen), *Aglaophenia tubulifera, Adamsia palliata, Scalpellum vulgare, Ebalia*

tuberosa, *Lyonsia norvegica*, *Lima loscombii*, *Dentalium entale*.

3. Off Fleshwick and round Bradda Head, half a mile off shore (with small trawl), 18 fathoms; algæ, with common species of *Echinus*, *Asterias*, *Solaster*, *Stenorhynchus*, *Inachus*, and *Hyas*.

It may be of some use to place on record the course of procedure at each dredging station on these expeditions. The plan for the day is arranged with the captain of the steamer, and when the first locality is reached the spot is determined on the chart, and the depth verified by casting the lead. Then the dredge (measuring 2 feet 6 inches by 1 foot, and weighing from 30 to 40 lbs.) is sent down with a tow-net tied on the line about two fathoms from the dredge. Very often a smaller dredge with a bag of cheese-cloth is sent over on the other side of the ship. One or more surface tow-nets are also put out. The tow-nets, both surface and deep, are looked after by Mr. I. C. Thompson, who, after hauling them, first turns out their contents into a clear glass jar of sea-water, and then, after noting the general character of the catch and any specially conspicuous forms, strains off the water through a small bag made of very fine miller's silk, and transfers the "plankton" left adhering to the silk into a tube containing a special preservative fluid formed of spirit, glycerine, and water.

When the dredge is brought up it is emptied on deck, and after a note of the general character of the deposit and assemblage of animals has been taken, any specially large or rare specimens are picked out and transferred to buckets or jars of sea-water, or to store-bottles of spirit. Then the heap is spread out so as to form a layer not more than one or two inches in depth, and one or two members of the Committee (Professor Herdman and another) now settle down beside it to pass the entire mass in review inch by inch, working it across a small space of bare deck and turning over every shell, stone and specimen with an iron spoon, so as to ensure that nothing escapes observation and due record in the note-book. In the meantime the contents of the bottom tow-net have been dealt with by Mr. Thompson, and the apparatus has been lowered for a second haul, or the vessel is steaming on to a new locality. Then Professor Herdman selects a fair sample of the deposit for preservation (for the Geological Survey) in a small canvas bag (10 by 5 inches), care being taken to include some of the characteristic bottom animals—shells, ophiuroids, polyzoa, &c. After this sample has been removed, and any special animals required have been picked out and put into store-bottles, the whole of the remainder of the haul is passed gradually through our set of three sieves (meshes $\frac{3}{4}$ inch, $\frac{1}{4}$ inch, and $\frac{1}{8}$ inch respectively), which work up and down in a tall iron cylinder filled with sea-water. The sieves are disconnected and examined at intervals, and in this way many of the smaller animals of all groups are detected and picked out. Finally, the water in which the sieves have been plunging is all strained by Mr. Thompson through his fine silk net, and in this way many of the rarer bottom Copepoda are obtained, while the finer sandy and muddy deposits retained by the finest sieve or in the bottom of the cylinder are packed in canvas bags by Mr. Alfred Leicester for further examination at home. These contain, of course, many minute Mollusca, Ostracoda, and Foraminifera. By the time all these processes have been completed the dredge has usually been hauled again, and a fresh heap is lying on the deck awaiting investigation. On a successful trip the members of the party, on an average four to six in number, are kept constantly occupied, each man at his own work, from the commencement of the first haul till the steamer is turned homewards, and after that the packing and labelling of specimens fill up the time until land is reached.

Additions to the Fauna.

As most of the expeditions took place round the Isle of Man, the material was generally brought back to the Port Erin Biological Station, and sorted out into groups in the laboratory there, and then sent to the specialists. Taking the groups in zoological order, the most notable additions as the result of this year's work have been—

Sponges.—Dr. R. Hanitsch reports that the only actual additions to our sponge fauna made during the last few months are (1) *Leiosella* (*Spongionella*) *pulchella*, Sowerby, which was dredged on May 14th, 1894, at 14 miles N. by W. from the Liverpool N.W. Lightship. This species was previously known from the coast of Durham, the Skerries, Shetland, the west coast of Ireland, the east coast of Greenland, and the North Pacific. (2) *Myxilla irregularis*, B., found at Port Erin and Fleshwick, at low tide, in August and September, 1894. This species has previously been recorded only from the Diamond ground off Hastings. We have also found at Port St. Mary a very fine specimen of *Leucandra gossei*, consisting of at least 16 "persons," while Haeckel describes the species as having 2 to 5, rarely 4 to 8 persons.

We are indebted for a list of the Hydroid Zoophytes and Polyzoa which we have collected to Miss L. R. Thornely, who has proved that the *Lafoëa pigmæa* of Alder possesses an operculum, and therefore belongs to the genus *Calycella*, and also has gonothecæ, which were previously unknown. The total number of species of hydroids in our area is now ninety, and one of the dredging expeditions has given us interesting additions to our fauna in *Dicoryne conferta*, which was growing on an *Aporrhais* shell, and was only known previously from Cullercoats, Orkney, and Shetland; and *Syncoryne eximia*, with numerous sacks or "galls" containing young Pycnogonids. Of polyzoa 123 species and 15 varieties have now been recorded. The most recent finds are *Crisia ramosa*, which was recently described by Harmer from Plymouth, and which we find also at Port Erin, and *Microporella impressa*, var. *a.*, found by Miss Thornely at Port Erin in July.

Mr. E. T. Browne has, during some visits to Port Erin, paid special attention to the MEDUSÆ, and has drawn up a list of about twenty species, one of which, at least, *Amphicodon fritillaria*, has not previously been recorded for British seas. The most interesting capture which he has made consists of several specimens of a beautiful Siphonophore, which appears to be a species of *Halistemma*, certainly new to the district and probably to the British fauna. Professor M'Intosh recorded a *Halistemma* in 1891 from St. Andrew's Bay, but our Port Erin species is not the same. Mr. Browne describes the colony as being about 25 mm. in length when expanded; it has a pneumatophore, about 6 large nectocalyces, about 4 polyps, with hydrophyllia, and long tentacles armed with clusters of nematocysts. The polypes and pneumatophore are of a deep reddish colour. The colonies were found in April, 1894.

The yellow variety (?) of *Sarcodictyon* (*Clavularia*) *catenata*, of which we dredged several colonies on August 25th, off the north-west of the Calf Is., in 22 fathoms, is an interesting addition to our fauna. It has only been found before in Loch Fyne and at two other spots on the west coast of Scotland. Some sections which I have made recently of these specimens show that the colonies were then (August) probably ready for reproduction, as the polypes contain mature ova. This is probably the *Sarcodictyon agglomeratum* of Forbes and Goodsir; a note on the subject will shortly be laid before the Biological Society.

Amongst WORMS new to the record are the Turbellaria *Fecampia* (the pear-shaped white cocoons of this form are not uncommon on stones in pools at Port Erin), and *Stylocoplana maculata* (identified by Mr. Gamble), and the annelid *Amblyosyllis* (*Gattiola*) *spectabilis* (Johnston) collected at Port Erin by Mr. Beaumont.

Professor G. S. Brady has kindly examined a number of gatherings of OSTRACODA, from dredged material, taken from 10 to over 40 fathoms, and reports the following species :—

Pontocypris trigonella, G. O. Sars; *P. mytiloides*, Norman; *P. serrulata*, G. O. S.; *Bairdia inflata*, Norman; *Cythere jonesii*, Baird; *C. tuberculata*, G. O. Sars; *C. tenera*, G. S. B.; *C. finmarchica*, G. O. S.; *C. confusa*, B. and N.; *C. concinna*, Jones; *C. dunelmensis*, Norman; *C. antiquata*, Baird; *C. emaciata*, G. S. Brady; *C. convexa*, Baird; *C. villosa*, G. O. S.; *Eucythere argus*, G. O. S. *Krithe bartonensis*, Jones; *Loxoconcha impressa*, Baird; *L. guttata*, Norman; *L. tamarindus*, Jones; *L. pusilla*, G. S. B.; *L. multifora*, Norman; *Cytherura cornuta*, G. S. Brady; *C. angulata*, G. S. B.; *C. cellulosa*, Norman; *C. striata*, G. O. Sars; *C. sella*, G. O. Sars; *Pseudocythere caudata*, G. O. Sars; *Cytheropteron latissimum*, Norman; *C. pyramidale*, G. S. B.; *C. alatum*, G. O. Sars; *Sclerochilus contortus*, Norman; *Paradoxostoma normani*, G. S. B.; *P. ensiforme*, G. S. B.; *P. variabile*, Baird; *P. hibernica*, G. S. B.; *Philomedes inter-*

puncta, Baird; *Cytheridea papillosa*, Bosquet; *C. punctillata*, G. S. B.; *Bythocythere acuta*, Norman; *B. constricta*, G. O. S.; *B. turgida*, G. O. Sars; *Machærina tenuissima*, Norman.

The common *Loxoconcha impressa* is extremely abundant sometimes on weed brought into the laboratory at Port Erin from the shore pools. About the *Cytheropteron pyramidale* noted above, Prof. Brady writes as follows:—"I find that it must be referred to *C. pyramidale*, a species of which there has been hitherto no undoubted British record. It comes very near to *C. latissimum* which, on our east coast, is a common species, but is not found on the west. In a gathering from 14 miles N. by W. of the Liverpool Lighcship, *C. pyramidale* is quite the prevailing form. This is very interesting. I do not think I have seen it in any of the Isle of Man gatherings."

In regard to the COPEPODA Mr. I. C. Thompson has drawn up a general report upon the additions to our knowledge of the group (see p. 283); while Mr. Andrew Scott, "Fisheries" Assistant at University College, has supplied the following notes upon some new species of *Ectinosoma* and other Copepoda, at which he has been specially working:—

"*Longipedia minor* T. & A. Scott.—A few specimens of this species were collected by hand-net in the rock-pools at Hilbre Island in March. It is easily distinguished from *L coronata* (Claus) by its much smaller size.

"*Ectinosoma normani*, n. sp. (T. & A. S.).—Several specimens of this *Ectinosoma* were obtained in material from Barrow Channel, collected by Professor Herdman in May, and it was also found by Mr. Thompson at Port Erin. When fresh this species has a brilliant red spot on the lower angles of the cephalothorax, and in this respect it agrees with *E. erythrops*, Brady.

"*Ectinosoma gracile*, n. sp. (T. & A. S.).—One or two specimens of this species were obtained among dredged material collected at Port Erin by Professor Herdman, Easter, 1894.

"*Ectinosoma pygmæum*, n. sp. (T. & A. S.).—This species was obtained from the same material as the last, and is the smallest *Ectinosoma* known to us; it measures only $\frac{1}{76}$ of an inch (·33 mm.)

"*Ectinosoma herdmani*, n. sp. (T. & A. S.).—One specimen of this was found by Mr. Thompson at Port Erin.

"*Bradya minor*, n. sp. (T. & A. S.).*—A few specimens of this new *Bradya* were obtained in rock-pools at Hilbre Island, along with *Longipedia minor*.

"*Dactylopus rostratus*, T. Scott.—A single specimen was obtained among some dredged material collected at Port Erin by Professor Herdman, at Easter, 1894.

"*Pseudanthessius sauvagei*, Canu.—A few specimens were obtained by washing a number of *Spatangus purpureus*, which were trawled in the central area, 21 miles W.N.W. from Morecambe Bay Lightship, on April 3rd. This rare species was only added to the British fauna last year, when it was found in the Firth of Forth, and the present is the second time it has been observed in the British area."

Lichomolgus (*Doridicola*) *agilis* (Leydig), was found in the bottom tow-net, Morecambe Bay, May, 1894. *Diosaccus propinquus* (T. & A. S.), *Ameira exigua*, T. Scott, *A. longiremis*, T. Scott, *Laophonte inopinata*, T. Scott, *Pseudowestwoodia pygmæa*, T. & A. S., and possibly a new *Laophonte*, and one or two other doubtful species

* The above *Ectinosomas* and *Bradya* are figured and described in a revision of the British species of Copepoda belonging to the two genera *Ectinosoma* and *Bradya*, by T. and A. Scott, which is to be published at an early date.

were all obtained from washings from sponges collected by Dr. Hanitsch at Port Erin in August, 1894.

Mr. Thompson reports as follows:—

"In addition to those mentioned by Mr. Scott, seven species of Copepoda, new to the district, have been recorded during the past year, viz., *Cyclops magnoctavus*, *Cyclops ewarti*, *Centropages typicus*, *Ameira longicaudata*, *Acontiophorus elongatus*, *Cancerilla tubulata*, and also one species new to science, viz., *Pseudocyclopia stephoides*, n. sp. This crustacean has just been described, and its description and figure will be shortly published in the 'Transactions of the Liverpool Biological Society.' It combines some of the characters of the genus *Stephos* with those of *Pseudocyclopia*, the latter predominating sufficiently to determine its position in that genus.

"Surface tow-nets have been continually employed during the several marine expeditions undertaken by the Committee, also tow-nets attached to the rope a few fathoms above the dredge. The latter device has proved a success, collecting some good species of Copepoda, as well as Cumacea and Amphipoda, which are seldom or never obtained on the surface. Amongst the Copepoda thus obtained were several specimens of *Pseudocalanus armatus*, found along with a shoal of *Pseudocalanus elongatus*. A widely extending shoal of *Anomalocera patersonii* was observed off the Isle of Man in May, the only occasion on which we have taken this species during the year. On several occasions during the past summer we have taken *Centropages typicus* in fair quantity, a species which has never occurred before in our district, although carefully looked for, and not a rare species elsewhere. On several occasions, notably in the early part of June, the surface organisms have been singularly scarce.

"Special care has been taken to wash and sieve through fine silk as much as possible of the material brought up by the dredge during marine expeditions, and it is by this means that several of the above-mentioned Copepoda new to the district have been obtained, as well as the new species *Pseudocyclopia stephoides*. Large quantities of ophiuroids, chiefly *Ophiocoma nigra* and *Ophiothrix fragilis*, were amongst the dredged material, and it is probably from one or other of these that the two specimens of *Cancerilla tubulata*, Dalyell, a male and female, were taken, as the species is parasitic on ophiuroids. The first record of this rare copepod occurs in Dalyell's "Powers of the Creator," 1851, and it has since been taken by Mr. Gamble at Plymouth, and off the French coast, but not before in our district. *Cyclops magnoctavus*, Cragin, was found along with quantities of *Temorella affinis* and *Tachidius brevicornis* in tow-nettings taken by Mr. Ascroft in low-water marine pools at Lytham: these being brackish species, it is probable that a considerable amount of fresh-water finds its way into the Lytham pools. *Cyclops ewarti*, Brady, although first taken in the Forth estuary, was suspected by Brady to have a fresh-water origin. Ours are evidently strictly marine, two specimens, both males, having been dredged at 20 fathoms by Mr. Thompson at Port Erin."

Mr. A. O. Walker reports as follows upon the HIGHER CRUSTACEA :—"Collections have been examined from the following places, viz.—

1. Off Port Erin at various points, dredged in (usually) 10 to 50 fathoms by Professor Herdman and Mr. I. C. Thompson, in March, July, August, and September, 1894.

2. Off the Little Orme, North Wales, 5 to 10 fathoms (dredged by A. O. Walker).

3. In the Menai Straits, near the Suspension Bridge (both above and below), on April 2nd and May 31st, 1894 (dredged by A. O. Walker).

The additions made to the list published in last year's report are marked with an asterisk.

Podophthalmata.—*Gonoplax rhomboides*, Linn., one specimen on July 7th, 1894, on mud, 45 fathoms; 7 miles W. of Niarbyl, Isle of Man.

**Pisa biaculeata*, Mont., off Port Erin, Easter, 1894.

Palæmonetes varians, Leach, in a small pool by the Afonganol, Colwyn Bay, in company with *Neomysis vulgaris*. The pool had probably been filled by a combination of flood in the little river and a high tide, but seemed to have been long cut off. The pool was full of *Ruppia maritima*. The *Palæmonetes* were 40 mm. long, and females had ova in the pouches; the *Neomysis*, on the other hand, were small, females with ova being only 14 mm. long.

Cumacea. — **Nannastacus unguiculatus*, Bate, one specimen from Menai Straits.

**Campylaspis macrophthalma*, G. O. Sars, one female from 4½ miles west of the Cronk, July 8th, 1894, 22 fathoms. This is a Mediterranean species, new to Britain.

**Petalosarsia declivis*, Sars, 8 miles W. of Fleshwick Bay, 33 fathoms; from bottom tow-net at 14 miles N.W. of Liverpool N.W. Lightship (A. Scott). This species, first recognised in our district by Mr. Scott, is only known elsewhere in British seas from the Firth of Forth and the Moray Firth. It is therefore an addition to the west coast fauna.

**Cuma pulchella*, Sars, dredged off Little Orme, in Sept.

Isopoda and Amphipoda.—*Cymodoce truncata*, Leach, off Port Erin.

**Eudorella nana* (Sars), in mud, at 30 and at 38 fathoms, West of Dalby and Peel, on July 8th, 1894 (new to Britain). This agrees with Sars' description, but a re-examination of specimens reported as *E. truncatula*, from Puffin Id., shows that the teeth on the lower anterior margin of the cephalothorax differ from both species, so that this may be a variable character. If so, *E. nana* can hardly be separated from *E. truncatula*, Bate.

**Nannonyx spinimanus*, n. sp., Menai Straits, differs from the only other known species in the following points: Anterior coxal plates about the same depth as the body; eyes very large, dark brown; propodos of first gnathopod with five or six strong denticles on the hind margin; third joint of last pereiopods but little expanded behind; maxillipedes also different.

**Socarnes erythrophthalmus*, Robertson; Port Erin 15 to 20 fathoms, March 24th, 1894; Menai Straits.

Urothoë brevicornis, Bate; off Kitterland, 20 fms., male.

Phoxocephalus fultoni, Scott; Port Erin, 15 to 20 fathoms; Menai Straits.

**Harpinia lævis*, Sars, two specimens in mud, from 45 fathoms; 7½ miles west of Niarbyl, on July 8th (new to Britain).

**Gammaropsis* (? n. sp.), in sandy mud, from 30 fathoms, W. of Dalby, on July 8th. This is probably a new species near *G. melanops* (Sars), but differing in the form of the propodos of the first gnathopods and in the secondary appendage of the upper antennæ, which is three jointed, the last joint being minute.

Leucothoë lilljeborgii, Boeck; Port Erin, 15 to 20 fms.

**Iphimedia minuta*, Sars; Colwyn Bay, Port Erin.

Mæra batei, Norman; Port Erin.

Leptocheirus pectinatus, Norman; Port Erin, Menai Str.

Autonoe longipes, Lilljeborg; Menai Bridge.

Janassa capillata, Rathke; Port Erin.

Colomastix pusilla, Grube; Menai Straits.

Corophium bonellii, M. Edw.; Little Orme, Port Erin.

There still remains a quantity of material to be examined."

Mr. Alfred Leicester, of Southport, who has taken part in most of the expeditions, and has collected and identified the Mollusca, reports that the year's work has added fifty-one fresh records to the lists for the southern part of the Isle of Man, and that of these the following nine are new to our district of the Irish Sea:—*Cardium minimum*, Phil., *Psammobia vespertina*, Chem., *Scrobicularia nitida*, Müll., *Chiton marginatus*, Penn., *Propilidium ancyloides*, Forb., *Rissoa inconspicua*, Ald., *Cæcum trachea*, Mont., *Aclis gulsonæ*, Ch., and *Philine angulata*, Jeff.

Finally two additions have been made to our list of local fishes, viz., *Zeugopterus unimaculatus*, four specimens trawled 10—12 miles west from Morecambe Bay Lightship in May, depth 23 fathoms; and *Gobius pictus*, Malm, caught by Mr. Walker in shore pools at Colwyn Bay.

The Submarine Deposits.

Turning now to the submarine deposits, the determination and distribution of which the Committee feel to be a very important part of their work, it is still too soon to attempt anything like a detailed account of the floor of the Irish Sea, but still sufficient observations have perhaps been made to warrant the following preliminary account. The accompanying chart (Plate I.) shows the zones of depths in the district, 0—10 fathoms, 10—20 fathoms, 20—50 fathoms, and upwards of 50 fathoms, being separated from one another. At those places where the Committee have obtained samples of the bottom, conventional symbols are placed on the map* indicating, ○ stones, △ shells, ▭ mud, $\boxed{\times}$ sand, × nullipore deposits (*Melobesia* and *Lithothamnion*), and ⧖⧖ shell concretions. The chief conclusions we have arrived at so far are:—

* One mark frequently stands for a number of different dredgings in the same neighbourhood.

1. The most extensive shallow-water deposit is sand. In most localities along the coast of Lancashire, Cheshire, and North Wales, from the sea-shore out to the 10-fathom contour, the bottom is formed of more or less pure quartz sand. Occasionally in spots there are local patches of stones, of shells, or of mud; but these can generally be accounted for by tidal or estuarine currents, by the entrance of fresh-water streams carrying down alluvium, or by the presence of littoral or sub-littoral boulder clay. These spots are all, however, of small area, and the great extent of the bottom down to 10 fathoms is sand.

2. Further out, however, between 10 and 20 fathoms, the sand becomes greatly mixed with mud, and much diversified by large tracts of shelly deposits or by patches of gravel, and the fauna on the bottom also becomes much more abundant. In some spots, at about 20 fathoms, it is made up over considerable areas almost entirely of ophiuroids (*Ophiocoma nigra* and *Ophiothrix fragilis*), which fill the dredge haul after haul. At two localities off the Isle of Man, viz., along the east coast from Clay Head to St. Ann's Head, and off the west coast between Contrary Head and Niarbyl, at depths between 10 and 20 fathoms, are great nullipore deposits formed of *Melobesia* and *Lithothamnion*, which have a most characteristic appearance, smell, and fauna.

This area of the sea-bottom, from 10 to 20 fathoms, extends across from the north of Lancashire to the Isle of Man, so that opposite Barrow, for example, there is a wide extent of about 50 miles in length of sea-floor at depths of not more than 15 or 16 fathoms. The Isle of Man is connected with England by this plateau, and is separated from Ireland by deep water.

3. Depths of over 20 fathoms are only found to the west, north, and south of the Isle of Man; and depths of

from 20 to 50 fathoms give us the most varied bottom deposits and the richest fauna. As a rule, the sand is more or less mixed with mud, and as the bottom goes deeper the amount of mud gets greater. When there is a considerable admixture of mud with coarse sand, that forms what is known to the trawlers as a "reamy" bottom, and that is the ground upon which the sole and some other fish are generally found spawning.

Shells and other hard parts of animals play an important part in the deposits at depths of about 20 fathoms and upwards. In places the dredge comes up filled with Pecten shells, dead and alive, chiefly *P. opercularis* and *P. maximus*. At other places the deposit is practically composed of the shells of *Pectunculus glycimeris*. These and other shell beds form a rich collecting ground to the naturalist, as they support an abundant and varied fauna. Zoophytes and polyzoa are attached to the shells, and these serve as shelter for nudibranchs and other small mollusca, worms, and ascidians. On the whole the heterogeneous deposits support a richer fauna than do the homogeneous deposits, such as sand or mud, and it is chiefly in the zone of depth we are now considering that the heterogeneous deposits occur.

4. The depths over 50 fathoms contain a pure dark bluish grey mud, which is very tenacious, and sets when dried into a firm clay. This is abominable stuff to dredge in and to work with on deck. It clings to everything that touches it; it is almost impossible to see what is in it, and to get the animals out of it uninjured; it is too solid for the sieves, and the hose can be played upon masses of it almost indefinitely without dissolving it. The fauna of this zone is, in our district, quite peculiar and characteristic. In its shallower parts, about 50 fathoms, it contains great numbers of living and dead *Turritella terebra*, upon

many of which are attached one, two, or three specimens of the little red anemone, *Sagartia herdmani*, Haddon. In its deeper parts, up to 80 fathoms, are found *Calocaris macandreæ*, *Hyalinœcia tubicola*, a small *Lumbriconereis*, *Panthalis oerstedi*, *Lipobranchius jeffreysii*, *Brissopsis lyrifera*, *Amphiura chiajii*, and *Isocardia cor*. Numbers of large sausage-like muddy tubes, formed of stratified layers of interlacing threads of mucus in which the mud particles are closely entangled, are brought up in the dredge. These we have now proved to be the tubes of *Panthalis oerstedi*, and the living annelid has several times been found in the tubes, but most of those we dredge up are empty, and the tubes are certainly far more numerous than the worms. Possibly the explanation is that the *Panthalis* forms a tube as it lies in the mud, and then when it moves away leaves its tube behind it (one can scarcely imagine the animal dragging such a tube through this tenacious deposit), and after a time forms another in a new situation.*

These are the leading conclusions we have come to so far in regard to the distribution of sub-marine deposits in our area. Two further questions now present themselves; first, the biological one—the effect upon the fauna; and secondly, the geological one—the origin of the deposits. In regard to the importance of the nature of the bottom to the animals living upon it there can be no doubt. Probably the nature of the deposit is the most important of the various factors that determine the distribution of

* This suggested explanation was written in June, and was read in August before Section D of the Brit. Assoc. at Oxford. The work of Mr. Watson, at Port Erin at the end of August has pretty well established its correctness, as he watched a *Panthalis*, in a tank, desert its old tube and form a new one from mucus threads and mud particles (see p. 297). It must be remembered also that some of the empty tubes doubtless belong to dead worms.

animals over the sea-bottom within one zoological area. It is certainly more important than mere depth; a muddy bottom will support a similar fauna at 10 fathoms in one place and at 50 fathoms in another. Probably the most important influence in the environment of a lower animal is its food, and once beyond the narrow sub-littoral zone in which algæ flourish—and to which, of course, certain phytivorous animals must be restricted—it is probably chiefly the nature of the bottom which determines the food.* Many animals feed upon the deposit, others browse upon the polyzoa and zoophytes which can only attach themselves and grow where there are sufficiently large objects, such as shell valves, from which they can get the necessary stability; while others, again, feed upon their neighbours, which subsist on the deposit or are attracted by the zoophytes, &c.; for example, soles are frequently caught upon ground (known to fishermen as "sole ground") where *Flustra foliacea* lives in abundance, and the probable connection is that the fish are dependent upon the numerous amphipoda and other small animals which frequent the tufts of *Flustra*. The same locality may vary so much from time to time in the temperature, the salinity, and the transparency of the water, that it is probable that none of these factors—so long as the variations do not exceed certain limits—have so much influence upon the fauna as the nature of the deposit has. It is therefore quite to be expected that the fauna should vary from place to place with the nature of the bottom, and that is what we have observed frequently in our work round the Isle of Man. In practically the same water,

* The only food supply quite independent of the bottom is dead plankton, from the water above, which may reach the bottom uneaten; and possibly a small amount of decayed vegetation and other organic matter brought down by rivers from the land, and some of which may reach the sea-bottom.

identical in temperature, salinity, and transparency, at the same depth, with, so far as one can see, all the other surrounding conditions the same, the fauna varies from place to place with changes in the bottom—mud, sand, nullipores, and shell beds, all have their characteristic assemblages of animals.

As to the further, and very important, question of the origin of the deposits, that is to a great extent a purely geological inquiry, and one which cannot, until we have accumulated a much larger series of observations, be fully discussed; but there are a few matters which may be briefly pointed out as giving some idea of the range and bearing of the question.

1. It is necessary to make a most careful examination of the deposits. For example, all muds are not the same in origin. A deposit of mud may be due to the presence of an eddy or a sheltered corner in which the finer particles suspended in the water are able to sink, or it may be due to the wearing away of a limestone beach, or to quantities of alluvium brought down by a stream from the land, or to the presence of a submerged bed of boulder clay, or, finally, in some places, to the sewage and refuse from coast towns.

2. I have kept in view the possibility of some correlation between the geological formations along the beach and the sub-marine deposits lying off the shore. There is no doubt that the nature of the rock forming the shore has a great influence upon the marine fauna, and has sometimes *some* effect upon the neighbouring deposits. For example, the contrast between the deposits lying off the two prominent headlands, the Great Orme, in North Wales, and Bradda Head, in the Isle of Man, is well marked. The Great Orme is composed of mountain limestone, and the result of its weathering and erosion is that large blocks

are found lying scattered outside its base on the fine sand; but there is no deposit of smaller stones, gravel, and resulting sand farther out, probably because in the wearing of the rock and large detached blocks by the sea a great deal is removed in solution and the rest in suspension as very fine mud—this we have found to be the case round Puffin Island, which is also mountain limestone. Bradda Head, on the other hand, is a schistose metamorphic silurian rock, which breaks up into large fragments, and these into smaller, and so forms deposits of dark slatey more or less angular gravel, and then very coarse sand, extending for some way out from the foot of the cliff.

The influence of the shore rocks upon the littoral fauna is an important subject upon which we have accumulated some observations; but the matter requires further work and detailed discussion, and must be left over for a future report.

3. Probably the great bulk of the silicious sand which forms so large a part of the floor of our sea is derived proximately—whatever may have been its ultimate source*—from the great deposits of drift which were formed in the neighbourhood during the Glacial period, and large tracts of which may since have been broken up by the sea.

4. As examples of a few peculiar and specially noteworthy deposits which are not simply "terrigenous" in their origin, the following may be mentioned:—

South-east of the Calf Sound, about two miles out, at a depth of 20 fathoms, there is a white shelly sand which seems to be almost wholly composed of animal remains. There are broken fragments of the lamellibranchs *Pecten*, *Anomia*, *Pectunculus*, *Mactra*, *Venus*, and *Mytilus*, of the gastropods *Cypræa*, *Buccinum*, *Emarginula*, *Purpura*, and

* Probably to a great extent, Triassic sandstones.

Trochus, of various calcareous polyzoa, such as *Cellaria fistulosa*, *Cellepora pumicosa*, and lepralids, of *Balanus* and *Serpula*, and of various echinoderm plates and spines, and the whole shells of *Echinocyamus pusillus*. The deposit, when it comes up in the dredge, is of a gleaming whiteness, and has a very characteristic appearance. Such a deposit as this would form a rock almost wholly made up of fossils, and might compare well with some Tertiary fossiliferous deposits, such as the Coralline Crag.

A little further north, along the east coast of the Isle of Man, at about a corresponding depth and distance from land, we meet with a purely vegetal deposit formed of the nullipores *Lithothamnion* and *Melobesia*. On the other side of the island, again, between Port Erin and the Calf, at a depth of 18 fathoms, there is a tract of sea-bottom which, when brought up on deck, looks, at the first glance, like a peculiarly fibrous sand, but a closer examination shows that it is entirely composed of the comminuted plates, and especially the spines of echinids, chiefly *Spatangus*. I do not remember to have met with a reference to material such as this either amongst recent or fossil deposits.

The remarkable deposit of cemented shells, which was described in last year's report, from a locality half-way between the Calf and Holyhead, is also found off King William's Bank, between Ramsey and St. Bees. Plate II. represents a piece of this material.

The variety that is noticed in sub-marine deposits round the Isle of Man, from depths of 15 to 35 fathoms, as brought up in the dredge, is very striking. It is remarkable how differing proportions in the mixtures of sand, gravel, and shells give rise to very different colours and general appearance in the mass. As seen, when tumbled out of the dredge on to the deck, some deposits are white, some yellow, some grey, some reddish, of various tints from pink to ruddy brown, and others darker, of all shades of brown and dark grey. It is curious how, even in a composite deposit made up of many different constituents, there is usually a prevailing tint; for example, the bottom at one spot, although composed of mud, sand, nullipores, shells and stones, is distinctly of a rich ruddy brown tint. The importance of this presence of prevailing colours in the various sub-marine deposits is obvious in its bearing upon the colours and habits of animals.

Sample bags of all the more important sub-marine deposits we have come upon have been sent, at Sir Archibald Geikie's request, to the Museum of the Geological Survey in Jermyn Street. They are being examined there by Mr. Clement Reid, F.G.S., who writes the following preliminary note in regard to them:—

"On comparing these samples with British deposits of Tertiary date, one finds a marked difference in lithological character. Dredgings from the Irish Sea, and also from the North Sea, are characterised by a much coarser and more gravelly texture than one would expect at such depths—coarser, in fact, than one finds in the Pliocene deposits yielding a similar fauna, indicating similar or even smaller depths. A glance at these dredgings shows the reason for this, for they are largely composed of unworn or little worn fragments of rock, often entirely incrusted by organic growth. The stones evidently have not been transported far by water, or they would be well rounded, like the pebbles found in our Eocene beds. The incrusting organisms show also that the fragments have lain undisturbed on the sea-bed, yet they have often been derived from far distant sources. Though no Glacial striæ were observed, and no undoubted sub-fossil Arctic shells have yet been found at these localities, yet there seems little doubt that the bulk of the material on the sea-bottom over this area has been derived from the breaking up of pre-existing Glacial deposits. This may occur at a depth of several fathoms through the gradual washing away of the muddy and sandy matrix of a boulder clay or Glacial gravel. Coarse gravel is thus caused to accumulate at a spot where the currents may be too feeble to transport anything but sand.

"This sub-marine origin of angular gravel deposits should not be forgotten, for it affects the lithological character of the sea-bottom over most of the area which was formerly glaciated, even as far south as Cornwall. On the other hand, it does not affect, except to a small extent, the sea-bed beyond the former limit of the ice, and it does not affect pre-Glacial deposits. Thus we must always expect to find at similar depths the same fauna associated with deposits of finer texture as soon as we leave the glaciated area, or when we go back into Tertiary times.

"It is also worth noting that the occurrence of a stony bottom at 20 or 30 fathoms—where normally there would be no deposit coarser than sand—will probably lead to a disproportionate increase of all incrusting organisms, and of all organisms needing a solid base. This has certainly taken place, as anyone studying our shoal-water Tertiary deposits will have observed. They contain few stones, and though each stone or dead shell may be covered with incrusting organisms, yet the relative proportion of these to the free forms is far smaller than seems commonly to be the case in the seas that now wash our shores. The sole exception to this rule among the British Tertiary strata is found in the Coralline Crag, in which the contemporaneous consolidation of the limestone was sufficient to provide the necessary solid base for the incrusting and fixed organisms so abundant in that deposit."

In conclusion, it is clear that this investigation of our modern sub-marine deposits, their distribution, nature, origin, and associated fauna, has geological applications, and that our results may be of some importance, *e.g.*, to palæontologists, in aiding them to determine the conditions under which the fauna of a particular horizon probably existed in the past; but, from our point of view, the matter is a purely Biological one. We consider it of primary importance, in studying the distribution of the marine animals in our district, to investigate as minutely as possible their environment, and that not merely because it gives us some of the factors and possibly the explanation of the distribution, but also on account of the light it may throw upon the habits, variations, and other important characteristics of the species.

Other Faunistic Work.

In addition to the larger dredging expeditions (see p.269), a good deal of work has been carried on during the year from small boats in Port Erin Bay, and by shore-collecting at Port Erin, Port St. Mary, Perwick, Fleshwick, and the Calf Sound.

One interesting piece of work carried out in the Aquarium, was Mr. Arnold T. Watson's observations on the tube building of *Panthalis oerstedi*, a Polynoid worm. As is stated above (p.290), in the deep water off Port Erin we dredge in the mud large thick-walled tubes, which are sometimes associated with *Panthalis*, and which we supposed to be formed by that annelid. However, some doubt had been expressed on the matter, and a leading authority on the Annelida gave it as his opinion that the connection between *Panthalis* and the tubes had never been clearly established. Consequently, I suggested to Mr. Watson that he should come to Port Erin, obtain living specimens of the worm, and watch its habits in the Aquarium. Mr. Watson came on August 24th, and the following day we were fortunately able to take a steamer to the ground, and amongst the tubes brought up in the dredge, from over 50 fathoms, one contained a fine living *Panthalis*, which was successfully brought on shore and transferred to a small tank provided with a supply of the fine mud in which the animal lives. The worm was then kept under the closest observation by Mr. Watson during the whole day for the next week, and his enthusiasm and patient care have been rewarded by the collection of a number of drawings and notes and some photographs of the appearance and movements of the living animal. During that time the *Panthalis deserted its old tube and formed a new one in the mud*, fortunately using the glass for part of one side, so that the process of scooping out, the mud and of spinning the network of mucus threads and the various movements of the animal were readily enough seen—if one did not mind the inconvenience of lying for hours in a cramped position on the damp concrete floor of the Aquarium-room. This satisfactorily settled the *Panthalis* question, and established the correctness of our previous views as to the connection between the worm and the empty tubes brought up in the dredge.

Rev. T. S. Lea, M.A., on two visits to the Station, spent some time in taking photographs of characteristic specimens of the Marine Algæ *in situ* at low tide, and in making microphotographs in the laboratory. He also photographed some of our collecting grounds and pools, and some selected pieces of rock showing assemblages of animals and plants in their natural environment.

We have again been able to send specimens of the large red mite *Bdella basteri* to Mr. Michael to aid in his work on the Acarina. We have found the home of this species to be deep in the cracks and fissures of the cliffs round the Biological Station. From these holes the mites occasionally emerge in numbers, and are then found over the shore and on our concrete steps.

Mr. Chadwick made a special study of the plankton of Port Erin Bay during part of May, and collected a large amount of material, which is not yet fully examined. He found, amongst other things, various stages in the life history of *Amphicodon fritillaria*, post larval stages of *Polynoe*, *Terebella*, and *Pectinaria*, and also the *Halistemma*-like Siphonophore, which had been found by Mr. E. T. Browne in April.

Professor Weiss was at work during the spring at Port Erin, on Marine Botany. In part he was investigating the effect of different coloured lights on various living sea-weeds. He did not arrive at any definite result, but intends to pursue the matter further. He also spent some time in examining living Diatoms, with a view to clearing up some imperfectly known particulars in their life history. This work is also not yet completed.

Miss L. R. Thornely and Miss R. Alcock worked together at the Station for some time in June. Miss Thornely was occupied with the collection and determination of Polyzoa, and Miss Alcock was preserving material for investigations on the microchemistry of the tests of Tunicata.

In September we obtained some specimens of *Calocaris* with ova on the abdomen. The ova are of a pale red colour, and of relatively large size, measuring about 1·5 to 2 mm. in diameter in a specimen about 5 cm. long. There are from 45 to 60 ova on each individual. It is interesting to compare these measurements with those of the common shrimp, where an individual 7 cm. long may have about

5000 ova, measuring each about 0·7 mm. in diameter. So that in the *Calocaris* the ova are about three times as large, but not nearly so numerous, as in the case of its shallow water relation.

The "Drift Bottles."

In connection with the investigation of the surface life, in discussing the appearance and disappearance of swarms of certain Copepods and Medusæ, and in considering the possible influence of the movements of food matters upon the migrations of fishes, it has occurred to several of us at different times during the last few years, that it would be worth while to try to ascertain the set of the chief currents, tidal* or otherwise, such as the movement of surface waters caused by prevalent winds. The Prince of Monaco started a few years ago the system of distributing over the North Atlantic large numbers of small floating copper vessels, with the object of finding out where they drifted to. This plan we have adopted, with slight modifications. In September I selected a small, strong, buoyant bottle, measuring 7·5 cm. by 1·8 cm., which seemed well suited for the purpose, and which costs only 7s. per gross. I drew up a notice, as follows, to go in the bottles, and had a large number printed and numbered consecutively :—

* The tidal currents of the district are already to some extent known, and are marked in the charts and given in books of sailing directions, as Admiral Beechey's "Tidal Streams of the Irish Sea " but we desire to ascertain the resultant currents from all influences which would affect the drift of small floating bodies.

Any one who finds this is earnestly requested to write the place, and date when found, in the space (on the other side) for the purpose, place the paper in an envelope, and post it to

PROFESSOR HERDMAN,
University College,
LIVERPOOL.

Postage need not be prepaid.

No.......

[Turn over.

[OTHER SIDE.]

Please write distinctly, and give full particulars.

LOCALITY, where found ....

....

....

DATE, when found...

Name and address of sender.

....

....

A paper was then placed in each bottle, so folded that the number could be readily seen through the glass, the cork was well pressed down, and dipped in melted paraffin. Nearly two hundred of these bottles have, since September 30th, been dropped into the sea in various parts of our area, a record being kept of the locality and time when each was set free. Several dozen were let off from the Isle of Man steamer in crossing to Douglas and back, at intervals of quarter of an hour, and from our trawler when dredging between Port Erin and Ireland. Several dozen have been let off from Mr. Alfred Holt's steamers in going round to Holyhead and in coming down from Greenock. The fishery steamer "John Fell" has distributed a number along the coast in the northern part of the district, and others have been set free at stated intervals during the rise and fall of the tide from the Morecambe Bay Light Vessel, and from the Liverpool North-west Light Vessel. Altogether, over 30 per cent., or nearly one in three of the bottles distributed have been subsequently picked up on the shore and returned to me. They come from various parts of the coast of the Irish Sea—Scotland, England, Wales, Isle of Man, and Ireland. Some of the bottles have gone quite a short distance, having evidently been taken straight ashore by the rising tide. Others have been carried an unexpected length, *e.g.*, one (No. 35), set free near the Crosby Light Vessel, off Liverpool, at 12-30 p.m., on October 1st, was picked up at Saltcoats in Ayrshire, on November 7th, having travelled a distance of at least 180 miles* in 37 days; another (H. 20) was set free near the Skerries, Anglesey, on October 6th, and was picked up one mile N. of Ardrossan, on November 7th, having travelled 150 miles in 31 days; and bottle No. 1, set free at the Liverpool Bar, on September 30th, was picked up at Shiskin, Arran, about 165 miles off, on November 12th. On the other hand, a bottle (J. F. 34), set free on November 7th, at the Ribble Estuary, was picked up on November 12th at St. Anne's, having gone only 4 miles.

It would be premature as yet—until many more dozens or hundreds have been distributed and returned—to draw any conclusions. It is only by the evidence of large numbers that the vitiating effect of exceptional circumstances, such as an unusual gale, can be eliminated. Prevailing winds, on the other hand, such as would usually affect the drift of surface organisms are amongst the normally acting causes which we are trying to ascertain. I may state, however, that so far nearly 50 per cent. of the bottles

* More probably, very much further, as during that time it would certainly be carried backwards and forwards by the tide.

found had been carried to Ireland, and they are chiefly ones that had been set free in the southern part of the district (between Liverpool and Holyhead) and off the Isle of Man. The bottles set free along the Lancashire Coast and in Morecambe Bay seem chiefly to have been carried to the south and west, *e.g.*, to about Mostyn, in North Wales, and Douglas, Isle of Man. It is only a few exceptional ones so far that have been carried out of our area through the North Channel.

Plate I. shows by the dark dashes the lines along which the drift bottles have been set free, and the arrow heads give some idea of the direction which some of the bottles have apparently taken.

Publications.

Sufficient material has now been accumulated to form a new volume of the "Fauna of Liverpool Bay." Consequently, Volume IV. will be issued early in 1895, and will contain, in addition to the reports and papers which were mentioned last year as printed off, the Supplementary Report on the Hydroid Zoophytes, by Miss L. R. Thornely; a list of the Nemertida found at Port Erin, by Messrs. Beaumont and Vanstone; a revision of the Nomenclature and Classification of British Sponges, by Dr. Hanitsch; a Report on the Fishes of the District, by Professor Herdman; a paper on *Synapta*, by Mr. Chadwick, and one on the Tube-building Habits of *Panthalis*, by Mr. Watson; a report on the L. M. B. C. Medusæ, by Mr. Edw. T. Browne; and a Supplementary Report on Copepoda, by Mr. I. C. Thompson.

It has been suggested that a general index should now be drawn up to the species recorded in the volumes on the Fauna and Flora of Liverpool Bay. There can be no doubt that such an index would be useful, and will eventually be necessary, but as the work of identifying species is still in active progress, and fresh records are being made annually, it is perhaps a little premature to undertake such a piece of work now. Probably an appropriate time for the compilation of such an index would be at the conclusion of the labours of our British Association Committee, which will probably submit its final report on the occasion of the visit of the British Association to Liverpool in the autumn of 1896.

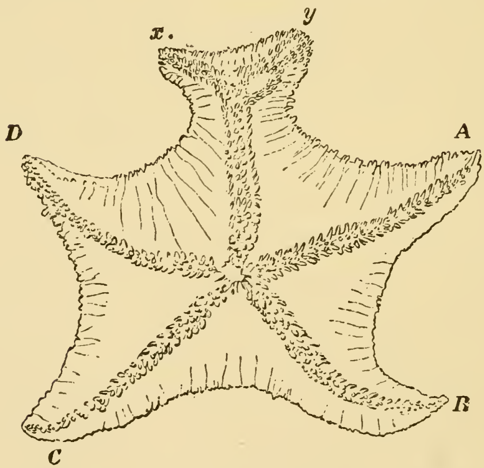
The surplus copies of the five Annual Reports upon the Marine Biological Station formerly on Puffin Island (1888 to 1892, the complete set) have been collated and bound up to form an 8vo. volume of about 180 pages, illustrated with cuts and plates, and containing the original lithographed covers. There are 20 copies of this vol. which are now offered by the Committee at 3s. each nett (post free); apply to Mr. I. C. Thompson, 4, Lord Street, or to Prof. Herdman, University College.

Future Work.

During the coming year the Committee propose, in the course of their dredging, trawling, and tow-netting investigations, to pay special attention to the nature of the sea-bottom and to the assemblages of animals and plants found on particular deposits. They hope, with the co-operation of Mr. Clement Reid, and of any local Geologists who will help them, to work up more thoroughly the Geology of the sea-bottom, and so attempt the solution of that interesting problem, the date and circumstances of formation of the Irish Sea and of the separation of the Isle of Man from England. They propose also to continue for at least a year the observations on currents by means of "drift bottles," and would be glad of any assistance in this from shipowners and captains, especially in distributing bottles along lines crossing the northern and southern entrances to the Irish Sea, such as from Port Patrick to Belfast, or from Belfast to Whitehaven, and from Holyhead to Dublin, or thereabouts.

A further subject upon which the Committee are very desirous of doing some work is sea-fish hatching and fish culture. That, however, is a somewhat expensive matter, requiring special arrangements and apparatus. If the various County Councils and Fishery Boards having jurisdiction over the territorial waters of the Irish Sea, could see their way to unite in promoting a Fish Hatchery at Port Erin, it would be a benefit to the whole sea-district. This northern area of the Irish Sea, in the centre of which the Isle of Man lies, is a natural fishery district, with its own spawning grounds, "nurseries," feeding grounds, and important fishing industries. The same bye-laws ought to apply throughout the area, and there ought to be a central fish hatching and rearing establishment in some convenient spot where the water is the purest obtainable and as free as possible from all suspended matters. Such a hatchery would not be for the benefit of Lancashire alone, nor of Cheshire, nor of the Isle of Man, but would benefit the fish population of the entire area, and the fisheries in general. The L. M. B. C., although very willing to advise, to co-operate, and to supervise if desired, cannot be expected unaided to carry out such an extensive scheme; but even if they receive no outside assistance, they are determined to start the matter by conducting some experiments in hatching during the coming spawning season, so as to demonstrate the suitability or otherwise of Port Erin for this purpose. In this connection the Hon. Treasurer begs to call attention to the fact that his small balance in hand will very soon be exhausted in making the necessary preparations for these experiments, and that he would be very glad to receive subscriptions for this or any other of the special purposes mentioned above.

The usual statement of the Hon. Treasurer, and the the list of subscriptions and donations for 1894 is appended to this Report.



An abnormal specimen of *Porania pulvillus*, where one of the rays shows a tendency to branch dichotomously. *A*, *B*, *C*, *D* are normal rays, while the fifth ray has divided into *x* and *y*, the latter of which has split and partially united at least twice. The specimen is in the Zoological Museum of University College, Liverpool. (For the use of this block we are indebted to the courtesy of Messrs. Macmillan & Co.)

Appendix.

SUBSCRIPTIONS and DONATIONS.

	Subscriptions.			Donations.		
	£	s.	d.	£	s.	d.
Alcock, Miss, Cambridge	0	10	0		—	
Banks, Prof. W. Mitchell, 28, Rodney-st.	2	2	0		—	
Beaumont, W. I., Cambridge	1	1	0		—	
Bickersteth, Dr., 2, Rodney-street... ...	2	2	0		—	
Boulnois, H. P., 7, Devonshire-road, Prince's Park	1	1	0		—	
Brown, Prof. J. Campbell, University College, Liverpool	1	1	0		—	
Browne, Edward T., B.A., 14, Uxbridge road, Shepherd's Bush, London ...	1	1	0		—	
Caine, Nath., 10, Orange-court, Castle-street	1	1	0		—	
Caton, Dr., 31, Rodney-street		—		1	1	0
Clague, Dr., Castletown, Isle of Man ...	1	1	0		—	
Clague, Thomas, Bellevue Hotel, Port Erin	1	1	0		—	
Comber, Thomas, J.P., Leighton, Parkgate	1	1	0		—	
Crellin, John C., J.P., Ballachurry, Andreas, Isle of Man	1	1	0		—	
Dawkins, Professor W. Boyd, Owens College, Manchester	1	1	0		—	
Denny, Prof., Firth College, Sheffield ...	1	1	0		—	
Derby, Earl of, Knowsley	5	0	0		—	
Gair, H. W., Smithdown-road, Wavertree...	2	2	0		—	
Gamble, Col. David, C.B., Windlehurst St. Helens	2	0	0		—	
Gamble, F. W., Owens College, Manchester	1	1	0		—	
Gaskell, Frank, Woolton Wood, ...	1	1	0		—	
Gaskell, Holbrook, J.P., Woolton Wood,	1	1	0		—	
Gell, James S., High Bailiff of Castletown...	1	1	0		—	

Gibbons, Fredk., 19, Ranelagh-street ...	1	1	0	—
Gibson, Prof. R. J. H., 41, Sydenham-avenue	1	1	0	—
Gifford, J., Whitehouse terrace, Edinburgh	1	0	0	—
Glynn, Dr., 62, Rodney-street	1	1	0	—
Greening, Linnæus, 5, Wilson Patten-street, Warrington	1	1	0	—
Hall, Walter J., Lindum House, Nantwich	0	10	0	—
Halls, W. J , 35, Lord-street	1	1	0	—
Henderson, W. G., Liverpool Union Bank	1	1	0	—
Herdman, Prof., University College, L'pool.	2	2	0	—
Hick, Herbert E., M.R.C.S., Southport House, Bradford	0	10	6	—
Hick, Thomas, B.A., Brighton-grove, Rusholme, Manchester	0	10	6	—
Holder, Thos., 1, Clarendon-buildings Tithebarn-street	1	1	0	—
Holland, Walter, Mossley Hill-road ...	2	2	0	—
Holt, George, J.P. Sudley, Mossley Hill ...	1	0	0	—
Howes, Prof. G. B., Royal College of Science, South Kensington, London...	1	1	0	—
Hoyle, W. E., Museum, Owens College, Manchester	1	1	0	—
Isle of Man Natural History and Antiquarian Society	1	1	0	—
Jones, C. W., J.P., Field House, Wavertree	1	0	0	—
Kermode, P. M. C., Hill-side, Ramsey ...	1	1	0	—
Lea, Rev. T. Simcox, 3, Wellington-fields	1	1	0	—
Leicester, Alfred, 30, Weld-rd., Birkdale...	1	1	0	—
Lomas, J., Amery-grove, Birkenhead ...	1	1	0	—
Macfie, Robert, Airds	1	0	0	—
Meyer, Dr. Kuno, University College, L'pool	0	5	0	—
Meade-King, H. W., J.P., Sandfield Park	1	1	0	—
Meade-King, R. R., 4, Oldhall-street ...	0	10	0	—
Melly, W. R., 90, Chatham-street... ...	1	1	0	—
Miall, Prof., Yorkshire College, Leeds ...	1	1	0	—
Monks, F. W., Brooklands, Warrington ...	1	1	0	—

Muspratt, E. K., Seaforth Hall	5	0	0	—
Newton, John, M.R.C.S., 44, Rodney-street	0	10	6	—
Odgers, Rev. J. E., Woodstock Rd., Oxford	1	1	0	—
Poole, Sir James, Tower Buildings ...	2	2	0	—
Rathbone, S. G., Croxteth-drive, Sefton-park	2	2	0	—
Rathbone, Mrs. Theo., Backwood, Neston	1	1	0	—
Rathbone, Miss May, Backwood, Neston ...	1	1	0	—
Rathbone, W., M.P., Greenbank, Allerton	2	2	0	—
Reading, N. C., Wake Green-road, Moseley	0	10	6	—
Roberts, Isaac, F.R.S., Tunbridge-wells ...	1	1	0	—
Shaw, Prof. H. S. Hele, 26, Waverley-road	1	1	0	—
Shepheard, T., Kingsley Lodge, Chester ...	1	1	0	—
Simpson, J. Hope, Annandale, Aigburth-drive	2	2	0	—
Smith, A. T., junr., 24, King-street ...	1	1	0	—
Stevenson, W. A., Ballakreighan, Castletown, Isle of Man	1	1	0	—
Talbot, Rev. T. U., 4, Osborne terrace, Douglas, Isle of Man	1	1	0	—
Thompson, Isaac C., 19, Waverley-road	2	2	0	—
Thornely, James, Baycliff, Woolton ...	1	1	0	—
Thornely, The Misses, Baycliff, Woolton ...	1	1	0	—
Toll, J. M., 340, Walton Breck-road ...	1	1	0	—
Tomlin, B., 59, Liverpool-road, Chester ...	0	5	0	—
Walker, Alfred O., Nant-y-glyn, Colwyn Bay	3	3	0	—
Walker, Horace, South Lodge, Princes-park	1	1	0	—
Walters, Rev. Frank, B.A., King William College, Isle of Man	1	1	0	—
Watson, A. T., Tapton-crescent, Sheffield	1	1	0	—
Weiss, Prof. F. E., Owen's College, Manchester	1	1	0	—
Westminster, Duke of, Eaton Hall ...	5	0	0	—
Wiglesworth, Dr., Rainhill...	1	1	0	—
	101	15	0	1 1 0

THE LIVERPOOL MARINE BIOLOGY COMMITTEE.

Dr. IN ACCOUNT WITH ISAAC C. THOMPSON, HON. TREASURER. **Cr.**

1894.	£	s	d.
To Balance due Treasurer, 1893	46	14	2
,, Expenses of Dredging Expeditions	31	11	8
,, Rent of Port Erin Biological Station and Aquarium	15	0	0
,, Boat Hire	4	0	9
,, Apparatus, Furniture, Books, &c., at Port Erin Biological Station	13	19	4
,, Printing, Dobb & Co, Reports, &c., &c	22	10	6
,, Postages, Carriage of Apparatus, &c	3	5	6
,, Sundries	5	2	1
,, Salaries to temporary Curator. and laboratory boy	20	19	0
,, Balance in hand	3	6	2
	£166	9	2

1894.	£	s.	d.
By Subscriptions and Donations	101	15	0
,, Royal Society Grant	50	0	0
,, Dividend, British Workman's Public House Co. Ltd., Shares	4	2	7
,, Sale of Reports	5	17	6
,, Bank Interest	1	10	2
,, Sale of Museum Specimens	0	14	1
,, Admissions to Aquarium (Port Erin)	2	9	10
	£166	9	2

Endowment Fund Investment :—

	£	s.	d.
Brit. Workman's Public House Co.'s Shares	173	1	0
Cash pending Investment	7	10	0
	£180	11	0

ISAAC C. THOMPSON,

HON. TREASURER.

Audited and found correct,

ALFRED LEICESTER.

LIVERPOOL, *December* 31*st*, 1894.

L.M.B.C. NOTICES.

The public are admitted by ticket to inspect the Aquarium from 12 to 1 and from 6 to 6-30 p.m. daily, when the Curator will be, as far as possible, in attendance to give information. Tickets of admission, price sixpence each, to be obtained at the Biological Station or at the Bellevue Hotel. The various tanks are intended to be illustrative of the marine life of the Isle of Man. It is intended also that short lectures on the subject should be given from time to time by Prof. Herdman, F.R.S., the Hon. Director of the Station, or by other members of the Committee.

Applications to be allowed to work at the Biological Station, or for specimens (living or preserved) for Museums, Laboratory work, and Aquaria, should be addressed to Professor Herdman, F.R.S., University College, Liverpool.

Subscriptions and donations should be sent to Mr. I. C. Thompson, F.L.S., 19, Waverley Road, Liverpool.

The L.M.B. Committee are publishing their Reports upon the Fauna and Flora of Liverpool Bay in a series of 8vo. volumes at intervals of about three years. Of these there have appeared :—

Vol. I. (372 pp., 12 plates), 1886, price 8/6.
Vol. II. (240 pp., 12 plates), 1889, price 7/6.
Vol. III. (400 pp., 24 plates), 1892, price 10/6.

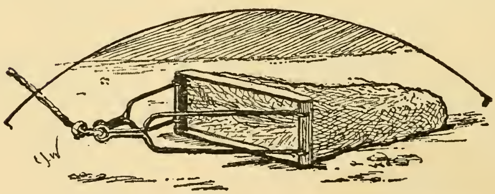
Copies of these may be ordered from the Liverpool Marine Biology Committee, University College, Liverpool, or from the Hon. Sec., 4, Lord Street, Liverpool.

Isaac C. Thompson,
Hon. Sec. and Treas.

Explanation of the Plates.

Plate I.—Chart of the Irish Sea showing the zones of depth (contours 10, 20, and 50 fathoms), the nature of the bottom (see p. 287), and the lines of distribution (thick dotting) of the drift bottles.

Plate II.—Calcareous "concretion," containing shells, sand grains, &c., cemented with carbonate of lime and a little carbonate of iron (see last report, p. 31). From a photograph by Rev. T. S. Lea.




50

RECENT ADDITIONS to the COPEPODA of LIVERPOOL BAY.

By Isaac C. Thompson, F.L.S., F.R.M.S.

With Plates VI and VII.

[Read November 9th, 1894.]

Since the Revised Report on the Copepoda of Liverpool Bay was published last year, twenty-four species new to the district have been recorded, one of these, *Pseudocyclopia stephoides*, being new to science.

Surface tow-nets have been continuously employed during the several marine expeditions undertaken by the Committee, also tow-nets attached to the rope a few fathoms above the dredge. The latter device has proved a success, collecting some good species of Copepoda, as well as Cumacea and Amphipoda, which are seldom or never obtained on the surface. Amongst the Copepoda thus obtained were several specimens of *Pseudocalanus armatus*, found along with a shoal of *Pseudocalanus elongatus*. A widely extending shoal of *Anomalocera patersonii* was observed off the Isle of Man in May, the only occasion on which we have taken this species during the year. On several occasions, notably in the early part of June, the surface organisms have been singularly scarce.

Special care has been taken to wash and sieve through fine silk as much as possible of the material brought up by the dredge during marine expeditions, and it is by this means that several of the above-mentioned Copepoda, new to the district, have been obtained, as well as the new species *Pseudocyclopia stephoides*.

Mr. Andrew Scott, "Fisheries" Assistant at University College, has worked through a large amount of material collected at low water and on various marine expeditions, with excellent results, the majority of those here mentioned having been found by him. To his kindness and skill in delineation I am also indebted for the drawings from which the plates accompanying this paper are engraved.

Description of Species.

COPEPODA.

Family Pseudocyclopiidæ.

Pseudocyclopia stephoides, n. sp. (Pls. VI and VII, figs. 1 to 14).

Length, exclusive of caudal setæ, 1·2 mm. Cephalothorax robust, four-jointed, the first segment being two-thirds the combined length of the other three. Abdomen five-jointed in the male (fig. 14), four-jointed in the female (fig. 13); the lower portion of the first joint in the male abdomen (fig. 14) is covered with fine very short hairs or spines; the first joint in the female abdomen is about equal in length to that of the combined succeeding three joints. Rostrum short.

Anterior antennæ (fig. 2) of moderate length, twenty jointed. Basal joint large, almost equal in length to the succeeding six joints, and bearing three plumose setæ and one shorter seta; the seventh, ninth, thirteenth, and twentieth joints have long sensory filaments; the nineteenth joint has one plumose seta; each joint bears one or more ordinary setæ. The proportional lengths of the joints are about as follows:—

24	5	3	3	4	5	6	3	4	3	3	3	3	3	3	3	3	3	3	4
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Primary branch of posterior antennæ (fig. 3) two-jointed, in this respect and no other differing from the generic character of *Pseudocyclopia*, Scott, in which the primary branch is described as being three-jointed. The basal joint has two marginal setæ, the terminal joint having a number of apical setæ. Secondary branch large, five-jointed, the first, second, and apical joints being about twice as long as broad, the third and fourth about half as long as broad.

Mandibles (fig. 4) large, consisting of a broad biting part furnished with two plumose spines, and a two-branched palp, one of the branches being two, the other four-jointed.

Anterior foot-jaw (fig. 5) four-jointed, with several marginal processes, bearing long setæ, some finely plumose, the third joint having two powerful serrated claw-like spines; the fourth joint very small, and terminated with two long setæ. The posterior foot-jaw (fig. 6) is seven-jointed, the basal joint large, about twice as long as broad, bearing several marginal spines, the upper distal angle protruding upwards, and terminated by three long setæ, the lower one plumose. The second joint is about equal in length to the first, and little more than half its width; the inner margin clothed with short setæ, and having three long plumose setæ; the five terminal joints are small, their combined length being rather less than the first or second joints, and all thickly clothed with long setæ.

The swimming feet are very similar to those of *P. crassicornis*, Scott. The outer branch of the first pair (fig. 7) is three-jointed, each joint being provided with a stout dagger-like spine at the outer distal angle; the inner branch is one-jointed, and rather longer than the first joint of the outer branch. The outer branch of the second pair (fig. 8) is also three-jointed; each of the first and second joints bear one, and the last joint four, stout serrated spines of variable length, the terminal one being serrated only on the inner side; the inner branch is two-jointed, about half the length of the outer branch, its inner joint being about half as long as the outer one. The densely plumose setæ in the second, third, and fourth swimming feet are all jointed at about one-third of their length. The third (fig. 9) and fourth pairs (fig. 10) have both branches three-jointed. The outer branch in both pairs is very similar to that of the second pair. The inner branch of the fourth pair (fig. 10) has a strong hairy spine at the distal angle of the first and second joints in place of jointed seta in the fourth pair. Each of the fifth pair in the female (fig. 12) is one-branched, two-jointed, the first joint short, about as long as broad, with a spinous prolongation in the centre on the inner side. A similar projection, as well as a smaller one occur on each inner side of the segment from which the fifth feet spring. The second joint of the fifth pair is produced into three plumose spines (without articulation), the inner terminal one being longer than the two outer lateral ones. Each of the fifth pair of feet in the male (fig. 11) is one-branched and four-jointed, and together form a powerful clasping organ. The right foot is long and slender, the terminal joint being about the combined length of the other three; its centre portion almost forms a semi-circle, the continuation being a long sharp spine. The left foot is shorter; there are several setæ and a short blunt spine on the third joint; the fourth, which is small, terminating in a curved claw-like prolongation, with a sharp spine near the apex.

The caudal stylets (fig. 13) in the female are about as long as broad, those of the male (fig. 14) being rather longer; each bears three long and one short plumose setæ.

Three specimens only, two males and one female, were found in washings from dredged material taken outside Port Erin, in 15 fathoms, in March, 1894.

It was by no means easy to decide into which genus to place this well-marked species, as it has strong points of resemblance in common with the three genera, Pseudocalanus, Stephos, and Pseudocyclopia. With Pseudocyclopia it agrees in all points excepting in the number of joints in the anterior antennæ, and the primary branch of the posterior antennæ, and, as in general appearance and in the first four pairs of swimming feet, it strongly resembles Pseudocyclopia, I have decided provisionally to place it in that genus. Its fifth pair of feet, however, are more like those of Stephos.

In the Twelfth Annual Report of the Fishery Board for Scotland, Mr. Thomas Scott has added a new species belonging to this genus, recently found by him in the Forth area.

As the genus Pseudocyclopia forms a sort of missing link between the families Calanidæ and Misophriidæ, Scott has wisely constituted a new family, the Pseudocyclopiidæ, for its reception. The species of Pseudocyclopia, described by Scott having respectively sixteen and seventeen joints in the anterior antennæ, he has made that number a family character. The species here described has, however, twenty joints in the anterior antennæ, and as it otherwise agrees in all respects with the family characters of Pseudocyclopiidæ, I would suggest that the words "sixteen to seventeen jointed" be altered to "sixteen to twenty jointed" as a character of this new family.

Family Cyclopidæ.

Cyclops magnoctavus, Cragin.

One or two specimens of this brackish species were found along with quantities of *Temorella affinis* and *Tachidius brevicornis* in tow-net gatherings sent to me by Mr. Ascroft, taken by him in low water marine pools at Lytham. It is evident that a considerable amount of fresh-water finds its way into the Lytham pools.

Cyclops ewarti, Brady.

This species, first taken in the Forth estuary, was suspected by Brady to have a fresh-water origin. Ours are evidently strictly marine, two specimens, both males, having been dredged at 20 fathoms off Port Erin.

Family Harpacticidæ.

Longipedia minor, T. & A. Scott.

A few specimens of this species were collected by hand-net in the rock-pools at Hilbre Islands in March, by Mr. A. Scott. It is easily distinguished from *L. coronata*, Claus, by its much smaller size.

Canuella perplexa, T. & A. Scott.

Frequently found in dredged material taken about Port Erin. It has probably been overlooked from its general resemblance to *Longipedia coronata*, the points of difference being enumerated by Scott.

Ectinosoma normani, T. & A. Scott.

Several specimens were obtained by Mr. A. Scott in material from Barrow Channel, collected in May by Professor Herdman, and I have also dredged it off Port Erin. When fresh this species has a brilliant red spot on the lower angles of the cephalothorax, and in this respect it agrees with *E. erythrops*, Brady.

Ectinosoma elongata, A. & T. Scott.

One specimen was found in material from pools at Hilbre Island.

Ectinosoma gracile, T. & A. Scott.

One or two specimens of this species were obtained among dredged material collected at Port Erin by Professor Herdman.

Ectinosoma pygmæum, T. & A. Scott.

This species was obtained from the same material as the last, and is the smallest known *Ectinosoma*: it measures only $\frac{1}{76}$th of an inch (·33 mm.).

Ectinosoma herdmani, T. & A. Scott.

One specimen was found in dredged material taken off Port Erin.

Bradya minor, T. & A. Scott.*

A few species of this new *Bradya* were obtained in rock-pools at Hilbre Island, along with *Longipedia minor*.

Ameira longicaudata, Scott.

One specimen was found in material dredged at 15 fathoms between Port Erin and Peel.

Dactylopus rostratus, T. Scott.

A single specimen was obtained among some dredged material collected at Port Erin by Professor Herdman, at Easter, 1894.

Diosaccus propinquus, T. & A. Scott, *Ameira exigua*, T. Scott, *A. longiremis*, T. Scott, *Laophonte inopinata*, T. Scott, *Pseudowestwoodia pygmæa*, T. & A. S., and possibly a new *Laophonte*, and one or two other doubtful species were obtained from washings from sponges collected by Dr. Hanitsch at Port Erin in August, 1894.

Family Hersiliidæ.

Cancerilla tubulata, Dalyell.

The first record of this rare Copepod occurs in Dalyell's "Powers of the Creator," 1851, and it has since been taken by Mr. Gamble at Plymouth, but not before in our district. I found it lately on examining the results of

* The above species of *Ectinosoma* and *Bradya* are figured and described in a revision of the British species of Copepoda belonging to the two genera *Ectinosoma* and *Bradya*, T. & A. Scott, which is to be published at an early date.

a recent expedition from Port Erin. Large quantities of ophiuroids, chiefly *Ophiocoma nigra* and *Ophiothrix fragilis*, were amongst the dredged material, and it is probably from one or other of these that the two specimens of *Cancerilla tubulata*, Dalyell, male and female, were taken, as the species is parasitic on ophiuroids. It has recently been fully described and figured in "Les Copépodes du Boulonnais," by Dr. Eugène Canu.

Family Sapphirinidæ.

Pseudanthessius sauvagei, Canu.

A few specimens were obtained by washing a number of *Spatangus purpureus*, which were trawled in the central area, 21 miles W.N.W. from Morecambe Bay Lightship, on April 3rd. This rare species was only added to the British fauna last year, when it was found in the Firth of Forth, and the present is the second time it has been observed in the British area.

Lichomolgus (*Doridicola*) *agilis*, Leydig, was found in the bottom tow-net, Morecambe Bay, May, 1894.

Family Artotrogidæ.

Acontiophorus elongatus, Scott.

One specimen was found among the strained washings of *Pecten maximus*, dredged at 15 fathoms, off Port Erin.

Family Caligidæ.

Lepeoptheirus pectoralis.

Several specimens, male and female, were found on the flounder, taken off Morecambe, and also from *Arnoglossus megastoma*, at Professor Herdman's Fisheries Laboratory.

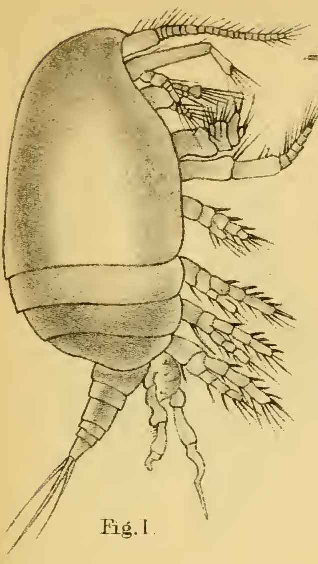


Fig. 1.

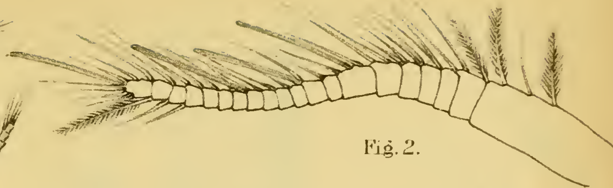


Fig. 2.

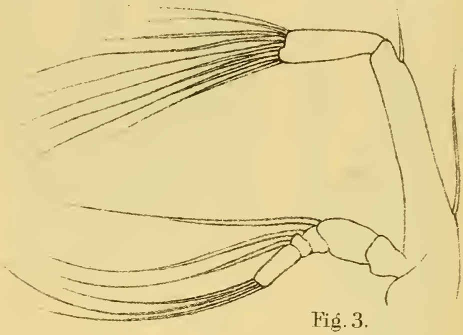


Fig. 3.

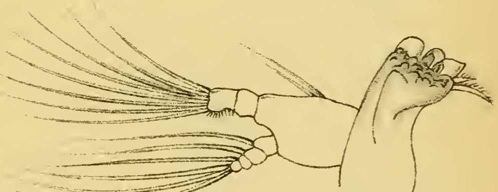


Fig. 4.

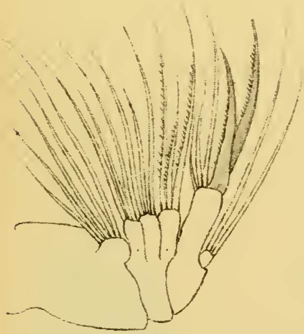


Fig. 5.

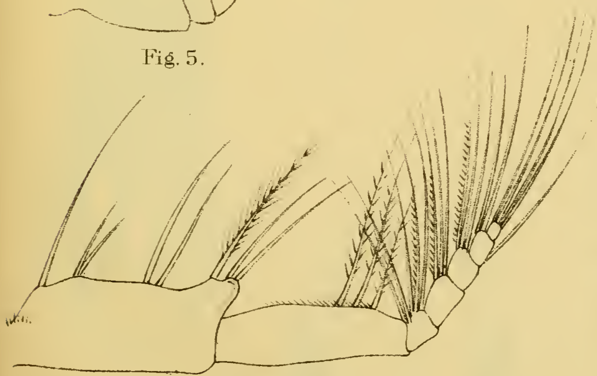


Fig. 6.

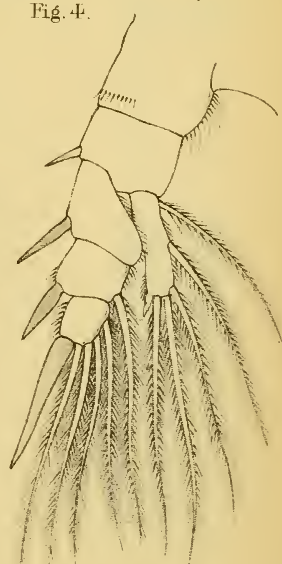


Fig. 7.

A. Scott, del ad nat.

PSEUDOCYCLOPIA STEPHOIDES, n. sp.

W & A.K. Johnston Edinburgh & London

Fig. 8.

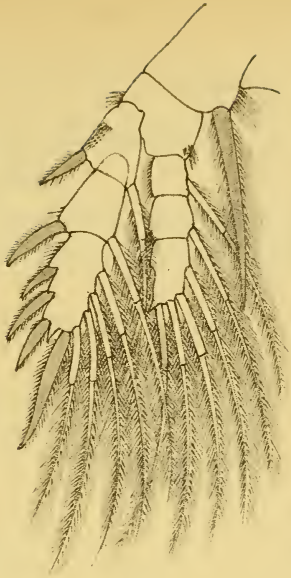


Fig. 9.

Fig. 10.

Fig. 11.

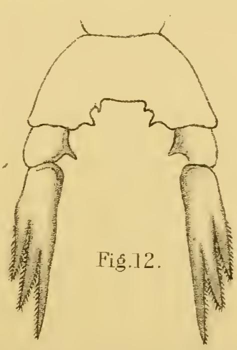


Fig. 12.

Fig. 13.

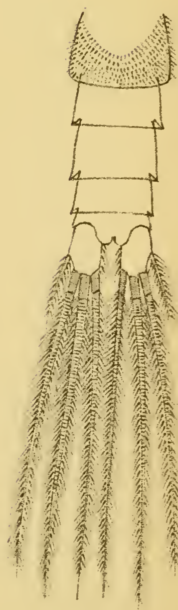


Fig. 14.

A. Scott, del ad nat.

PSEUDOCYCLOPIA STEPHOIDES, n. sp.

W. & A. K. Johnston, Edinburgh & London.

Family LERNÆIDÆ.

Anchorella appendiculata.

Several specimens were found attached to the gills of the hake at Professor Herdman's Fisheries Laboratory.

EXPLANATION OF PLATE VI.

Pseudocyclopia stephoides, n.sp.

Fig. 1. Adult male.
Fig. 2. Anterior antenna.
Fig. 3. Posterior antenna.
Fig. 4. Mandible and palp.
Fig. 5. Anterior foot-jaw.
Fig. 6. Posterior foot-jaw.
Fig. 7. Foot of first pair.

EXPLANATION OF PLATE VII.

Pseudocyclopia stephoides, n.sp.

Fig. 8. Foot of second pair.
Fig. 9. Foot of third pair.
Fig. 10. Foot of fourth pair.
Fig. 11. Fifth pair of feet, male.
Fig. 12. Fifth pair of feet, female.
Fig. 13. Abdomen and caudal stylets, female.
Fig. 14. Abdomen and caudal stylets, male.

[WORK FROM PORT ERIN BIOLOGICAL STATION.]

NOTE upon the yellow variety of *Sarcodictyon catenata*, Forbes, with remarks upon the GENUS and its species.

By W. A. HERDMAN, D.Sc., F.R.S.,

PROFESSOR OF NATURAL HISTORY IN UNIVERSITY COLLEGE, LIVERPOOL.

[Read December 14th, 1894.]

Plate VIII.

IN 1883, I published a somewhat detailed account* of the structure of the ordinary form of *Sarcodictyon catenata*, Forbes, from the examination of specimens dredged at Lamlash and in Loch Fyne, on the West Coast of Scotland, in 1880 and following summers. Some of my colonies from Loch Fyne were of a pale yellow colour, and an investigation of these showed that they only differed from the red colonies in having the numerous calcareous spicules of the mesoglœa perfectly *colourless* in place of being of a dull red tint. Hence, I came to the conclusion that here, just as in *Alcyonium digitatum*, where several distinct colours of colony are found, the red and the pale yellow colonies were merely cases of colour variation, and that all the specimens that I had examined were to be referred to the one species, *Sarcodictyon catenata*. Moreover, I made the suggestion that probably Forbes' second species, *S. agglomerata*, which was said† to differ from *S. catenata* in being of an "ochraceous yellow" colour, and in having the polypes placed in little groups of from three to five instead of in single file, would prove to be the same species, since (1) several of my red colonies had the polypes in groups, and (2) the yellow colonies bridged the gap as regards colour.

* Proc. R. Physical Soc. Edinburgh, vol. viii., p. 31.

† Trans. Roy. Soc, Edinburgh, vol. xx., p. 307, 1851.

Three years later, in 1886, I added* some further details in regard to *Sarcodictyon catenata* in the living condition from colonies dredged off Port Erin, in the Isle of Man, and which I had been able to keep alive for some time. In that paper I figured the polypes in the fully expanded condition, showing that the polype may extend to three times its usual height (*i.e.*, to 5 or 6 mm.), the translucent white upper expanded part of the body being about twice the length of the lower opaque red-coloured part. The figures (loc. cit. pl. iii.) showed a colony of thirteen polypes fully expanded, natural size, and one expanded polype, magnified, like the one now reproduced here (Pl. VIII., fig. 3).

Since that date we have frequently, during the L.M.B.C. expeditions, dredged colonies of the red *Sarcodictyon catenata* off the south and west of the Isle of Man, at depths of from 10 to 40 fathoms, and generally attached to shells or to stones. Last summer (1894) in a haul of the dredge taken at 2 miles off the north side of the Calf Island on August 25th, depth 22 fathoms, bottom sand and shells, I was fortunate enough to obtain several colonies of yellowish tints, which I think are quite sufficient to show conclusively that Forbes' *Sarcodictyon agglomerata* is the same species as *S. catenata*. I had previously shown that there were red colonies in the agglomerated condition, and yellow colonies with the polypes in single file. Now I have yellow colonies of several tints in the agglomerated state, and one of these, in its "ochraceous yellow" colour and in the grouping of polypes in threes and fives, exactly corresponds with Forbes' original description (see Pl. VIII., fig. 1).

On cutting sections of some of these yellow colonies I find that they have not all colourless spicules only, as I

* Fauna of Liverpool Bay, vol. i. p. 120.

found was the case with the Loch Fyne specimens in 1883, but that there are two distinct tints of yellow colony, one paler and greyer (Pl. VIII., fig. 2) in which the spicules are all colourless and the yellowish tint is merely due to the superficial tissues (chiefly the ectoderm) of the polypes and stolon, and the other of a much richer yellow (Pl. VIII., fig. 1), with sometimes a tinge of orange, and in these most of the spicules are very distinctly of a yellow colour, even when seen singly in thin sections (Pl. VIII., figs. 6, 7, 8), and when in mass along with the soft tissues they make up the rich yellow seen on the outside of the colony. The spicules which are yellow in these cases are exactly the ones which are red in the red colonies, viz., those of the stolon and of the lower thick opaque part of the body-wall, leaving those of the upper translucent part of the body-wall and of the tentacles colourless (see Pl. VIII., fig. 7). I succeeded in keeping yellow colonies, of both tints, alive and fully expanded in the aquarium at Port Erin for some time last summer. The upper parts of the body wall and the tentacles are exactly like those of the red form (see Pl. VIII., figs. 4, 5).

Consequently, there are altogether three colour varieties of *Sarcodictyon* which I know of :—

1. The red form, with red spicules in the stolon and lower part of the polype;
2. The bright yellow form, with yellow spicules in the stolon and lower part of the polype;
3. The pale yellow form, with colourless spicules throughout the colony.

All of these usually have the polypes in single file, but any of them may exceptionally have the polypes grouped in little clumps (as in Pl. VIII., fig. 1). Consequently, the characters distinguishing *Sarcodictyon agglomerata* fall to the ground, and that name must be regarded as a synonym of *S. catenata*, Forbes.

In all the other details of structure as seen in working through thin sections I find that the yellow colonies agree with the ordinary red ones—the only difference is in the colour of the spicules. I have been fortunate in coming upon ova in the yellow colonies recently examined—I had failed to find any trace of reproductive organs in the specimens examined in 1883. The ova are of rather large size, 0·09 mm. in diameter, and have a very distinct germinal vesicle and spot. They are enclosed in cellular follicles, about 0·12 mm. in diameter, which hang by long narrow pedicles from the edge of the mesenteries—projecting into the inter-mesenteric cavities in groups of two three and four together (Pl. VIII., fig. 10). I have seen no trace of spermatozoa, so it is very possible that the colonies are unisexual and that I have only examined female colonies.

In conclusion, I desire to make a few remarks in regard to the genus. Prof. Hickson has recently published a paper* on the genera of the Alcyonaria Stolonifera in which he deals critically with the various genera which have been placed in the family Clavulariidæ, and in the course of his analysis of this group he refers (*loc. cit.* p. 332) briefly to *Sarcodictyon* and comes to the conclusion that it must be merged in the genus *Clavularia*. There is no doubt that the three genera *Sarcodictyon*, *Rhizoxenia* and *Clavularia* are, if distinct, very closely related groups, and our British species *Sarcodictyon catenata* has by some writers been placed in *Rhizoxenia* and by others in *Clavularia*. It cannot, however, be referred to *Rhizoxenia* as that genus was characterised by Ehrenberg, its founder, and

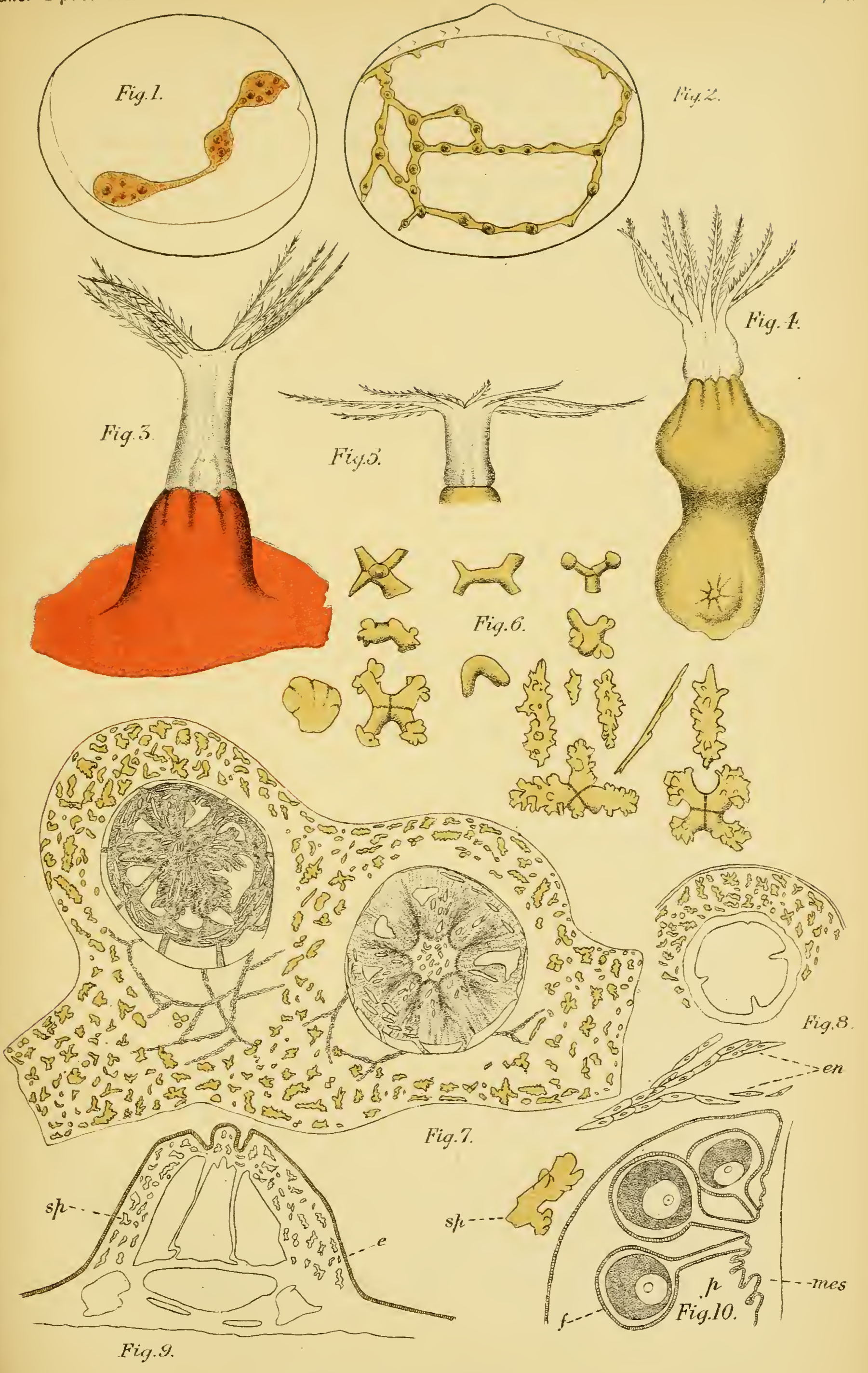
* Trans. Zool. Soc. Lond., vol. XIII., pt. IX., p. 325, Oct. 1894.

since that by Milne-Edwards and Haime, as having the polypes non-retractile, while *S. catenata* has eminently retractile polypes.

There remains then the question, ought our species to be included in *Clavularia?* If it cannot be separated from the species of that genus, *Clavularia* as a name has priority, having been established by Quoy and Gaimard in 1834 while *Sarcodictyon catenata* was not discovered by Forbes till 1845 and was not described till 1847. I am of opinion, however, that the constitution of the polype wall out of two very distinct parts, a lower thicker opaque coloured part into which the upper thinner translucent colourless part can be retracted, is so different from the condition seen in the species of *Clavularia* (see Hickson's beautiful plates, which show, in all the species figured, the body-wall extending in an unmodified state up to the bases of the tentacles) that it gives us sufficient grounds for the separation of *S. catenata* generically. And although the character of the body-wall above referred to was not included in the original description of *Sarcodictyon*, still the species *S. catenata*, Forbes, was the type of that genus and consequently *Sarcodictyon* is the name that ought to be retained as the generic title.

As to the further question whether there are any other species of *Sarcodictyon*, that is a very doubtful matter. Hickson mentions two species in all,—the well-known *S. catenata*, and another "*S. colinabum*" which I have never heard of. He gives as the locality Scotland, and as authority "Forbes (?)," but I cannot find the name in Forbes' works, and am inclined to think there must be some mistake about it.* Hickson does not include in his list of the species he desires to add to *Clavularia*, *Sarco-*

* Since the above was printed I have heard from Prof. Hickson that he possibly mistook a note book entry of *S. agglomerata* for "*S. colinabum*."



A. H. DEL.

SARCODICTYON

dictyon agglomerata, Forbes, and *S. rugosum*, Pourtalès. I have already expressed my opinion above that the former of these must be merged in *S. catenata*, and I feel that we require further detailed information about Pourtalès' West Indian form before being able to decide either that it is distinct from *S. catenata* or that it really belongs to the genus *Sarcodictyon*. Finally, *Rhizoxenia filiformis*, Sars, *R. alba*, Grieg, and *R. albicolor*, Norman, probably fall into our genus, but whether they are all distinct from *Sarcodictyon catenata* I cannot say.

Explanation of Plate VIII.

Fig. 1. Colony of bright yellow form of *Sarcodictyon catenata*, (this is the *S. agglomerata* of Forbes), nat. size, painted from life.

Fig. 2. Colony of pale yellow form, nat. size.

Fig. 3. Expanded polype of ordinary red form, enlarged.

Fig. 4. Expanded polype of yellow form, enlarged.

Fig. 5. Anterior end of another expanded yellow polype.

Fig. 6. Series of spicules from the body-wall of a yellow form ($\times$ 200).

Fig. 7. Part of a horizontal section through a yellow colony, showing two polypes cut in section, with yellow spicules in the outer body-wall and in the stolon, and colourless spicules in the invaginated part of the polype ($\times$ 50).

Fig. 8. Part of a section of a yellow polype showing zone of spicules ($\times$ 50).

Fig. 9. A vertical section of a pale yellow polype ($\times$ 50).

Fig. 10. Part of a transverse section of a yellow polype showing the ova in their capsules attached by pedicles to a mesentery, ($\times$ 200).

[WORK FROM THE PORT ERIN BIOLOGICAL STATION.]

OBSERVATIONS on the TUBE-FORMING HABITS of *Panthalis oerstedi*.

By ARNOLD T. WATSON, Sheffield.

With Plates IX.—X.

[Read January 11th, 1895.]

ON the 5th of June, 1893, when dredging with Professor Herdman and the Members of the Liverpool Marine Biology Committee on board the s.s. "Mallard," at a depth of 60 fathoms, 14 miles West of Dalby (Isle of Man) a number of long, curious, soft muddy masses were brought to the surface, which in the absence of knowledge of their character were promptly, and for the time being, appropriately described as "mud sausages." These masses were at once carefully examined with the object of ascertaining whether they contained any tenant. The search was unsuccessful, except as regards one mass, from which, after long and careful manipulation under water, I succeeded in expelling a living specimen of *Panthalis oerstedi*, about 2 inches long.

Since that time, a fair number of these mud masses (which on examination proved to be mud tubes) have been brought up when dredging in deep water off the Isle of Man. Many of them were empty, but others inhabited; the most frequent tenant being *Panthalis*; and the question arose whether *Panthalis* was the fabricator of the tubes, or simply a tenant; and if the former, by what method such curious heavy structures were made.

Panthalis is a Polynoid worm of the sub-family Acoëtidæ, all the members of which are rare. A few of them, dwellers in southern waters (*Polyodontes maxillosus*, *Acoëtes pleei*, *Euarche tubifex*, and perhaps others) are recorded as "dwellers in tubes;" but any such habit on the part of the northern form, *Panthalis*, appears to have been unknown, and Kinberg, who describes and figures the animal, makes no reference to it.

From the fact that *Panthalis* when found off Port Erin has always been associated with these mud tubes, it seemed most probable that it was the maker of them: still, this could only be accepted as a probability, and it was obviously most desirable, that if possible, the question should be definitely settled.

The tube-masses, which are very soft, and easily pulled asunder, are usually about $1\frac{1}{4}''$ to $1\frac{1}{2}''$ in external diameter by about $3\frac{1}{2}$ inches long, with loose mucus-like extensions at either end, thus concealing the entrances. The estimated internal diameter of the tubes is usually about $\frac{3}{8}''$. Careful examination, by sectionising, shews the thickness of the walls in the centre to be about $\frac{1}{4}''$; these are composed of a number of thin layers; the one nearest the animal being simply a coating of mucus-like threads, slightly sprinkled over with fine mud, followed by other thin layers, distinguished by colours varying from dark to reddish-brown, and consisting of a felty structure in which mud is loosely entangled, until the outermost layer is reached, which is generally of a drab colour, and very loose in texture. In the early part of last year I embedded portions of these tubes in paraffin, and prepared others by staining, hardening and grinding-down, to form thin sections, with the object of ascertaining, if possible, the method of fabrication; but these preparations, though now valuable, at first afforded very little information, and I was consequently wishful to observe the habits of the living worm, an opportunity for which was last summer afforded me by Professor Herdman.

On the 25th of August he kindly took me on the s.s. "Albatross" to the ground on which *Panthalis* had previously been found, and we were fortunate in securing two promising mud masses, which, with a supply of mud from the same spot, I took to the aquarium at Port Erin. About noon on the following day these masses were placed close against the glass sides, in different parts of a small portable tank, and deposited in the aquarium building. The water was changed by syphoning, twice daily, to correspond with the tides (this was a needless precaution, but I wanted to avoid any chance of failure), but no mud was in the first instance supplied, as I wished to make the worms, if present, shew the position of the openings of their tubes, so that I might re-arrange them if unfavourably placed for observation; or take means of guiding them, if needful, in the direction of the glass. At 10.30 p.m. one of the tubes displayed an opening at each end, but no animal was yet visible. At 7 o'clock next morning, however, at the opening away from the light, the tip of the head, and two long palps were visible, but the animal was exceedingly sensitive to vibration, and on my approach immediately retreated. Having ascertained my "bearings" I, about noon, covered the floor of the tank, round the tube, with some of the fine mud brought for that purpose, but restricting the depth to half an inch, in order that any movement of the animal might be traced. The tank was carefully watched, but no change took place during that day; on examining it next morning, however, there were signs which led us to think that the worm had, during the night, travelled five or six inches on the surface of the mud, and returned to its starting point, whence it had burrowed along the front of the tank, forming a channel the whole length between the glass and the underside of the old tube. The latter action was all that one could desire, and was in fact the exact state of affairs I was aiming to produce, but had not hoped to attain so easily. This habit of annelids in captivity burrowing or building against the glass, has often been helpful to me. It affords excellent opportunities for studying the form and habits of the animals under natural conditions, the interior of the channel being exposed to view. By carefully changing the water (by syphoning) the worm was soon made to feel at home, and except for the occasional vibrations to which it was always most sensitive, seemed to be unaware of the shallowness of the water to which it had been transferred. At first *Panthalis* was somewhat cautious about exposing itself in the clear channel, and the only parts visible were the head, and two long palps; between which, two red spots were seen, and on either side the cirri of the first pair of parapodia. These were seen peeping out into the new channel, the remainder of the body of the worm being hidden in the old tube, or under the mud which had been placed on the floor of the tank.

Gradually the animal gained confidence, and during the day an inch of its length was exposed to view, and by night almost the full length of its body was reposing quietly in the new channel, the posterior extremity only remaining buried in the old tube. Upon examination by lamp-light, I found that the glass, just at the commencement of the clear burrow, was for a very short distance covered with mucus-like threads forming a "cobweb." The animal itself was at first very sensitive to the artificial light, but subsequently bore it better, though it evidently felt the heat, as it contracted the portion of the body on which the light was concentrated. As seen in its burrow, the animal possessed 60 pairs of parapodia, and was about 3½ inches long, (the tube in which it was captured being about half an inch longer). The width, across the animal's back, to the extremities of the parapodia, was about $\frac{5}{16}''$; the two sides being approximately parallel, excepting just at the two extremities, where the outline of the body tapered off markedly.

In a dorsal view were seen the two greyish-flesh coloured palps, extending about $\frac{5}{16}$ of an inch in front of the prostomium; on either side of the palps, the cirri of the first pair of feet were visible (appearing like antennæ), and apparently between the palps, two eyes, with reddish stalks (between which is a minute tentacle) occasionally peeped out from beneath the first pair of elytra. Excepting at the two extremities, where the elytra of the sides meet and overlap, rather more than the central third of the back was uncovered, the anterior part of its length being of a pearly white, with a central pink stripe. Further on it was flesh-coloured, due to the internal organs being partially visible through the semi-transparent, finely striated integument. The dorsal blood-vessel was most striking. For the greater length of the body it undulated just beneath the skin, and a beautiful red, bead like effect was produced. About one third the width of the back, on either side, is covered by the pearly-white, semi-transparent elytra, the first few pairs of which are flat, and the remainder campanulate. During life, these do not rest upon the body, but in front are tilted-up, so as to meet at an angle above the prostomium, the last few pairs of elytra also assuming a similar position. Possibly this rule may apply to the intermediate elytra, but I had no opportunity of ascertaining this.

A constant rising and falling of the elytra, as though to facilitate the passage of water for purpose of respiration, was observable, and the positions of the parapodia were dimly indicated through them. Laterally, the anterior portion of the animal was most interesting, as in addition to the organs mentioned as visible in a dorsal view, the second pair of parapodia, to which are attached special and important functions, came into sight. These limbs carry the first pair of elytra, and possess parts, equivalent to those in succeeding parapodia, modified and adapted to their work, which, as will be explained, is chiefly that of forming the tube inhabited by the worm. Their ventral cirri are much longer, and apparently stronger, than those which follow; their tips are semi-transparent, but for the greater part of their length they are of an opaque whitish colour (other ventral cirri are in parts of a reddish tint) and being situate near the opening of the mouth, have the appearance of buccal tentacles, or bristles, which are usually directed forwards and downwards, the tips almost meeting. The parts which correspond with the ventral and dorsal lobes of other parapodia, are modified in shape, and opaque white at their extremities; but these limbs are twisted downwards on their axes, so that the portions which correspond to the dorsal lobes in other parapodia, instead of being above, are in advance of the ventral lobes. They are striking objects even to the naked eye. The setæ also differ, in that they are chiefly long and straight or regularly curved, and although some of them may be described as weak bristles, these are spear-like in form, and devoid of the short terminal "whip" or hair, which is characteristic of *Panthalis*. The long curved setæ, which issue from the cleft between the lobes of the parapodia, are directed across the mouth of the worm, and their object is probably to draw the threads across, in the weaving process shortly to be described. In this view, too, the outline of the front portion of the body is noteworthy. At a distance of about $\frac{3}{16}$ of an inch from the extreme front, the dorsal integument, which is here less covered by elytra than further on was swollen up, giving the appearance of a shallow blister about $\frac{1}{2}$ an inch long; while ventrally commencing at a somewhat corresponding point the integument rose abruptly, forming a sac over the blood vessel and producing the effect of a broad longitudinal keel. This portion of the body is capable of very considerable expansion, the advantage of which will shortly appear. In ventral view and outline, the sides of the body, including the parapodia, are approximately parallel, the anterior extremity being bounded by a semi-circle, and the posterior by a curve more or less acute according to the elevation or depression of the elytra. Forward, for about $\frac{5}{16}$ of an inch, stretched the two palps, on either side of which the cirri of the first pair of parapodia (as antennæ) were sometimes visible; and between the palps, rising from the under-side of the eyestalks, two small tentacles; while, with a lens, the tip of the small median prostomial tentacle could also be seen. About $\frac{1}{16}$ of an inch from the extreme anterior boundary of the prostomium, are situate the two buccal bristles or tentacles, one on either side of the mouth, which appears as a short longitudinal line extending forwards between these tentacles. This line indicates the depression, into which the integument folds in graceful curves from every direction, when the proboscis is retracted. Just in front of the buccal tentacles, occupying the space between these and the bases of the palps, come the ventral and dorsal lobes, of the second pair of parapodia, or as I propose calling them the "weaving feet." Centrally situate, at a distance of about $\frac{3}{32}$ of an inch behind the bases of the buccal tentacles, the dark red ventral blood vessel was a most conspicuous feature. Its front boundary was square and broad, about $\frac{1}{16}$ of an inch wide, but the vessel was rapidly reduced in size, and after a course of say half an inch, ran as a moderately fine red line to the posterior extremity. After death the course of this vessel is marked by a longitudinal ventral ridge which has been referred to by a previous writer as the covering of the nerve cord. The ventral surface of the animal was opalescent, with a golden shade towards the sides, caused probably by the spinning glands and setæ of the parapodia. The posterior extremity of the body was broadly forked, owing to the last pairs of parapodia being usually directed backwards.

As specimens in alcohol are in every way much contracted and altered, this description of the large *Panthalis* under observation will probably be of interest, the dimentions given being a rough guide to the relative positions of the organs, though other specimens which I have examined vary very considerably both in size and colour.

The third day after being deposited in the tank, the animal was evidently quite settled, and it proceeded to complete the burrow against the glass, with the object of making an opening at the left hand extremity of the old tube. Early in the morning of that day I found *Panthalis* had forced about $\frac{3}{4}$ of an inch of its body through the mud at this point, and was "prospecting;" on my approach this was quickly withdrawn; but the animal remained in the burrow the greater part of the day, thus affording ample opportunity for observation of which I availed myself by making careful sketches both with and without the microscope. The most noteworthy occurrence of the day was an example given by the animal of its power to very largely expand the forepart of its body, which it utilised for enlarging the diameter of its burrow. By this means it lifted the old heavy tube fully $\frac{1}{4}$ of an inch, and almost rolled it way from the glass. By night, a clear passage and opening into the water had been made. The following morning I again found *Panthalis*, lying on its back, with about ½ an inch of the forepart of its body projecting from the opening most recently made. During the night it had searched round the mouth of the old tube for a distance of about an inch, and had lined the new mouth of the burrow with "cobwebs." In the course of the following twelve hours it partially buried this cobweb with mud which it had drawn in at the opening, and it was evidently commencing a solid tube. It also now shewed great activity by burrowing under, and violently upheaving the mud at the opposite end of the burrow, with the object of making a second opening in that direction, which it ultimately accomplished. I therefore watched it until 11 p.m. and made a careful sketch of the floor of the tank, in order to observe any change which might take place during the night. Just before leaving, I found that a considerable amount of "cobwebbing" had been done during the evening, and I saw the animal, for the first time, reverse its position in the burrow, by doubling upon itself ventrally. On returning to the aquarium at 7 o'clock next morning, I found *Panthalis*, as usual, with its head just at the new mouth of the burrow, to which, it had, during the night, added a piece of tubing between the glass of the tank, and the opening of the old tube; the material for which had been obtained by digging a hole about ½ inch diameter and ¼ of an inch deep, in the mud close by. As no food had yet been supplied, I now attempted to feed *Panthalis* by offering it a small red marine worm; but this caused alarm, and as the worm intended for food commenced to burrow into, and I feared would destroy the new piece of tube, I at once removed it. *Panthalis* had, the while, retreated into its burrow, but in course of about ten minutes returned; forced its head slowly and carefully through the mouth of the new tube, and proceeded to repair the damage, lying on its back, and thus affording me a splendid view of its operation through the open top of the tank. Thus seen, the mouth of the new tube had the appearance of a minute crater about $\frac{1}{2}$ an inch external diameter with walls barely $\frac{1}{16}''$ thick at the edge. With its head very slightly projecting through the opening, and the two long palps bent over the edge ventrally, *Panthalis* began moving the second pair of parapodia in a manner quite different from the ordinary rowing or walking action of such limbs; the motion, instead of being longitudinally, was transversely to the body, *i.e.*, the extremities of the right and left pairs of parapodia were brought together so as almost to meet in the central line of the underside of the body.

At intervals of two or three seconds, the animal, for several minutes at a time, continued thus to bring together and to separate these limbs; the tips of the buccal tentacles or bristles, too, at short intervals were brought together and applied first to one point and then to another of the tube, as though grasping and removing something from place to place; and although no threads could with certainty be seen (though I thought I saw the haziness of a cobweb) I had not the slightest doubt that *Panthalis* was thus weaving its tube; combing and weaving the threads by means of the setæ contained in these parapodia, and arranging them with the buccal tentacles, an opinion which I have since confirmed with another specimen, when I saw the threads actually carried, as described above. The process was repeated at different levels in the tube which would account for the layers originally noticed in the tube structures. Now and again the elytra took part in the formation of the tube, and by rising and falling were used to expand its mouth, whilst occasionally the edge was drawn in upon the animal and then forced out again, possibly either with the object of shaking the fine grains of mud amongst the threads, or of causing the latter to become entangled. Rather long rests were made between each spell of weaving, possibly to afford time for further secretion of the threads. The action of the "weaving feet," as described above, would result in an arrangement of the threads approximately parallel with each other, in a direction transverse to that of the length of the tube, and upon examining, with the microscope, part of the cobweb formed against the glass in the burrow, it was found that this was actually the case. I ought, however, to add that in subsequent instances this regularity of direction was not always observable; the cobweb being of a dense description similar to that formed by some spiders.

The worm continued its weaving operations at intervals during the morning until about noon, and then retired into its burrow. It being impossible for me to remain longer at Port Erin, I decided to convey *Panthalis* in its tank to Sheffield, and there continue my observations. This, with some difficulty was accomplished, and I was fortunately able to keep the animal alive until the 17th of September, a period of 23 days from the date of its capture.

Shortly after arrival in Sheffield the worm settled down in its new quarters, and after clearing the openings of its tube seemed habitually to lie with its head at one or other of these points, the two long palps extended, or resting on the mud externally. In this position it is most probably watching for prey. On one occasion, when the palps had remained thus outstretched for many hours, I feared the animal was dead, and, in order to test it, gently raised one of them with a quill, whereupon *Panthalis* attacked the quill savagely with its Proboscis.

During its life at Sheffield *Panthalis* afforded me an opportunity of watching its method of mingling the fine mud with the cobwebs, one of the points needful to complete the process. This was done by the same limbs as those used in weaving, the mud being swept into the mouth of the tube by striking backwards, the edge of the tube was also at the same time pulled in upon the animal and forced out again as previously described. The dorsal cirri of the 3rd pair of parapodia also appear occasionally to assist by drawing fine mud into the tube. It being evident on the 17th September, that *Panthalis* was ailing, I decided to remove it from its tube and examine it under the microscope while still alive, as I had yet to ascertain the source of the mucus like threads, and how they were conveyed to the "weaving feet," Thanks to Miss Buchanan's admirable paper on *Eupolyodontes cornishii* in the Quart. Journal of Microscopical Science of January, 1894, in which she briefly describes the members of the sub-family Acoëtidæ, and gives the bibliography on the subject, I was already aware of the existence of Eisig's "spinning glands" in the parapodia of *Polyodontes*, and consequently prepared to expect something similar in *Panthalis*.

This particular living specimen afforded no evidence on that point, but by observation of others, and also by dissection of dead specimens, I am convinced that these glands, which exist in all the parapodia of *Panthalis*, except the anterior eight pairs, are the source of the mucus-like threads. The glands correspond very closely with those of *Polyodontes maxillosus* described and figured by Eisig (Monographie der Capitelliden), and their large, bronze-like coils, seen on opening the body of the animal either from above, or by transverse section, are most striking objects. In the latter view the chætal sac when opened, reminds one of a lock of hair, the long, exceedingly fine capillary chætæ, lying compactly side by side, readily separable with a dissecting needle. The extensions from these coils can easily be traced to the cleft between the upper and lower lobes of the parapodia, from which points I have, more than once, seen the white, tube-forming threads to issue. Whether these threads are themselves prolongations of Chætæ, or are fabricated by gland secretions, forced through the chætæ, which are shewn as tubes by Eisig, is a point to which I hope to give further attention.

It may be noted that the dorsal lobes of the parapodia endowed with spinning-glands, are much wider than those of the preceding limbs.

On the remaining point, viz., how the threads are passed forward to the "weaving feet," I fortunately gained a clue from this living specimen. Kinberg in his description of *Panthalis oerstedi* ("Fregatten Eugenies Resa" Zool. Annulater) specifies the setæ as of three kinds "subulato-serrulate, bipennato-penicillate, and aristate," and states that the first-named occupy the lowest position as regards the parapodium; the aristate setæ, the medium, and the bipennato-penicillate the superior or dorsal; the action of the medium and superior setæ is described as perpendicular, and that of the inferior setæ, as horizontal. These setæ, as well as the animal itself, are figured in the work above referred to, but those observed in my specimens appear to be a combination of the setæ given both for *Panthalis* and *Eupompe grubei*, and correspond most closely with the latter. (Possibly Kinberg got his figures mixed.) None of these figures, however, give quite the correct impression of the "bipennato-penicillate" setæ of Kinberg. When in action, it is really that of a minute brush, in which the bristles have flexible attachments round the tip of a long central shaft, somewhat like the ribs of an umbrella which has been turned inside out. Often these ribs are partially closed up, and shew no movement, but I have several times seen them when at work opening and closing, probably by the pull of the threads and the resistance of the water. It should be noticed that the "brush-like" setæ are attached *only* to the parapodia *possessing* "*spinning-glands*" and their use is at once obvious. All the setæ in *Panthalis* proceed from the *ventral* lobes of the parapodia; the position of these brush-like bristles, as described by Kinberg is *uppermost*; they are capable of very considerable extension and also of being retracted almost entirely within the body of the animal; the threads from the "spinning gland" issue from the cleft between the upper and lower lobes of the parapodia, *i.e.*, *just against these* setæ, and they are caught-up and carried outwards and forward by the action of these brushes assisted, to some extent, in the latter movement by other setæ. I have seen this actually take place, and on examination of dead specimens the observation is confirmed, the brush-like setæ being frequently found directed forward with masses of threads entangled in them.

The parapodia possessing "spinning glands" are endowed with all three kinds of setæ mentioned by Kinberg; but the six pairs between the last "spinning gland" and the "weaving feet" have *two* kinds only, the brush-like setæ being replaced by a second set of serrulate setæ similar to those figured by Kinberg for *Eupompe*.

The foregoing, I think, describes fully the formation of a single thin tube; but it will be remembered that the tube inhabited by *Panthalis* is quarter of an inch thick, composed of *many* apparently parallel layers, formed one inside the other, and I therefore still had some difficulty in understanding how this strong, heavy structure could be produced. An examination of the hardened and embedded sections of tubes first made, and of fresh sections of tubes in their natural condition; and an external examination of the tubes themselves under running water (bearing in mind the bursting action possessed and exercised by the forepart of the animal's body) afford, I think, a simple explanation.

The sections shew that the layers, although *apparently* parallel, do not run horizontally the full length of the tube, but *all curve outwards*, and it is due to this fact, that *Panthalis* is able to construct a tube of so great thickness. The process, most probably, is as follows:—A moderately thin tube is first formed, consisting of cobwebs and mud. In consequence of the layers being added *internally*, the tube would soon become inconveniently small, and the animal thereupon bursts the anterior portion (as I saw it burst its original burrow) by expansion of the forepart of its body, thus throwing the mouth of the tube *backwards*. It then proceeds alternately with the addition of more internal layers and the bursting process, by which means the free ends of the internal tubes are successively thrown outward and the layers are made to take the outward curve above referred to, the final effect being that of a series of hollow truncated cones, one inside another.

That this is the case is proved both by the fresh section in which the layers can be separated, and by an *external* examination of the tube masses under running water. By the latter means the different tubes can be partially folded back, but as the split side is always made good in the formation of the new inner tube to which it is attached, these tubes can only be folded back for a portion of the circumference. The long straggling mucus threads which always accompany the tubes are probably formed by the animal when exploring its surroundings.

In this paper I do not profess to have gone minutely into details of the anatomy of *Panthalis*, but in the course of my observations, one or two points of interest have come before me, and a brief reference to them may be useful.

The sight of the animal is evidently very good, and a remark as to the structure of the organs of sight will be interesting. The eyestalks, as also the cephalic mass to which they are attached, are brownish-red in colour, and have at their tips a rounded papillated appearance. Each eyestalk is faced with a clear lens, the curve of which is occasionally somewhat acute, though this seems to vary, and possibly the animal may have some means of adapting it to circumstances.

The structure and action of the Proboscis also deserve a passing note. As is usual in annelids, this organ is very often protruded in the act of dying, and thus affords an opportunity for observation of its action. In Kinberg's figures of *Panthalis* and *Eupompe* the proboscis is shown protruded, but the peculiar structure of this organ is hardly noticeable. My specimens agree more closely with his figure of *Eupompe* than with that of *Panthalis*. As described by Claparède (Les Annélides Chétopodes du Golfe de Naples, 1868) the proboscis is divided into two parts, a longer inferior portion consisting of a cylinder of somewhat ordinary form, and a short superior portion, which carries the jaws and is fringed with papillæ, the central ones of which, both dorsally and ventrally, are considerably elongated. The dorsal one being about $\frac{3}{16}$ of an inch long (in my large specimen) forms a tentacle. The action of the organ is a double one, and as follows :— the lower part only of the proboscis is first protruded, either for the purpose of burrowing in the mud (as I have seen it used) or in search of food. In the latter case, the central dorsal tentacle attached to the margin of the proboscis simultaneously appears resting in a fold on the upper surface of this lower part. This tentacle doubtless ascertains whether food is within striking distance in which event the second portion of the proboscis is brought into action, seizing its prey by means of the four savage-looking fangs, assisted by the smaller teeth with which the animal is endowed.

The campanulate structure of the elytra is interesting, and raises questions in my mind as to how far these are organs of respiration specially adapted to expose as large a surface as possible to the action of the water, in view of the confinement in which *Panthalis* usually lives.

From specimens which I have had under observation during several months I should gather that, although *Panthalis* does occasionally desert its tube and make new ones, as suggested by Prof. Herdman, (see British Association Report, Oxford, 1894) this is not a very frequent occurrence, and that when once the worm is *well-settled* its general habit is to rest with its head at the mouth of its tube watching for its victims, an opinion apparently supported by the facts that two tubes dredged in September last, have each one end hard and leathery, as though it had been long buried and hardened by absorption of excreta or other matter, and that the complete formation of such tubes seems to be a work of time. The animal appears always to leave its tube when about to die, which will account for many empty ones being brought up in the dredge.

As to its mode of locomotion, *Panthalis* usually walks or creeps upon the mud. I have only once seen it swim, which it did in a clumsy way, by moving its elytra and body on an occasion when the water had become foul and unbearable.

Throughout this paper, I have, for the sake of convenience, referred to the threads secreted by *Panthalis* as "mucus-like" but I don't intend thereby to express an opinion as to the nature of the material of which they are composed. They are secreted by Eisig's spinning glands and appear to be very similar to those formed by *Polyodontes maxillosus*, which Eisig describes as "chitinous." They are very slightly, if at all, soluble in boiling caustic potash.

As explained at the outset, my chief object in these observations was to ascertain whether *Panthalis* made the tube which it inhabits and if so how? and I think I have satisfactorily answered both questions.

The tubes of the Acoëtidæ, from the absence of any membranous lining, and their general construction, would appear to be unique amongst annelids. In this connexion see Quatrefages' reference to *Acoëtes pleei*, (Histoire Naturelle des Annélés, I, p. 216), Eisig's account of *Polyodontes maxillosus*, and Ehler's description of *Euarche tubifex* (Florida Anneliden, pp. 54-6). No minute description has previously been given, but from the similarity of their organs, it seems probable that the tubes of all these worms will more or less closely resemble each other.

In closing this paper I would take the opportunity of expressing my great appreciation of, and gratitude for the advantages afforded me at the Port Erin Biological Station, to which the success of my experiments has been largely due. Absolute stillness was a most important factor, and I am greatly indebted to Prof. Herdman, both for the steps which he took to ensure this, and also for very much valuable advice and assistance. To him this paper is really due, as excepting for his kindness in making special journeys with me on August 25th, and September 30th, 1894, to the ground where *Panthalis* is to be found, these observations would have been impossible.

Explanation of Plates.

Plate IX.

Fig. 1. Longitudinal section of wall of tube of *Panthalis*. Sketch (slightly enlarged) made from portion of tube sectionised under water to shew the series of layers thrown outwards. The darkest part (*b*) is the inside of the tube.

Fig. 2. Sketch of *Panthalis* in its burrow, shewing it in a very frequent position, viz., twisted so as to expose the front ventral, and posterior dorsal parts. The palps extend in front; the buccal tentacles almost meet in the form of a V, and the ventral bloodvessel, with its broad front, runs horizontally towards the rear. The cobweb first formed, is indicated to the right of the burrow, and at the opposite end is seen the remnant of the cobweb, by means of which (mingled with mud) the new tube was made. The opening of the new tube is shewn as a little mound (*a*) at the left of the picture. The old tube forms the mass above the burrow.

Fig. 3. Enlarged sketch. Ventral view of anterior portion of *Panthalis* shewing the two long palps (*a*) (ends broken off); cirri of first pair of parapodia (*b*); eyes and eye-stalks (*c*); between which is seen the tip of the median small tentacle (*d*), and in front the small paired tentacles. The "weaving-feet" (*e*), with bristles, and ventral cirri or buccal tentacles, directed across the mouth, followed by other parapodia. The ventral bloodvessel (*f*) with its broad square termination.

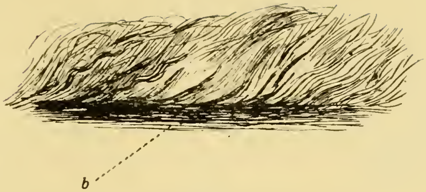


Fig. 1.

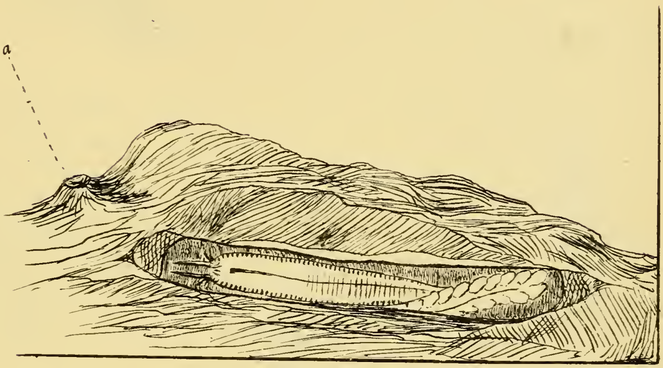


Fig. 2.

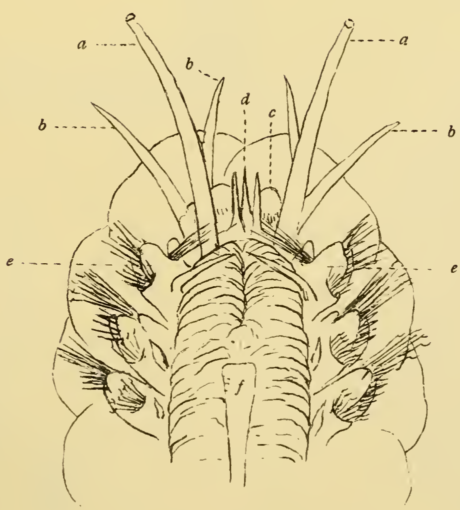


Fig. 3.

A. W. & A. T. W., del.

PANTHALIS OERSTEDI

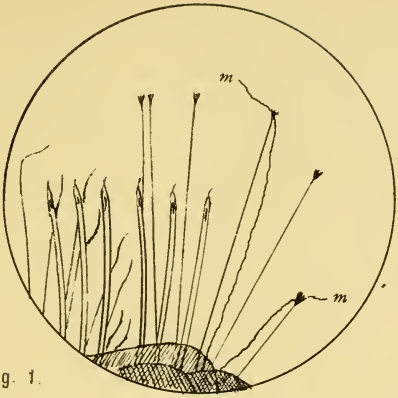


Fig. 1.

Fig. 2.

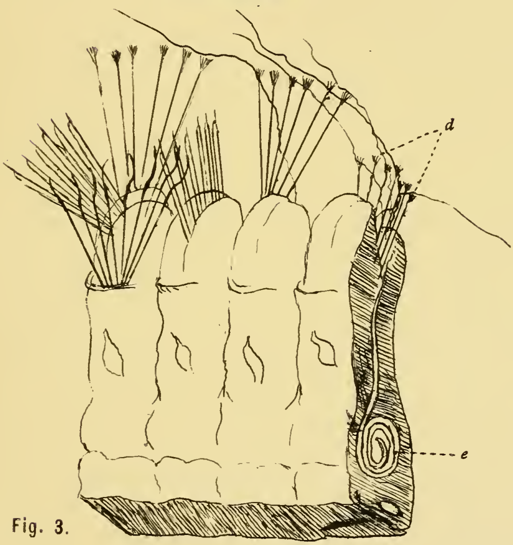


Fig. 3.

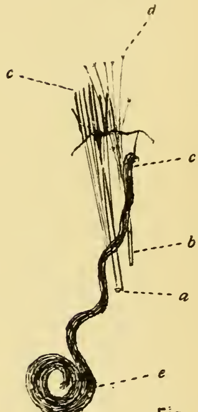


Fig. 4.

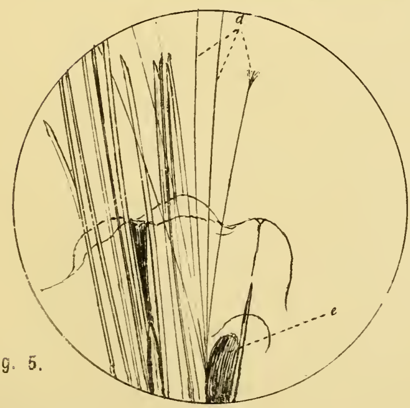


Fig. 5.

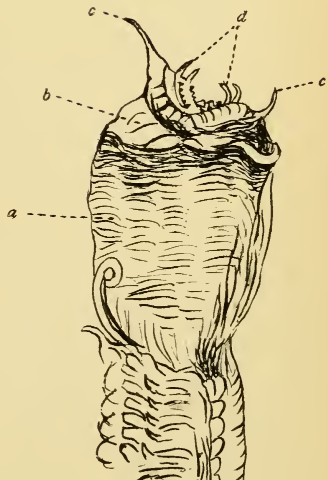


Fig. 6.

A. W. & A. T. W., del.

PANTHALIS OERSTEDI.

Plate X.

Fig. 1. Sketch from micro-photograph of a "spinning-foot" shewing all three kinds of setæ, and two "mucus" threads (*m*) entangled in the brushes.

Fig. 2. Sketch from micro-photograph of a "weaving-foot" shewing its peculiar, very finely serrated setæ. *v*. Ventral Lobe. *d*. Dorsal Lobe.

Fig. 3. Diagram. Ventral view of lateral portion of *Panthalis*, shewing arrangement of setæ in a "spinning-foot." To the left are shewn all three kinds. The ventral and dorsal setæ have been removed from the second foot; the dorsal "brush-like" setæ only are shewn in the third foot; and the position and form of the "spinning-gland" (*e*) with threads issuing and carried away by the "brush-like" setæ (*d*), are seen in the 4th.

Fig. 4. Sketch from micro-photograph of "spinning-gland" dissected out and partly uncoiled. Shewing the strong ventral (*a*), and weaker dorsal (*b*) acicules; also the stout median setæ (*c*), and the delicate brush-like setæ (*d*). The latter will be seen to emerge close to the mouth of the "spinning-gland" (*e*), which has, however, got pulled slightly out of position in dissection.

Fig. 5. Sketch from micro-photograph of front part of above more highly magnified. In it the "brush-like" setæ (*d*) can be distinctly traced passing by the mouth of the "spinning-gland" (*e*).

Fig. 6. Proboscis (lateral view) shewing the palps, which are usually straight, but have curled up in dying. The two portions, viz., the trunk (*a*) of Proboscis, and the jaws (*b*), with long median tentacles (*c*), the large fangs (*d*) and smaller teeth. (Much enlarged.)

NOTES on some points in the STRUCTURE of the CERATA of *Dendronotus arborescens*.

By Joseph A. Clubb, B.Sc. (Vict.).

VICTORIA UNIVERSITY SCHOLAR IN ZOOLOGY ;
ASSISTANT-CURATOR OF THE DERBY MUSEUM, LIVERPOOL.

With Plates XII. and XIII.

[Read April 5th, 1895.]

The present paper is the outcome of part of the work carried on in the Zoological Laboratory of University College, Liverpool, under the direction of Prof. Herdman, while in residence for the period covered by the Victoria University Scholarship awarded me in June, 1894.

I. The Liver and the Cerata.

In the Second Report on the Nudibranchiata of the L. M. B. C. District,* drawn up by Prof. Herdman and myself, attention was directed to the published descriptions by Alder and Hancock† and Dr. Rudolph Bergh‡ of the structure of the cerata of *Dendronotus arborescens*. These distinguished zoologists described and figured the liver of *Dendronotus* as giving off branched prolongations which run upwards into the dorsal tentacles (rhinophores), and other dorsal processes (cerata). Alder and Hancock figure these hepatic cæca as conspicuous prolongations from each side of the liver, while Bergh represents them as being of large size in the terminal twigs of the cerata,

* Trans. Biol. Soc., Vol. III., p. 225.

† Ray Society, "British Nudibranchiata," Part II., fam. 3, Pl. II.

‡ "Bydragen tot de Dierkunde," Natura artis magistra, Afl. XIII. VIII., p. 25, Amsterdam, 1886.

but does not figure the basal portions. As the result of our investigations, both by dissections and by means of thin serial sections we ventured to express our disbelief in the existence of these hepatic cæca in the cerata; we described and figured what we considered to be the correct structure of the cerata, and showed that although the liver is prolonged into short processes which run in the direction of some of the cerata, there is no hepatic tissue to be found in the cerata themselves.* Last year Dr. Paul Pelseneer, in his "Recherches sur divers Opisthobranches,"† in a paragraph on the digestive system of *Dendronotus* briefly refers to our conclusions with regard to the structure of the cerata. He says "D'après Herdman, le foie ne ramiferait pas dans les deux premières pairs d'appendices dorsaux; les individus étudiés m'ont présenté ces appendices pareils aux autres; le foie est donc répandu dans toutes les saillies dorsales et dans le corps, où il occupe la même position que dans *Tritonia*."

It appears from this that Pelseneer has somewhat misunderstood the results we then arrived at, for we not only stated that the liver did not ramify into the first two pairs of cerata, but also that it did not ramify into any. Prof. Herdman at once suggested, as part of my work while holding the University Scholarship, that I should carefully revise all our previous investigations, examine afresh our old preparations, and make what new ones I should find necessary in order to settle definitely this vexed question of the hepatic processes and dorsal cerata of *Dendronotus*.

This I proceeded to do. I went carefully over the whole

* *Loc. cit.*, p. 230.

† Extrait du tome LIII. des *Mémoires couronnés et Memoires des savantes étranger*, L'Academie royale des sciences, des lettres et des beaux-arts de Belgique, 1894.

of my series of sections, consisting of (1) a complete series of transverse sections of the entire animal cut from end to end, and arranged serially (containing some 600 or 700 sections), (2) a series of longitudinally cut sections, (3) various sections of cerata isolated from the body, cut in every direction. I minutely compared the figures published in 1889, with the particular sections from which they were drawn, and made fresh dissections of the animal. The result of my work in this direction was to verify in every particular the conclusions come to in our former paper with regard to the cerata. I then set myself to consider in what further directions I could proceed in order to obtain additional evidence, and it occurred to me that a series of sections cut horizontally, in a plane as nearly parallel as possible with the creeping surface, would be of great service. I could then pass from section to section, tracing the liver from below upwards to its most dorsal terminations, finally cutting transversely through the bases of the cerata themselves; and by this means determine exactly the relations of the liver to the bases of the cerata. I obtained some living *Dendronotus*, from Hilbre Island, and as the histological methods employed were not described previously I will here describe them. The *Dendronotus* is allowed to expand in a little sea-water, and then deluged with sulpho-picric acid (Kleinenberg's formula), which by a rotatory movement of the hand is made to whirl round in the vessel. This treatment has the effect of fixing nudibranchs before they can retract. Even with the more delicate species of Eolidæ, which, with almost all other methods, break away the cerata from the body, this method is usually successful. The specimens are allowed to stand in this fluid, changed once or twice, for two or three hours according to size. They are then transferred to gradually increasing per centages of alcohol rising up to about 75%. Afterwards stained "in toto" in picrocarmine, treated with acidulated alcohol, dehydrated, embedded in paraffin in the usual way, and cut with the Cambridge "Rocking" microtome.

In order to make the sections of a manageable size, I cut off the anterior and posterior moities, leaving the central portion bearing the first and second pairs of cerata only. A study of the sections showed me that they had not been cut quite horizontal, the anterior end of the section being relatively higher than the posterior. I traced, first of all, the anterior prolongations from the main lobe of the liver, which we had figured* running towards the first pair of cerata. These I could follow through several sections, lying alongside the stomach, to a point immediately below the first pair of cerata. But I found as I advanced through the sections and gradually rose to a higher level, that the liver processes disappeared, and disappeared before the stomach; which showed that they terminated actually before the level of the top of the stomach was reached. I then directed my attention to the second pair of cerata. I picked up the main mass of the liver at a point which I estimated to be immediately below them, and as I advanced through the sections, gradually rising to a higher level, I traced the formation of two lateral portions distinct from the central mass (Pl. XII., fig. 1, *l'*). These lateral portions were evidently the lateral caeca, previously figured† as running up towards the bases of the second pair of cerata. But I now find that these lateral masses actually disappear before the central mass; the right hand side one, two sections beyond the one figured (fig. 1), and the left hand side one, four

* *Loc. cit.*, Pl. XII., fig. 1.

† *Loc. cit.*, Pl. XII., fig. 1.

sections beyond; while the central mass is continued for twenty sections more.

The section figured (Pl. XII., fig. 1) shows the anterior pair of cerata (c'), on the point of being separated off from the body, while the second pair are not yet distinguishable in any way. The liver (l) is here seen as I have described, with a central mass and two lateral smaller masses, and the ventricle of the heart (v) is shown lying in the pericardial cavity ($p\ c$).

Figure 2, is drawn from a section fifteen higher in the series than fig. 1. Here the anterior cerata are quite distinct, and the posterior (c'') are showing as distinct prominences. The lateral processes of the liver (l') seen in fig. 1, have now disappeared, and the much reduced central mass remains. The cœlomic cavity (*cœ*) is also much reduced, as the sections are now at a level at which the mesodermal tissue of the dorsal body wall is appearing. The distance of the liver mass from the place where the cerata arise is very noticeable.

Figure 3 is a section thirty higher in the series than fig. 2. Here the second pair of cerata (c'') have now become almost entirely separated off, although a slight attachment still persists in one. The liver has entirely disappeared some twenty sections before, but the second pair of cerata have not yet become quite distinct even here. The first pair of cerata are here (fig. 3) cut, among the smaller terminal branches.

The minute examination of these sections of cerata, whether taken before they are completely separated off from the body and only showing as prominences at the sides, or whether taken so as to cut through their base just after separation, or whether sections of the terminal twigs only, does not reveal any tissue that could possibly be mistaken for liver.

In fact, I am convinced of the correctness of the description given in our previous paper of the minute structure of the cerata, notwithstanding the doubt thrown upon it by Pelseneer. That description* is as follows:—

"1. Large spaces in the mesoderm, containing blood corpuscles (*Loc. cit.*, Pl. XII., figs. 2 and 3, *c s*). These run in the main longitudinally. They occasionally branch, and they open into innumerable minute lacunæ in the mesodermal tissues, all of which here and there contain blood corpuscles.

2. A good deal of pigmented connective tissue forming branched masses and ramifying threads of a brownish colour. These frequently, in a surface view of the terminal branches of the cerata under a low power, give rise to the appearance of a dark coloured granular central caecum such as that figured by Bergh (*Loc. cit.*, Pl. II., fig. 22). Sections, however, show the true nature of this pigmented tract.

3. Masses of large distinctly nucleated cells lying in meshes of fibrous connective tissue. These are possibly mucus secreting glands. They occur chiefly in the smaller meshes of the cerata."

I would respectfully suggest that a point of this character, requires some of those "complicated methods of histological investigation" which Pelseneer in his preface, says he was unfortunately not in a position to make use of. Without the aid of thin serial sections, I think it would be impossible to determine with certainty this point, and if, as was suggested in our previous paper, these distinguished zoologists who differ from the conclusions come to, have worked without these aids to the determination of minute structures, as I gather Pelseneer has, then it is not surprising that they have been led into error.

---

* *Loc. cit.*, p. 230.

It has been suggested that our Hilbre Island specimens are of a variety differing in the structure of the cerata from the specimens examined by others. I have endeavoured to obtain specimens of *Dendronotus* from other localities but without success. For myself, I do not think it likely. However, I shall be very happy to exchange some of our Hilbre Island specimens for some of these supposed "ceratal hepatic caecal" bearing forms, if by so doing Drs. Bergh and Pelseneer can be convinced of the correctness of my conclusions, at least with regard to the Hilbre Island *Dendronotus*.

II. The Innervation of the Cerata.

In the Quarterly Journal of Microscopical Science, a joint paper* was published by Prof. Herdman and myself, in which we showed from the examination of a series of types of Nudibranchs, that instead of the cerata being always innervated by the pleural ganglia, as Pelseneer had previously supposed,† or always supplied by pedal nerves, there are in fact various arrangements of the nerve supply. We found from our investigations that "the dorsal lateral processes of the body wall, which we call cerata, may be supplied entirely by the pleural ganglia (*e.g.*, *Polycera* and *Ancula*), or chiefly by the pleural with a small supply from the pedal, by means of a pleuro-pedal anastomosis (*Dendronotus*), or entirely by the pedal ganglia (*Tergipes*), or chiefly by the pedal ganglia with a small independent accessory supply from the pleural (as in *Facelina*)." If then the cerata are to be regarded as homologous structures throughout the series of nudibranchiata, the nerve supply cannot be taken as a

* "On the Innervation of the Cerata of some Nudibranchiata," Vol. XXXIV., p. 541.

† "Bulletin Scient." t. XXIII., p. 439, Aug. 18th, 1891.

sure indication of homology, and we put forward the suggestion that possibly the innervation has undergone modification so that, while these ceratal outgrowths may be truly epipodial, commencing as pedal structures, supplied with nerves from the pedal ganglia, they may have secondarily acquired in the different types mentioned, as the result of changes in form, position and relation to other organs, the various conditions of innervation which we described. This, however, was merely a suggestion, and requires further elucidation by the examination of the nerve supply in other species, which as soon as I can obtain the necessary material I hope to undertake.

The immediate object of this communication is with regard to the nerve supply to the cerata of *Dendronotus arborescens*. Since the previous paper in the Q. J. M. S., Prof. Pelseneer in his "Recherches sur divers Opisthobranchs"* refers to the conclusions we arrived at in regard to this point. In *Dendronotus* we described and figured† an anastomosis of a branch from the pedal nerve with the pleural element of at least a part of the epipodial nerve. We found from the examination of a complete series of sections of an entire *Dendronotus* arranged serially, that a nerve, arising from the pleural ganglia (epipodial nerve), runs backwards for a short distance and then divides into a dorsal branch (dorsal epipodial nerve), and a ventral branch (lateral epipodial nerve); also that a nerve arising from the dorsal aspect of the pedal ganglion (dorsal pedal nerve) runs backward a short distance, and then divides into two. The upper branch anastomoses with the lateral epipodial nerve just after it has given rise

* Extrait du tome LIII. des *Mémoires couronnes et Mémoires des savantes étranger*. L'Academie royale des sciences, des lettres et des beaux arts de Belgique, 1894.

† *Loc. cit.*, Pl. XXXIV., fig. 27.

to the dorsal epipodial nerve, so that the resulting nerve, we pointed out, possesses both pedal and pleural elements. Pelseneer while admitting the junction of the two nerves, denies that the fibres pass from one to the other. In a brief account of the nervous system of *Phyllirhoe bucephalum* he describes and figures a branch from "le nerf palléal" (epipodial nerve), which comes in contact with a dorsal pedal nerve, and forms with it a plexus, but with only a simple juxtaposition and without any interchange of fibres. In a footnote* he says "La meme chose s'observe dans l'autres Tritoniens; par example *Dendronotus*, où Herdman et Clubb l'ont signalèe, concluant de ce fait que des fibres *pédieuses* passent dans le nerf innervant les papilles dorsales. Or je me suis assuré que chez *Dendronotus*, comme chez *Phyllirhoe*, il y a simple juxtaposition locale des deux nerfs." He again refers to it in similar language in a subsequent paragraph dealing generally with the innervation of the dorsal appendages.

It is obvious in a point like this in which the course of the individual fibres of the nerve is concerned, that the microscopic examination of thin serial sections with high powers of the microscope is absolutely necessary, and that it is impossible to determine it satisfactorily by means of promiscuous sections or dissection only. It is somewhat difficult to obtain sections in a perfect condition of the region where this plexus is placed, owing to the proximity of the odontophore, the radula of which is apt to tear and destroy the sections, unless the animal has been killed without undue contraction so that the odontophore lies in its more normal position, in front of the plexus. I have been fortunate enough, however, to obtain a series in which it is possible to trace the course

* *Loc. cit.*, p. 42.

of the nerves and their origin from the different ganglia. With the higher powers of the microscope it is also possible to make out the nerve fibres themselves, cut transversely, in each of the sections. I have thus been enabled to determine to my complete satisfaction that there is a junction of nerves and not merely a running alongside or juxtaposition without the fibres of the pedal branch mingling with those of the pleural branch. In order to demonstrate this I give drawings made with a Zeiss objective D from the various sections concerned in this anastomosis of the two nerves. In Pl. XV., figs. 2, 3, and 4 are made from three consecutive sections, and show the origin of the branch from the dorsal pedal nerve. Fig. 3 is made from the section through the point of origin; fig. 2 just anterior to it; and fig. 4 just posterior to it. In these sections the transversely cut fibres with the nerve sheath or perineurium can be distinctly seen.

Fig. 2 shows two nerves (*a* and *b*), lying in the cœlomic cavity (*cœ*), with part of the wall of the œsophagus (*œ*). The nerve marked *a* is the epipodial nerve originating from the pleural ganglia; the nerve marked *b* is the dorsal pedal nerve arising from the dorsal aspect of the pedal ganglia. For the sake of distinctness other structures in the neighbourhood are left out.

Fig. 3, taken from the next section succeeding fig. 2, shows a constriction appearing in *b*, with the perineurium or investing sheath extending inwards from the constriction, suggesting the beginning of the branch nerve *c* which in the succeeding section, shown in fig. 4, is seen separated by a complete sheath. Here although the nerve *b* and its branch *c* are not actually apart, still the fibres are, and the succeeding four sections show this branch gradually getting more distant from *b*, and rising towards *a*.

In fig. 5, taken from the fourth section in the series after fig. 4, the branch *c* is seen some distance from *b* although not completely separated, there being a remnant of connective tissue present. But it is much nearer the nerve *a* and also connected with it by connective tissue.

Fig. 6, taken from the next section, shows the pedal branch *c* absolutely separated from *b*, and in close connection with *a*, although still surrounded by its own sheath. But the nerve *a* is here seen to be giving rise to a branch *d*. The next section (fig. 7) shows this branch divided off by a complete sheath, so that here there are sections across three nerves (*a*, *d* and *c*) which are in organic connection, but the fibres of each are completely separated by clear and distinct sheaths. They remain in much the same relation to each other through the following three sections. But in the next section (fig. 8) *a* and *c* come into closer relation, there is a common investing sheath, while the portion of the perineurium between the two has become thinner and less pronounced; and in the next section (fig. 9) it breaks down altogether and the two nerves unite, the fibres of the branch *c* becoming common, and enclosed in the same sheath as *a*. There are seen now but two nerves, the upper (*d*), a branch from *a*, and the lower, formed of the remainder of *a* plus the fibres of the nerve *c*, which is a branch from the dorsal pedal nerve *b*. The nerve *a* arises from the pleural ganglion and therefore contains pleural elements, while *c* is a branch of the pedal nerve *b*, which arises from the pedal ganglia, and contains pedal elements, and therefore the resulting nerve ($a+c$) contains both pleural and pedal elements.

The crucial point is evidently at the junction of *a* and *c*, as these are the two nerves which Pelseneer admits come into contact with each other, but the fibres of which he says do not pass into the same sheath. I have, therefore, examined with particular care the sections concerned in this junction, and carefully noted any accessory evidence with regard to the surroundings, shape, conformation and other particulars seen in both sections (figs. 8 and 9), and which help in any way to define exactly the relations of the two nerves. There is a piece of connective tissue, marked with an asterisk, in fig. 8 just above the thin, but still distinct partition separating the two nerves (*a* and *c*) at this point. In fig. 9 this piece of connective tissue, of exactly the same shape and relative position is present, and so marks exactly the point where in the previous section the partition existed, but which has here completely disappeared. There is no doubt that the branch nerve (*d*), arising as it does from *a*, looks, when viewed by dissection only, like the continuation of *a*, and that the nerve $a+c$. also when so viewed looks like the continuation of *c*, and it is not surprising that the mistake has been made of supposing the junction merely a juxtaposition and not a union of nerves. But when subjected by means of thin serial sections to the higher powers of the microscope, it obviates any chance of making errors of observation of this character, and such a study of my sections convinces me that the fibres of the branch *c* pass into, and are enclosed in the same sheath as *a*, and therefore that the lateral epipodial nerve contains both pleural and pedal elements, as originally stated by Prof. Herdman and myself.

Explanation of Plates.

Reference letters :—Pl. XIV., *a*, auricle ; c', first pair of cerata ; c'', second pair of cerata ; *cœ*, cœlome ; *cs*, ceratal sinus; *dlv*, dorso-lateral vein; *l*, liver; *l'*, lateral lobes of liver; *ls*, blood lacunæ in mesoderm; *m*, muscle bands; *mt*, muscular tissue; *pc*, pericardial cavity; *r*, rectum; *v*, ventricle.

Pl. XV. *a*, nerve arising from the pleural ganglia (epipodial nerve); *b*, nerve arising from the dorsal surface of the pedal ganglia (the dorsal pedal nerve); *c*, branch nerve arising from the dorso-pedal nerve; *d*, branch nerve arising from the epipodial nerve; $a + c$, the nerve formed by the union of the epipodial with the branch *c*, from the dorsal pedal nerve; *cœ*, cœlome; *œ*, œsophagus; *p.g.*, pedal ganglion; *pl.g.*, pleural ganglion; *p.n.*, pedal nerve.

Plate XIV.

Fig. 1. Horizontal section through the portion of the body of *Dendronotus arborescens* which bears the first and second pairs of cerata, and passing through the upper part of the visceral mass. The anterior end of the section is relatively higher than the posterior so that the anterior pair of cerata are seen almost separated off from the body, but the posterior pair are not yet distinguishable, the section passing below them.

Fig. 2. Taken from a section fifteen in number higher in the series than fig. 1. The bases of the anterior cerata are shown, cut through transversely and completely separated from the body; and the posterior pair are seen as distinct prominences at the sides.

Fig. 3. Taken from a section thirty higher in the series than fig. 2. The upper parts of the first pair of cerata are seen, cut transversely; and the second pair are cut through their bases and almost completely separated from the body.

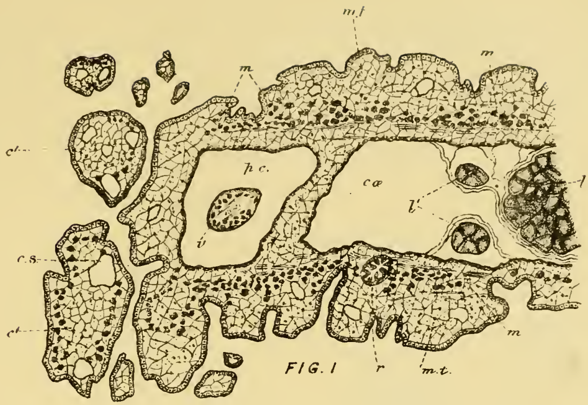


FIG. 1

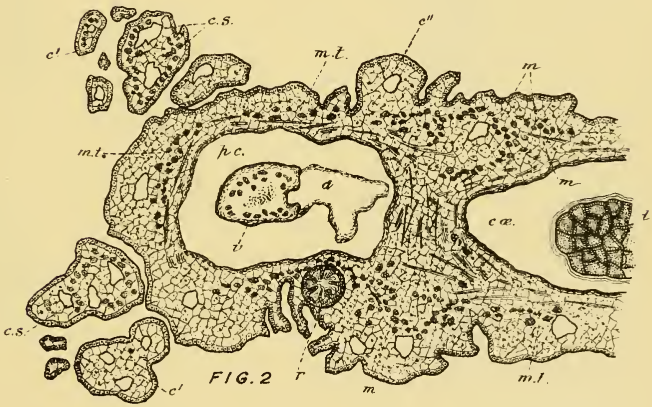


FIG. 2

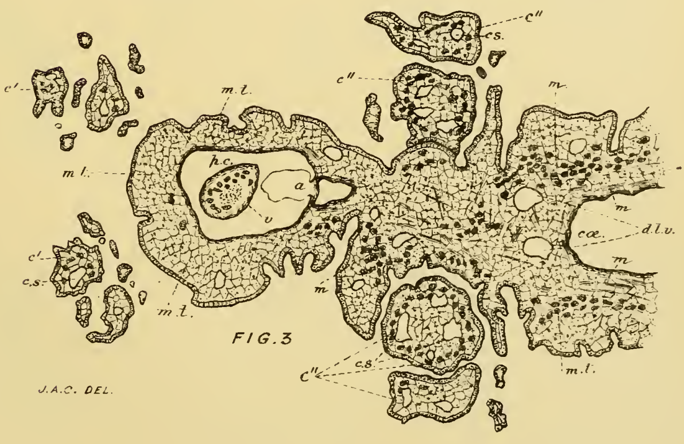


FIG. 3

J.A.C. DEL.

DENDRONOTUS.

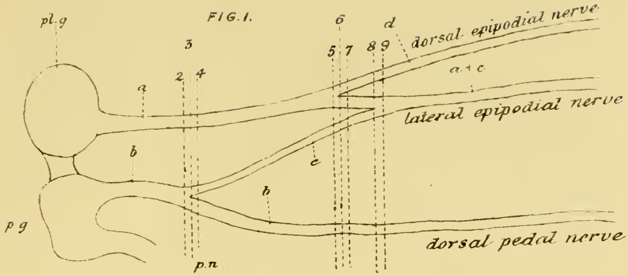


FIG. 1.

FIG. 2

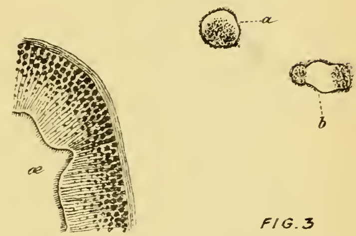


FIG. 3

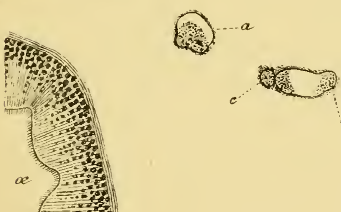


FIG. 4

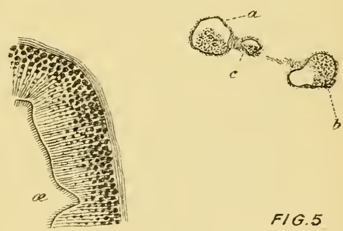


FIG. 5

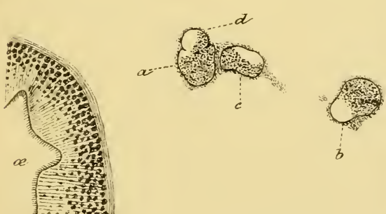


FIG. 6

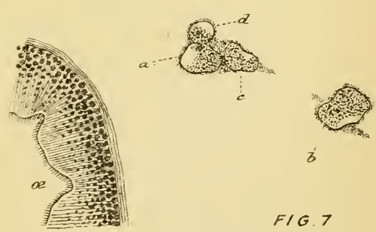


FIG. 7

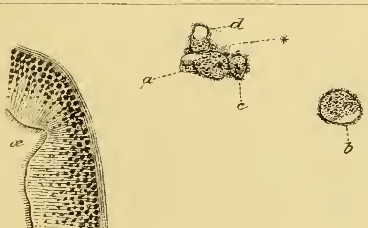


FIG. 8

J. A. C. DEL.

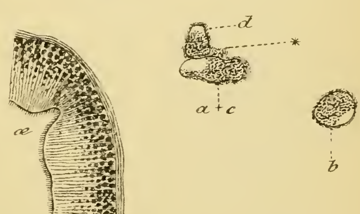


FIG. 9

DENDRONOTUS.

Plate XV.

Fig. 1. Diagrammatic scheme of the anterior part of the dorsal and lateral epipodial nerves of *Dendronotus arborescens*, showing in lateral view their origin from the ganglia, their branches, and the anastomosis between *a* and *c*.

Fig. 2. Drawn from a T.S. section (the 283rd in the serial series) through the body of *Dendronotus* just anterior to the point of origin of the branch from the dorsal pedal nerve (in the plane marked by the dotted line 2 in the diagrammatic scheme, fig. 1). The relative position of the nerve *a* (epipodial nerve) arising from the pleural ganglion, of the nerve *b* (dorsal pedal nerve) arising from the pedal ganglion and of the œsophagus *œ* is seen.

Fig. 3. Drawn from the next section behind fig. 2 (in the plane of the dotted line 3 in fig. 1). Here the branch *c*. is beginning, and the perineurium is seen partly cutting it off from *b* (dorsal pedal nerve).

Fig. 4. Drawn from the next section posterior to fig. 3 (in the plane of the dotted line 4 in fig. 1). The branch *c* is now completely invested in its distinct sheath, and its fibres are completely separated from those of *b* (dorsal pedal nerve).

Fig. 5. Drawn from the fourth section posterior to fig. 4 (in the plane of the dotted line 5 in fig. 1). The branch *c* is now seen some distance from the pedal nerve *b*, and close to the epipodial nerve *a*.

Fig. 6. Drawn from the succeeding section to fig. 5 (in the plane of the dotted line 6 in fig. 1). The epipodial nerve *a* is here seen to have a distinct constriction, with a part *d* being separated off.

Fig. 7. Drawn from the next section to fig. 6 (in the plane of the dotted line 7 in fig. 1). Shows the portion *d*, completely separated by a distinct sheath, so that there is a group of three nerves, cut transversely, united by connective tissue, *viz.*, *a* epipopdial nerve proper, *c* the branch from the pedal nerve, and *d* the branch from *a*.

Fig. 8. Drawn from the fourth section behind fig. 7 (in the plane of the dotted line 8 in fig. 1). Shows the three nerves *a*, *d*, and *c* still surrounded by distinct sheaths, but the sheath between *a* and *c* is not so well marked as in previous sections.

Fig. 9. Drawn from the succeeding section to fig. 8 (in the plane of the dotted line 9 in fig. 1) Shows that the partition separating *a* and *c* has broken down and the fibres of the two nerves are invested in the same sheath.

[WORK FROM THE PORT ERIN BIOLOGICAL STATION.]

NOTES on SOME SPECIMENS of *Synapta inhærens* from PORT ERIN.

By HERBERT C. CHADWICK.

With Plates XVI. and XVII.

[Read January 11th, 1895.]

DURING a visit to the Port Erin Biological Station in September, 1893, Prof. Herdman drew my attention to a number of living specimens of *Synapta inhærens*, which he had found in the muddy gravel at about half-tide mark immediately below the station. As the species had not been identified, I gladly assented to the suggestion that I should examine and report upon the specimens. A further supply was obtained, and after being kept in clear sea-water for some days, in order that the contents of their intestines might be voided, they were fixed in an extended condition by the addition of sulphuric ether to the sea-water in a tube, and finally preserved in 70 % alcohol. Since the time above mentioned I have carefully examined the specimens; and I would like at this point to acknowledge my indebtedness to my friend Dr. C. H. Hurst of Owens College, for placing at my disposal some large specimens of the closely allied species *Synapta digitata*, from Naples, by the dissection of which I have been able to supplement the results obtained from dissection of the smaller and less easily examined British specimens. My thanks are also due to my friend Mr. F. W. Gamble, M.Sc., of Owens College, for valuable assistance with the literature.

Specimens for sectioning were prepared by decalcification in a 10 % solution of nitric acid, and staining in a rather weak solution of borax carmine, the specimens remaining in the solution for from two to three days.

I think it advisable to preface my description of the specimens from Port Erin by stating the characters of the genus, and those by which the three British species are distinguished by Prof. Bell in his "Catalogue of British Echinoderms in the British Museum," published in 1892. Genus *Synapta*: Tentacles ten to twenty-five; deposits anchors, anchor plates, and fine granules; hermaphrodite.

Synapta inhærens. Twelve tentacles, each with six or seven digitate processes on either side;* a single madreporic canal; one to three Polian vesicles; edge of fluke of anchor serrated; several of the anchor plates with serrated holes; miliary granules not largely developed.

Synapta buski. Eleven tentacles, with three true digits and two or three transverse ridges which look like digits; a single madreporic canal; one Polian vesicle. Anchor plates with seven dentate holes, and long narrow handle.

Synapta digitata. Twelve tentacles, each with four or five digitate processes on either side; a single madreporic canal and Polian vesicle. Fluke of anchor smooth or slightly serrated; the holes of the anchor-plates smooth or with fainter serrations than in *S. inhærens*; miliary granules numerous and in places crowded.

Several inconsistencies between these definitions and the figures which adorn the plates of the Catalogue impair the usefulness of both. *S. inhærens* is said to have "several" of the anchor plates with serrated holes; while each of the five plates figured have serrated holes. *S.*

* Prof. Théel, in his Report on the Holothuroidea of the "Challenger" Expedition gives the number of digitate processes on the tentacles of *S. inhærens* as from twelve to fifteen.

buski is described as having anchor-plates with "seven dentate holes and long narrow handle." The three figures represent plates with five or six large holes and a number of smaller ones, all of which have perfectly plain margins, the handle of the anchor being short and stout.

S. digitata is said to have tentacles "with four or five digitate processes on either side," while the figure on Plate VII. of the Catalogue represents a circlet of tentacles with two digitate processes only on either side. This figure is a fairly accurate representation of the tentacles of a *Synapta* from Millport, given to me by Mr. P. Cameron of Manchester, and of the tentacles of the large specimens labelled *S. digitata* from Naples, which were entrusted to me by Dr. Hurst. Of the three forms just enumerated *S. digitata* appears to me to be distinct, but I am strongly inclined to think that were specimens from a sufficient number of localities available for examination the other two would be found to be inseparable.

I have referred the specimens from Port Erin to *Synapta inhærens*. It is true that the number of digitate processes on the sides of the tentacles never exceeds four, and is very commonly three (Pl. XVII., fig. 1). The flukes of the anchors are, however, in nearly all cases distinctly serrated, and not more than ten per cent. of the anchor plates have holes with plain margins (Pl. XVII., fig. 6), the denticles being well marked, though not so numerous as those of the plates figured by Prof. Bell. The so-called miliary granules, though numerous, are not so thickly scattered as are those of the large specimens of *S. digitata* from Naples. There is but one Polian vesicle, which attains a very considerable length (Pl. XVI., fig. 1, *p.v.*) The lateral borders of the twelve tentacles are crowded with calcareous spicules of minute size and simple form, most of them being dumb-bell shaped. As the peristomial disk is approached, the shape gradually changes until it becomes distinctly lenticular.

Upon the oral face of each tentacle are seated in two irregular rows from two to eight peculiar bodies which have been described as tentacular pedicels (Pl. XVII., fig. 1, *t.p.*) In shape they resemble a wine glass without the stem (fig. 3, *a*), and so suggestive of a sucker is their appearance when seen *in situ*, that the older zoologists may well be excused for comparing them with the tube-feet of Asterids and Echinoids. In minute structure, however, they are entirely different. Each consists of an outer envelope composed of ordinary ectoderm cells (fig. 3, *b*), enclosing a cup-shaped mass of cells, also ectodermal, but of a more specialised kind. They are much longer than ordinary ectoderm cells, especially those which lie at the bottom of the cup, and the nucleus is basal. It is highly probable that the free ends of these cells bear long cilia, but I have not satisfied myself upon this point. Occupying the same position on the tentacles of *S. digitata* are a number of bodies (sixteen to twenty-four), first described by Quatrefages as suckers, and since, by Hamann as sense organs, which are obviously similar in structure to those just described (Pl. XVII., fig. 2). There are, however, certain important points of difference. The mass of specialised cells does not project above the surface of the tentacle, and the cavity which they surround in *S. inhærens* is here occupied by a solid core of elongated cells, the basal ends of which pass into a bundle of nerve fibres which can be traced into continuity with the tentacular nerve. Hamann states that the free ends of these cells are ciliated. I have examined my sections of *S. inhærens* with a view of discovering a nervous connection if such existed, between the organs I have described and the tentacular nerves, but without success.

The body walls conform to the typical structure (Pl. XVI., figs. 1 and 2). Beneath the ectoderm (*ect*) is a thick layer of connective tissue (*ctl*). Then comes the layer of circular muscular fibres (*cm*) lined by the ciliated epithelium of the body cavity.

The bodies to which I have twice referred under the name of miliary granules are ectodermal structures which project wart-like above the general surface of the body (Pl. XVI., figs. 1 and 2, *mt*). In the substance of each is lodged a relatively large ganglion-like mass of nerve tissue (Pl. XVII., fig. 7). From the latter a large number of fibrillar processes radiate, some if not all of which become continuous with the filiform basal ends of the ectoderm cells, the "sense cells" of Hamann and other writers. Many of the ganglion-like masses are continuous with bundles of nerve fibres which most probably arise from the radial nerves. Another point of interest is the presence in the connective tissue layer of what for want of a better name, I have called giant cells, in allusion to their large size. Occasionally they occur in groups of two or three, but as a rule singly (Pl. XVII., fig. 8). The protoplasm is finely granular, and the majority of the cells are multinuclear, the larger ones invariably so. They seem to occur only in the most superficial portion of the connective tissue layer, just beneath the ectoderm.

The nervous system consists of a circum-oral ring (Pl. XVI., fig. 1, *conr*) from which five radial nerves (*rn*) proceed along the radii of the body. A well marked sheet of nerve fibres is given off from the. circum-oral ring to the oral face of each of the tentacles (*tnl*). Seen in transverse section this presents a crescentic figure, lying just beneath the ectoderm cells (Pl. XVII., fig. 5). The circumoral ring almost completely encloses a tubular space (*ts*). This, like the nerve ring gives off branches which lie beneath and are partly bounded by the radial nerves. The circular water vessel (*cwv*) gives off branches (*twv*) to each of the tentacles, entrance to the tentacle being made on the inner side of the calcareous ring (*cr*). Other appendages of the circular water vessel are the madreporic tube, or water tube, (*w*) and the single Polian vesicle (*pv*). The former, a simple tube lined by (probably ciliated) epithelium, is seated on the upper surface of the water vessel, and its free end opens into the body cavity; the latter is also tubular, and of great length, but its free end is imperforate. It depends from the lower face of the water vessel. The intestine (*i*) though much sacculated and occasionally bent upon itself, runs a practically straight course from mouth to anus, being suspended from the dorsal interradius by the mesentery (*m*). It is accompanied in its course by the typical dorsal and ventral vessels (*dv* and *vv*). The genital organ consists of two bundles of cæcal tubes (*g*) which lie one on either side of the mesenterial fold which suspends the intestine. The main tube of the left bundle joins that of the right by penetrating the mesentery. A single duct is thus formed which, passing forwards in close proximity to the water-tube opens by a single pore between two, and just outside of, the ring of tentacles (*ga*). Attached to the fold of mesentery by which the intestine is suspended, just at the point where it joins the body wall, there occur a great number of funnel-shaped bodies with strongly everted margins, and lined by ciliated epithelium (Pl. XVI., fig. 1, *cf*). These are the "ciliated funnels" of Semper. Each funnel is attached by its pointed apex to the mesentery; and in addition to those borne by the intestinal mesentery, another series, appearing to the naked eye as an irregular but quite continuous line, occupies the middle of the interradius next on the left of the dorsal one. A few also occur scattered over the walls of the cœlom. Their function is at present unknown.

Explanation of Plates XVI. and XVII.

List of reference letters.

cf Ciliated funnels; *cm* circular muscles; *conr* circum oral nerve ring; *ctl* connective tissue layer of body wall; *cwv* circum-oral water vessel; *cr* calcareous ring; *dv* dorsal vessel; *e* ectoderm; *g* gonad; *ga* genital aperture; *i* intestine; *lmb* longitudinal muscle bands; *m* mesentery; *mlt* muscular layer of tentacles; *mt* miliary granules; *pv* Polian vesicle; *rn* radial nerve; *t* tentacles; *tp* tentacular pedicels; *tnl* tentacular nerve; *ts* tubular space underlying nerve; *vv* ventral vessel; *w* water-tube.

Plate XVI.

Fig. 1. Diagram of the anatomy of *Synapta inhærens*, constructed from dissections and serial sections.

Fig. 2. Diagram of a transverse section of *Synapta inhærens*.

Plate XVII.

Fig. 1. A tentacle of *Synapta inhærens* showing the so-called tentacular pedicels in situ.

Fig. 2. Outline figure of a tentacle of *Synapta digitata*, showing the bodies described by Hamann as sense organs.

Fig. 3. (*a*) A tentacular pedicel viewed in situ; (*b*) vertical section of the same.

Fig. 4. Diagram of a longitudinal section of a tentacle of *Synapta inhærens*.

Fig. 5. Transverse section of a tentacle of *Synapta inhærens,* taken at the level of the dotted line* in fig. 4.

Fig. 6. Plates and anchors of *Synapta inhærens* ; (*a*) is an abnormal form of anchor ; (*b*) smaller calcareous plates.

Fig. 7. Vertical sections of three miliary granules of *Synapta inhærens*, showing the ganglion-like nerve endings.

Fig. 8. Section of ectoderm and connective tissue layer of the body wall, showing giant cells in the latter.

Fig. 1.

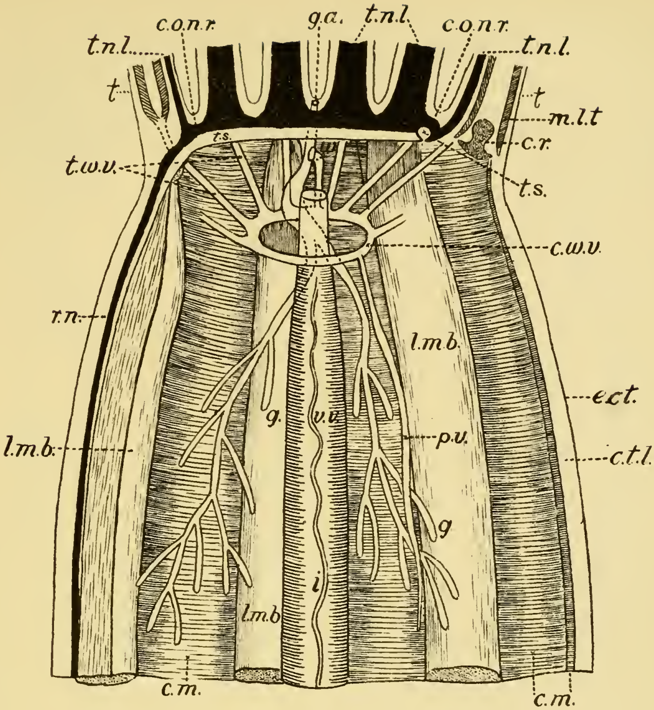
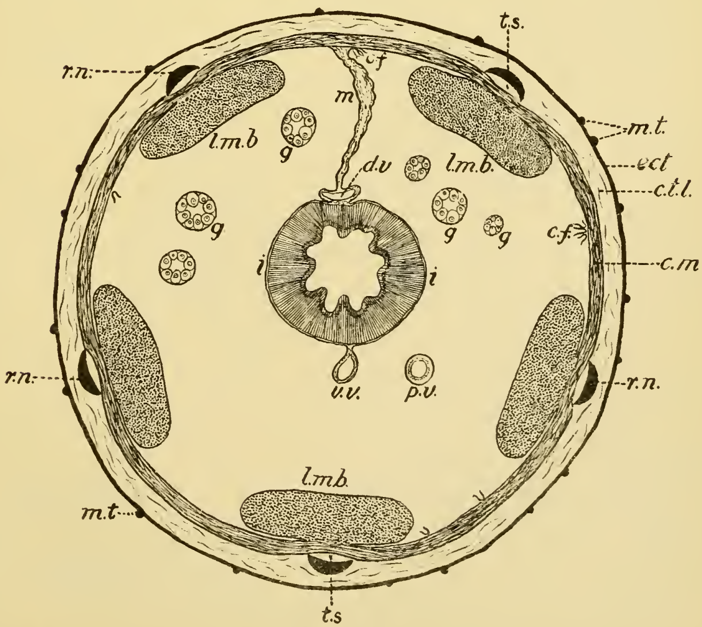
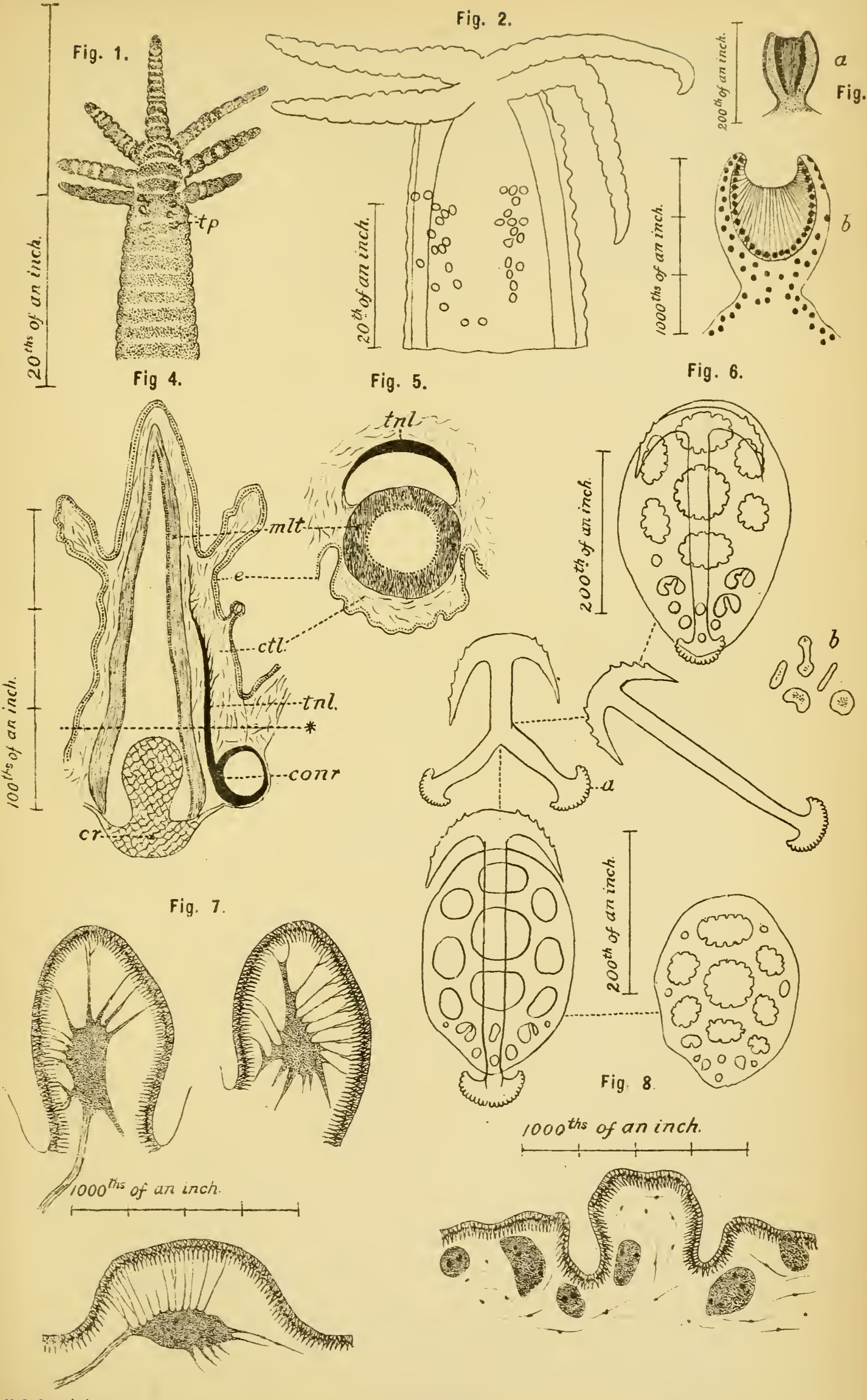


Fig. 2.



H.C.C., del.

SYNAPTA.



H.C.C., del.

SYNAPTA.

[WORK FROM THE PORT ERIN BIOLOGICAL STATION.]

REPORT on the MEDUSÆ of the L.M.B.C. DISTRICT.

By Edward T. Browne, B.A.
UNIVERSITY COLLEGE, LONDON.

[Read March 8th, 1895.]

It is nearly nine years since the first report on the Medusæ of the L.M.B.C. district was published by Mr. J. A. Clubb (*7*). It contains a list of medusæ collected by Prof. Herdman off the south end of the Isle of Man in 1885, and by Byerley (*6*) and other naturalists who have worked in Liverpool Bay. Most of these species I have recently taken at Port Erin, some others, which I have not met with and which are mentioned in the first report, are again recorded in this report so as to make the present list as complete as possible.

My own records are chiefly based upon work done at the Port Erin Biological Station between April 28th and June 7th, 1893, and also between March 22nd and May 14th, 1894. I have confined my attention to the small Hydromedusæ and have not specially searched for the other groups. Mr. W. I. Beaumont (*5*) in 1893 published an account of the Lucernarians of Port Erin. I owe to Mr. Beaumont my sincere thanks for the great aid which he has so often generously given in helping me to collect specimens of the Hydromedusæ. I have not met with any new species, but have added a few interesting ones to the list of Manx medusæ and also show that some, described as species, are stages in development of other species already recorded.

This report can only be regarded as a preliminary one, as it is simply an abstract of some of my notes. I hope at a later date to publish an account of each species with figures. The great obstacle which prevents progress is not being able to collect sufficient specimens of a species so as to trace its development and to see how far it is necessary to allow for variation. So far my attempts to rear medusæ from their hydroids, or to keep them in confinement have been failures. The rearing of a medusa in confinement is the only safe method for tracing its life-history, and until this can be done the uncertain method of catching a sufficient quantity of specimens must be adopted. Some species have a characteristic feature, like the eight radial canals of *Melicertidium*, which distinguish them from other allied species, and by which it is easy to identify them at any stage in development. But unfortunately the majority of species have not such characteristic features, and it is difficult to distinguish the early stages of different species. The old genus *Thaumantias* of Forbes, which has been divided into many families and genera by Hæckel, still remains a great stumbling-block to the medusa-collector. Another difficulty which has yet to be overcome is the final indentification of a number of doubtful species of hydroids, which are known to bud off medusæ. When the life-histories of the hydroids with their medusæ are known and the specific differences correctly determined there will be no difficulty in adopting a single system of classification. At present two systems exist, one for the hydroids and another for the medusæ. I have used in this report Hæckel's system of classification and the names of his genera, but have also given the principal synonyms and references to those species which are mentioned by Forbes, Hincks and Allman. There is no need in this kind of report to give a description of the species. Nearly every species mentioned in this report is given by Forbes in his monograph.

My latest method for catching medusæ is to use a long tow-net made of bolting silk with a mesh not exceeding half a millimetre. At the end of the net is fastened a zinc can, instead of the usual glass bottle which generally breaks when the contents are specially wanted. I prefer to use a small rowing boat and work very gently against the tide with just a slight pull on the net. If the medusæ are not visible at the surface, I sink the net with a weight about two fathoms, and if not successful, try near the bottom. The net is left down from 10 to 20 minutes and the contents emptied into a large glass-bottle. It is best to pick out at once some of the best specimens with a large pipette and place them in another bottle full of clean sea-water. Medusæ are very delicate, and quickly die if crowded together in a small bottle.

The following is one of the best methods for killing and preserving small medusæ. Place the medusa in a large watch-glass with sufficient water to float in. Add with a pipette about 5 drops of a 2 per cent. solution of cocaine, and about 10 minutes later add another 5 to 10 drops; the quantity depends upon the species and its activity. When the medusa has become motionless and the tentacles expanded, add suddenly a saturated solution of picric acid. It is best to reduce with a pipette the quantity of water in the watch-glass just before adding the picric acid, and use plenty of the latter. Often when the picric acid is added a precipitate of cocaine is thrown down which must be removed at once by a pipette and fresh picric acid added. Specimens may be left in picric acid about half an hour and gradually transferred into 80 p.c. alcohol. I strongly recommend the use of the best glass-stoppered bottles and perfectly pure spirit for storing specimens in.

Finally I thank Prof. Herdman and the Committee for the use of the Port Erin Biological Station.

HYDROMEDUSÆ.

Order ANTHOMEDUSÆ.

Family Codonidæ.

Codonium pulchellum, (Forbes *15*).
Sarsia pulchella, Forbes (*9*).
Syncoryne pulchella, Allman (*4*).

This species was fairly abundant during May and the early part of June, 1893, in Port Erin Bay. The bulb at the base of the tentacles varies in colour in different individuals. It is usually of a brownish colour, but in some specimens either orange, crimson, or greenish. The "Scheitel-Aufsatz"—(the prolongation of the manubrium into the substance of the umbrella, forming a kind of apical knob to the manubrium) is present in all specimens; but the "Stielcanal" (which runs from the apical knob to the ex-umbrella, is not a true canal or tube, but the remains of the original canal connecting the young medusa with its hydroid) in some specimens is very narrow and difficult to see. In a few specimens it is entirely absent. Hæckel divides the genus *Sarsia* of Forbes into two genera, *Codonium* and *Sarsia*. The species of the former genus are characterized by the possession of a "Scheitel-Aufsatz" and a "Stielcanal." The genus *Sarsia* of Forbes still requires careful revision.

Codonium pulchellum swims actively about an aquarium, and usually has its manubrium and tentacles expanded. It resembles *Sarsia tubulosa*, Sars, rather than *S. pulchella* in its habits. The manubrium and tentacles, when fully expanded, are about twice the length of the umbrella. The umbrella of the smallest specimen taken measured 4 mm. in length and 3 mm. in width: the largest specimen 9 mm. long and 6 mm. wide. Other specimens measured—6 mm. long and 6 mm. wide; 6 mm. long and 7 mm. wide; 8 mm. long and 8 mm. wide.

Sarsia pulchella may be an early stage of *S. tubulosa*.

Distribution.—Shetland, St. Andrews, Plymouth, Firth of Clyde.

Sarsia tubulosa, Sars, (*9*).

Byerley (*6*) records this species.—"Caught in the Mersey, rare, Mr. Price." Haddon (*14*) records *S. tubulosa* in Dublin Bay.

I have taken in Port Erin Bay several specimens of young Sarsia, but have not been able to determine for certain the species.

Dipurena halterata, (Forbes *15*).

Slabberia halterata, Forbes (*9*).

Two specimens taken in August, 1892. One measured 2½ mm. in length and 2 mm. in width. Manubrium extended to 8 mm. Tentacles 2 mm. long. No reproductive organs present. The medusa may easily be distinguished by the large knob, containing nematocysts, at the free end of each of the four tentacles.

Distribution.—Jersey, Mount's Bay (Cornwall), Plymouth.

Steenstrupia rubra, Forbes (*9*).

Steenstrupia galanthus, Hæckel (*15*).

Steenstrupia flaveola, Forbes (*9*).

Forbes describes and figures the above species, the former taken off the Shetlands, the latter at Penzance. They mainly differ in colour. Hæckel regards them as the same species. I took two specimens off Port Erin in August, 1892. The contents of the tow-nets were unfortunately preserved at sea, so that the colour of the medusa was destroyed. In shape and size they resemble the figures given by Forbes of *Steenstrupia.* Hæckel regards *Steenstrupia galanthus* as the medusa of the hydroid *Corymorpha nutans*, of Allman and Hincks, but not of Sars. The various species of *Corymorpha* and their medusæ require careful revision.

Euphysa aurata, Forbes (*9*).

A single specimen of this medusa was taken on May 5th, 10th, and 20th; and five specimens on June 5th, 1893.

The umbrella of the largest specimen measured 4½ mm. in length and 3½ mm. in width; the smallest 3½ mm. long and 2 mm. wide. One specimen taken on June 5th with ring-canal coloured in several places with a crimson pigment. The three bulbs, without tentacles, had their centres coloured with a brilliant crimson pigment, but the basal bulb of the large tentacle was very faintly coloured with crimson.

One specimen, taken on March 22nd, 1894, the first day of tow-netting, measured 3¼ mm. in length and 2 mm. in width. None seen until April 18th when three were captured, the largest 6 mm. in length and 4½ mm. in width. After this date a few were regularly taken in the tow-net.

The umbrella is always longer than wide, and laterally very thick; the latter a characteristic feature by which this species may be readily distinguished from other uni-tentacular medusæ. The ex-umbrella has a few scattered nematocysts.

Forbes (*9*) in his description of this species writes:—"The orifice (of the umbrella cavity) is rather contracted and square. At each of the four angles is a large diamond-shaped ocellus, the upper half of which is bright golden yellow, and the lower half vivid scarlet or crimson. From each of the ocelli springs a short, reflexed, cylindrical, yellow tentacle, which I have never seen to extend itself. From one of the ocelli, below the short tentacle, arises a long and thick one, highly extensile, and of a golden colour, usually presenting a club-like shape."

This statement does not give a quite correct description of the species. I have examined the tentacle-bulbs of about two dozen specimens and failed to find an ocellus definite in shape and colour. The tentacle-bulbs are similar in shape, but one has a large tentacle and the other three are without tentacles. Forbes describes and figures each tentacle-bulb with a minute, reflexed, yellow tentacle, and one bulb having an additional large tentacle. The "minute tentacle" is the lower part of the tentacle-bulb, which slightly curls over the margin of the umbrella to which it is fixed.

The colour of the tentacle-bulbs varies considerably in different specimens. A few had no colour whatever in the bulbs and only the large tentacle faintly coloured with yellow. One specimen had the three bulbs, without tentacles, quite colourless, but the tentacle-bulb of the large tentacle of a yellowish colour. Most specimens, however, have yellow or orange pigments in the lower part of the bulbs, the part which corresponds to "minute yellow tentacles" of Forbes. In the most brilliantly coloured specimens the interior of the tentacle-bulbs has a crimson pigment, the part which corresponds to the crimson ocellus of Forbes. In one specimen the crimson colour extended a little way along the ring-canal on each side of the bulbs, and in two other specimens, brilliantly coloured, the whole ring canal was crimson. Crawford

(*8*) has also observed a crimson ring-canal in specimens taken at St. Andrews.

Alder, (*3*) describes and figures the medusa of *Corymorpha nana*, Alder, (= *Halatractus nanus*, Allman *4*), which he bred from the hydroid. Hæckel (*15*) considers, from Alder's description of this medusa and from the description of *Euphysa aurata* by Forbes, that the medusa of *Corymorpha nana* and *E. aurata* are identical and gives in his "System der Medusen" *Halatractus nanus* as the hydroid of the medusa *Euphysa aurata.* I believe Alder is the only person who has ever taken *Corymorpha nana*; and Hæckel apparently has not met with *Euphysa aurata*. The figure given by Alder of the medusa of *Corymorpha nana* has not the specific characters of *E. aurata*. The umbrella of *Corymorpha* is about as long as wide, and thin; the umbrella cavity is consequently very large. The umbrella of *Euphysa* is always longer than broad, and laterally very thick; also about one third of the aboral end is formed of solid tissue; the umbrella cavity is small compared with the external size of the umbrella. The manubrium of *Corymorpha* is long and extends beyond the velum, but the manubrium of *Euphysa* is about two-thirds the length of the umbrella-cavity and has never been seen to extend beyond the velum. *Euphysa aurata* may be easily recognised by the shape and great thickness of the umbrella. I think that the medusæ of *Corymorpha nana* and *Euphysa aurata* do not belong to the same species, and that the hydroid form, if one exists, of *Euphysa* has yet to be discovered.

Hæckel (*15*) describes and figures in his monograph another species of *Euphysa*—*E. mediterranea*—which he obtained at Villafranca. The umbrella is longer than wide (3 mm. long, 2 mm. wide), and thick. Three tentacle-bulbs, without tentacles, golden yellow, with purplish red ocelli. The other tentacle-bulb, golden yellow, bearing a large golden red tentacle, without a purplish red ocellus. Ring-canal purplish red. When I compared a living specimen of *E. aurata*, which possessed a crimson ring-canal and tentacle-bulbs coloured with orange and crimson, with the coloured figures given by Hæckel in his monograph, I failed to find sufficient differences to separate *E. aurata* from *E. mediterranea*.

Hæckel makes the chief specific difference the absence of the purplish red ocellus in the tentacle-bulb of the large tentacle. In *E. aurata* there is no proof that the part of the bulb coloured crimson is really an ocellus. In some specimens the colour is absent, but present in others in different shades of crimson. One specimen, taken in 1893, had the three bulbs, without tentacles, conspicuously coloured with crimson, but the bulb at the base of the large tentacle had only a faint tinge of a crimson colour, scarcely visible with the microscope. I have noticed in other species of medusæ a great variation in colour. *Amphicodon fritillaria* has usually dark brown or reddish brown tentacle-bulbs, and all the canals colourless; but in a few specimens the tentacle-bulbs are of a brilliant red colour and also the radial canals.

Distribution.—Shetland, St. Andrews.

Amphicodon fritillaria, (Steenstrup *15*).
Coryne fritillaria, Steenstrup (*21*).
Steenstrupia globosa, Sars (*20*).
Amphicodon globosus, Hæckel (*15*).
Diplonema islandica, Green (*13*).
Steenstrupia owenii, Green (*13*).
Hybocodon prolifer, Agassiz (*2*) Hæckel (*15*).
Amphicodon amphipleurus, Hæckel (*15*).

Steenstrup (*21*) during April and May, 1840, off Reikewig, Iceland, obtained specimens of a free-swimming medusa which he described as follows:—Umbrella bell-shaped, little longer than broad. Manubrium about $\frac{2}{3}$ the length of the umbrella cavity. Margin of the umbrella obliquely cut off, so that one side of the umbrella is longer than the other. Four radial canals. Four tentacle-bulbs; three of which are without tentacles, and the other, larger, with two tentacles situated on the longest side of the umbrella. A medusa-bud is also present on the large tentacle-bulb. The ex-umbrella has five longitudinal rows of nematocysts, one following the course of each of the three radial canals running to the non-tentacular bulbs, and two near the canal which joins the large tentacle-bulb carrying the two tentacles.

Steenstrup also found in the same locality specimens of a small solitary hydroid, attached to the empty shells of *Balanus*, etc. The hydroid is about $\frac{1}{2}$ inch long, with 5 or 6 tentacles in a single verticil upon the head. Below the head four bell-shaped, quadrangular, medusæ hang down, at right angles to one another. The medusa has the margin of the umbrella obliquely cut off. Four tentacle-bulbs, without tentacles. The bulb on the longest side of the umbrella is the largest. Steenstrup regarded the large medusæ with two tentacles as the adult stage of the young medusæ attached to the hydroid, and gave the same name—*viz.*, *Coryne fritillaria* to both of them.

Sars (*20*) found three specimens of a medusa, which he named *Steenstrupia globosa*, in May, 1836, at Floröen in Söndfjord. They resemble *Coryne fritillaria* in shape of the umbrella, but have three tentacles on the large bulb on the longest side of umbrella. In May, 1838, Sars again found three more specimens; one with three tentacles and the others with only one tentacle. Sars believed that these medusæ were probably the same as those taken by Steenstrup. The chief difference consists in the number of tentacles. Hæckel (*15*) considers that they are distinct species and places them in his genus—*Amphicodon*, which consists of three species—*A. fritillaria*, *A. globosus*, *A. amphipleurus*.

At Port Erin in 1893, on the first day of tow-netting, (April 29th), I obtained specimens of *Amphicodon*. They were fairly plentiful during the first few days of May and disappeared about the 10th. Altogether I collected about 50 specimens. The umbrella is about 2 to 3 mm. in length and not quite so broad. The opening of the umbrella cavity is small as the velum is fairly wide, and the large tentacle-bulb projects a little across the opening. There are three non-tentacular bulbs and one large bulb on the longest side of the umbrella which may carry one, two, or three tentacles, usually two are present. From the large tentacle-bulb medusæ are budded off, and often two, three or more buds are present in various stages of development. I saw one young medusa break away from its parent, which it resembled in every detail except size. The former was about 1 mm. in length and the latter was nearly 3 mm. Both carried two tentacles on the large bulb. The majority of specimens were without medusa-buds and had ova or spermatozoa upon the manubrium. The sexes are separate. At the end of March, 1894, I again visited Port Erin for the purpose of collecting more specimens. The first specimen was taken on March 29th, and during the whole of April *Amphicodon* was very abundant in the Bay.

All the specimens have the five longitudinal rows of nematocysts as described by Steenstrup. The colour of the tentacle-bulbs shows a considerable amount of variation. In the young specimens yellowish brown is the prevailing colour and in the adults a dark reddish brown. A few adult specimens were taken with brilliant crimson tentacle-bulbs and with the ring and radial canals also full of a crimson pigment, not in circulation, but as small particles in the endoderm cells. These brilliantly coloured specimens are an exception and duller colours usually prevail. Another medusa—*Euphysa aurata*—shows a similar brilliancy of colour in a few specimens only.

The most interesting feature connected with this medusa is the carrying of young hydroids in the umbrella cavity. So far as I know this has not been recorded before in any other medusa. I first observed this in the specimens taken in 1893 which led me to obtain more specimens in 1894 so that I might investigate the development of the ovum. This I have nearly completed by means of series of sections and the results will be published soon. When the medusa first appeared at the end of March the asexual method of budding medusæ from the base of the large tentacle alone existed, which must add considerably to the original number of medusæ which leave the hydroid. Each medusa buds off at least four other medusæ, all of which become sexual later on, and some of the young medusæ have also medusa-buds. About the middle of April the reproductive cells began to appear on the manubrium, at first as a slight swelling of a transparent gelatinous appearance, faintly tinged with a yellowish-brown colour. When squeezed, the mass breaks up into small round cells (germinal cells), each with a nucleus. As these cells increase in size a large oval mass is formed upon the manubrium. It appears from sections that one of the original germinal cells becomes the ovum which increases in size at the expense of the other germinal cells which are absorbed. The ovum remains attached to the manubrium until the hydra-stage is reached. The tentacles of the posterior verticil first make their appearance about 11 to 17 in number, and when they become about 2 mm. long, a second verticil of 8 tentacles appears. The body of the young hydra behind the posterior tentacles becomes covered with a thin perisarc. Sometimes the young hydra breaks away from manubrium before the appearance of the second row of tentacles and remains free in the umbrella cavity. The young hydra with the two verticils of tentacles is about 2 mm. long, and the tentacles of the posterior verticil are a little longer than the body. Often in the same specimen there is an ovum on the manubrium and two or three hydrae showing various stages of development. In a few specimens the asexual budding is taking place at the same time as the sexual reproduction on the manubrium. Sometimes the young medusa on the tentacle-bulb shows also the reproductive cells on the manubrium. Several of the young hydroids fixed themselves on the bottom of a glass aquarium, and grew to about 10 mm. in length. A great change took place in the body, which became stem-like and the coenosarc showed longitudinal striae of an orange-red colour. The eight oral tentacles increased slightly in length and the whole head became larger. These hydroids have every appearance of a young *Corymorpha*. I can see no reason for specifically separating the free-swimming medusæ taken by Steenstrup off Iceland and by Sars off Norway from the Port Erin specimens. It is clear from the development of the hydroid of the Manx medusæ that the hydroid is not the same as Steenstrup dredged off Iceland. It will be best to leave the Iceland hydroid under the name of *Diplura fritillaria* Allman (*4*), and regard Steenstrup's free-swimming medusæ with two tentacles, and those taken by Sars with one and three tentacles as *Amphicodon fritillaria*.

L. Agassiz (*2*) found in Massachusetts Bay a corymorpha-like hydroid budding off uni-tentacular medusæ, to which he gave the name *Hybocodon prolifer*. As Allman (*4*) gives a description of the hydroid and medusa there is no need to repeat all the details. The hydroid is about 2 inches long, about $\frac{1}{16}$th of an inch in diameter below the head, and thinner near the base. Perisarc smooth except near the head where there are a few annular constrictions. Coenosarc of the stem with longitudinal orange-red striae. Hydranth with two verticils of tentacles, about sixteen tentacles in each. The hydroid lives in rock-pools on out-lying rocks away from the shore, about the Laminarian Zone, usually three or four are together.

Between the two verticils of the tentacles the medusa-buds are situated just as in *Corymorpha nutans.* Medusæ are budded off from January to April. Agassiz apparently has not seen any specimens of the adult medusæ but only those either upon the hydroid or just liberated, and his description is confined to the earliest stage of the medusa. The umbrella of the young medusa has the margin obliquely cut off so that one side of the umbrella is longer than the other. On the longest side of the umbrella is situated a large tentacle-bulb carrying a solitary tentacle, and also medusa-buds. There are three other non-tentacular bulbs without tentacles in the usual places upon the margin of the umbrella. The ex-umbrella has five longitudinal rows of nematocysts which extend from the margin to within a short distance of the apex of the umbrella. One row is above each of the radial canals running to the tentacle-bulbs not bearing tentacles, and the other two rows are near the canal running to the large tentacle-bulb. The rows of nematocysts are conspicuous early in the year by their orange-red colour, but become inconspicuous about April.

The young medusa *Hybocodon prolifer* has all the characteristic features of the medusa, *Amphicodon fritillaria.* The shape of the umbrella, the five rows of nematocysts, and the budding of medusa from the base of the large tentacle are common to both. The young hydroids which I reared at Port Erin have every appearance of becoming similar to the hydroid taken by Agassiz. They agree in colour, in the longitudinal striae of the stem formed by the coenosarc, and the tentacles of the posterior verticil are about the same in number. The anterior verticil has only eight tentacles, but others may appear as the head grows larger. The discovery of the adult hydroid with medusæ on the Manx coast will settle the identity at once.

Böhm (Jena zeitschr. f. Naturw., Vol, XII, 1878) captured a specimen of a medusa off Heligoland which he believed to be identical with the American *Hybocodon prolifer.* The medusa has two tentacles on the large tentacle-bulb on the longest side of the umbrella and many medusa-buds, and also the five rows of nematocysts on the umbrella. Hæckel however, places *Hybocodon prolifer* of Böhm as a synonym of *Amphicodon fritillaria.*

In the last Annual Report (1894) of the L.M.B.C., it is stated on my authority that *Amphicodon fritillaria* is an addition to the fauna of the British seas, but I have recently read a paper by Mr. J. R. Green (13) on the medusæ on the coast of Dublin in which he clearly describes specimens of *Amphicodon fritillaria* found on that coast about 1856. He describes them as two new species—*Diplonema islandica* and *Steenstrupia owenii.*

Diplonema islandica, has two tentacles on the large bulb on the longest side of the umbrella. Tentacle-bulbs of a brilliant crimson colour. A medusa-bud on the large tentacle-bulb, and in one specimen a medusa-bud on one of the tentacles, some distance from the base. Green has read Steenstrup's description of *Coryne fritillaria* and states that there is a strong resemblance between the two species, but does not think that they are the same. Hæckel however believes that *D. islandica* is the same species as *A. fritillaria.* *Steenstrupia owenii* is very much like *D. islandica* in shape. It differs from it in possessing only one tentacle on the tentacle-bulb. A Stielcanal is also present, running from the top of manubrium to the ex-umbrella. Three medusa-buds at the base of the large tentacle. Hæckel believes that this species is probably the same as *Hybocodon prolifer*, Agassiz. It is interesting to notice that these specimens were taken on the coast of Ireland nearly opposite the Isle of Man. Hæckel describes another species of *Amphicodon—A. amphipleurus*, which he found on the coast of Normandy, at Granville. It has three tentacles on the large tentacle bulb on the longest side of the umbrella, and the usual five rows of nematocysts on the ex-umbrella. It differs only from the other species of *Amphicodon* in possessing a larger number of medusa-buds on the large tentacle-bulb, and in having a stiel-canal. The radial-canals, ring-canal manubrium, tentacle-bulbs and tentacles of a crimson colour. All the medusæ of *Amphicodon fritillaria* must have a Stielcanal on leaving the hydroid, but it usually disappears later in life. I saw one adult specimen at Port Erin with a Stielcanal. In some species of medusæ the Stielcanal remains throughout life; in others it disappears, but occasionally may be present in adult specimens.

Family Tiaridæ.

Tiara pileata, (Forskal *15*).

Oceania episcopalis, Forbes (*9*).

The medusa was first taken by Forskal in 1775. Since then it has been described under many names and by many naturalists.

One specimen taken at Port Erin, Aug. 1892. Fairly abundant during May and June, 1893. Many specimens were often left on the sandy beach by the tide. During April, 1894, I obtained several young stages in the bay. One specimen taken on April 18th, umbrella 7 mm. long, and 4 mm. wide. At the aboral end of the umbrella there is a large globular mass of tissue, which looks like a knob on the top of the umbrella. Four broad radial canals, manubrium about one-third the length of the umbrella cavity, mouth wide with four large lips. On the margin of the umbrella four perradial tentacles, of which two, opposite ones, are larger and longer than the others. The basal bulbs of these tentacles are large and long, each with a reddish ocellus. There are also four interradial tentacle-bulbs, with ocelli but without tentacles. A specimen taken on April 10th, with a short conical knob at the aboral end of the umbrella. On the margin of the umbrella there are four long perradial tentacles, four large interradial tentacle-bulbs without tentacles, and eight small adradial tentacle-bulbs. Another specimen taken on April 10th, umbrella 4 mm. long and 2½ mm. wide, four perradial tentacles, 20 mm. long when fully expanded, four short interradial tentacles, and eight adradial tentacular-bulbs without tentacles. These three specimens show clearly the increase of the tentacle-bulbs and tentacles. In some specimens the number of tentacles exceeds eighteen. Gosse records a specimen with twelve tentacles and three tentacle-bulbs between each, the central one being the largest. I have seen a specimen with eighteen tentacles, and a tentacle-bulb between every two of them. Probably the maximum number is about 48 tentacles.

Allman (Monogr. Gym. Hydr., p. 33, woodcut 8), figures a young stage of Tiara under the name of *Oceania coronata.* This is probably a young *T. pileata.* It has four long, perradial tentacles; four short interradial tentacles; and eight adradial tentacle-bulbs. It is exactly like a specimen taken at Port Erin on April 10th. Hæckel, however, places this specimen under the name of *Tiara octona.*

Distribution.—Mediterranean. Norway, Heligoland, Shetland, St. Andrews.

Turris neglecta, Lesson (*9*).

Byerley (*6*) records this species.—"Taken rarely in the Mersey, by Mr. Price."

I have not yet seen this species at Port Erin. It appears to be a fairly common medusa and no doubt will be recorded before long on the Manx coast.

Distribution.—St. Andrews, Southampton, Portland, Ilfracombe, Tenby, Liverpool.

Family MARGELIDÆ.

Dysmorphosa carnea, (M. Sars *15*).

Podocoryne carnea, Hincks (*16*), Allman (*4*).

One specimen taken on March 30th, 1894, with four long perradial and four short interradial tentacles.

Distribution.—Naples, Norway, St. Andrews, Firth of Forth, Plymouth, Falmouth.

Dysmorphosa minima, Hæckel (*15*).

This medusa was first discovered by Hæckel in 1865 off Heligoland, and has not been recorded since. The length of the umbrella is 0·8 mm. and the width 0·6 mm. Four simple oral tentacles terminating with a cluster of nematocysts. Medusa-buds upon the manubrium. Eight tentacles upon the margin of the umbrella, 4 single perradial and 4 single interradial. Blackish tentacle-bulbs. Hæckel's figure of *Dysmorphosa minima* shows a constriction across the umbrella cavity. I do not think this is a permanent constriction, but produced probably by injury or death. In all medusæ which have a permanent constriction across the umbrella, the constriction is either level with the top of the umbrella cavity or above it, so as not to interfere with the size of cavity and the contractions of umbrella. I have seen medusæ under the influence of cocaine die with a constriction across the middle of the umbrella cavity. In the museum of the Marine Biological Association at Plymouth I saw specimens of *Dysmorphosa minima*, but labelled *Dysmorphosa carnea*. Nine of the Plymouth specimens correspond to Hæckel's description and five others only differ in the number of tentacles. These show an increase in the perradial groups and have the tentacles arranged thus:—

Perradial	2211	2121	1112	2222
Interradial	1111	1111	1111	1111

The perradial groups with two tentacles have one tentacle longer than the other, the smaller one is evidently growing. I took a single specimen at Port Erin, 1894, of a medusa which is exactly like the specimens of *Dysmorphosa minima* at Plymouth. It has four simple oral tentacles; eight single marginal tentacles; and four medusa-buds upon the manubrium.

It is quite possible that *Dysmorphosa minima* is an early stage of *Lizzia blondina*. The Plymouth specimens clearly show an increase of tentacles in the perradial groups.

Dysmorphosa minima may easily be distinguished from *Dysmorphosa carnea* by the stomach being attached to a short peduncle, and also by the presence of medusa-buds upon the manubrium.

? *Cytæandra areolata*, (Alder *15*).

Hydractinia areolata, Alder (*3*).

Podocoryne areolata, Hincks (*16*), Allman (*4*).

I place temporarily under the name of *Cytæandra areolata*, until further evidence can be obtained, a number of medusæ taken at Plymouth and Port Erin. They all belong to the same species and show different stages of development. The youngest stage is somewhat like *Cytæandra areolata.* The uncertainty mainly arises on account of the great rareness of the hydroid stage and the plentifulness of the medusæ in Port Erin Bay, Alder first described the hydroid stage under the name of *Hydractinia areolata.* He obtained his specimens on a dead shell of *Natica alderi*, brought in by a fishing boat at Cullercoats, and Norman sent him another specimen from Shetland. Alder has seen the young medusæ leave the colony. The medusa has a moderately deep, subglobose umbrella, with nematocysts scattered upon the outside; four radial canals; four short perradial and four shorter interradial tentacles, and eight adradial bulbs on the margin of the umbrella; four clusters of nematocysts near the mouth.

Alder is the only person who has seen the young medusa, and since his observations no one has recorded this species. Hincks states that Hodge has taken the hydroid with medusæ at Seaham. Allman, however, omits this reference in his monograph, and I cannot find any statement referring to this species in Hodge's papers.

Hincks removed *Hydractinia areolata* to the genus *Podocoryne*, where it still remains. There are three species of *Podocoryne* recorded for Great Britain—*P. carnea*, *P. proboscidea* and *P. areolata*. *Podocoryne carnea* is the commonest; *P. proboscidea* was taken by Hincks at Ilfracombe, but has not been since recorded.

I had at Plymouth a colony of *P. carnea* in a bottle. It budded off many medusæ which were not like the figure of the medusa of *Podocoryne areolata* given by Alder, nor like the medusæ which I have taken at Port Erin. The Port Erin specimens approach nearer to Alder's figure of *P. areolata* than to any other known medusa. I prefer to leave them for the present under this name rather than to make a new species.

The earliest stage of the series I captured in Port Erin Bay on March 31st, 1894. The umbrella about as long as broad, $1\frac{1}{2}$ mm. in diameter; the ex-umbrella covered with nematocysts. There are sixteen tentacles—4 perradial, 4 interradial and 8 adradial. The perradial tentacles are longer than the interradial, and the latter are longer than the adradial. The large bulbs at the base of the tentacles, contain a reddish-yellow pigment. In addition to the tentacles there is one small bulb placed between two tentacles, which is evidently the commencement of another tentacle. Near the mouth there are four simple oral tentacles, each terminating in a cluster of nematocysts.

This naturally appears to be a later stage of Alder's medusa of *P. areolata*. The main difference consists in the presence of adradial tentacles in the place of the bulbs. It is, however, usual for tentacles first to appear as small bulbs upon the margin of the umbrella. The next stage was taken at Plymouth, September 30th, 1893. The umbrella nearly as long as broad, about 1 mm. in diameter, the ex-umbrella covered with nematocysts. On the margin of the umbrella there are 16 large tentacles—4 perradial, 4 interradial and 8 adradial. The tentacle-bulbs at the base of the tentacles of a dark brown colour. In addition to the large tentacles there are four small, slender tentacles, with colourless tentacle-bulbs. These are evidently in a state of development. Four simple oral tentacles with clusters of nematocysts.

A specimen taken at Port Erin, April 18th, 1894. Umbrella about 3 mm. in diameter. Sixteen large tentacles and six small ones. The oral tentacles are once dichotomously divided, each branch terminating in a cluster of nematocysts. It has been observed in several species of medusæ which have branched oral tentacles in the adult stages that they start life with simple, unbranched tentacles. In *Margelis* the number of branches increases with age.

Two specimens taken at Port Erin, June 5th, 1893, about 2 mm. in diameter. Sixteen large tentacles, with reddish brown tentacle-bulbs, and ten small tentacles, with faintly coloured brownish tentacle-bulbs. Four oral tentacles, once dichotomously divided, with terminal clusters of nematocysts.

A specimen taken at Plymouth, September 25th, 1893. Umbrella about 1 mm. in diameter. Sixteen large tentacles with dark brown tentacle-bulbs, and ten small tentacles. Four unbranched oral tentacles.

Three specimens taken at Port Erin, April 27th, 1894. Umbrella about 4 mm. in diameter, with 25, 28, and 30 uniform tentacles. Tentacle-bulbs dark red and very conspicuous. Four oral tentacles once dichotomously divided. Other specimens taken on May 5th and 9th somewhat similar to the above.

The youngest medusa of this series starts with sixteen tentacles and a small bulb. The other specimens show a gradual increase of 20, 22, 25, 26, 28 and 30 tentacles, the maximum number is probably 32. The young tentacles at first have colourless bulbs, but colour appears as they increase in size. In some of the largest specimens all the tentacles are alike in colour and size. The oral tentacles at first are unbranched and become branched later in life. The umbrella in all specimens is about as long as broad, in the older specimens the aboral end has a thick mass of tissue. The ex-umbrella is covered with nematocysts. This medusa may easily be identified, as it is the only British medusa with oral tentacles which has sixteen or more tentacles fairly evenly distributed on the margin of the umbrella. The other medusæ with oral tentacles have either less than sixteen tentacles, or a large number which are grouped into either four or eight bundles.

Lizzia blondina, Forbes (*9*).

Forbes first described this species from specimens taken in the Sound of Brassay, Shetland, 1845.

I took some specimens in Port Erin Bay at the beginning of May, 1894.

It is difficult at first to distinguish this species from the early stages of *Margellium octopunctatum.*

The umbrella is somewhat like *Margellium octopunctatum* in shape but smaller in size, usually about 1½ mm. long and 1½ mm. wide. On the margin of the umbrella, in the adult stage, there are three tentacles on each of the four perradial bulbs and only one tentacle on each of the interradial bulbs. The single interradial tentacle is one of the characteristic features of this species. In *Margellium octopunctatum* usually two or three tentacles are present on the interradial bulb. *Lizzia blondina* has never more than one interradial tentacle on each bulb.

The tentacle-bulbs have a light yellowish colour, but the tentacles are colourless.

There are four simple oral tentacles, each terminating in a single cluster of nematocysts. These never have two terminal clusters as in *Margellium octopunctatum.*

Margellium begins to appear early in the spring, usually abundant in April, and becomes scarce during May. *Lizzia* begins to appear about May. Forbes states that it is of solitary habit.

I have taken specimens with two tentacles in each of the perradial groups. Medusa-buds are usually present on manubrium, at first yellowish in colour.

It is possible that *Dysmorphosa minima* is the earliest stage of this medusa.

Distribution.—Shetland, St. Andrews, Cornwall.

Margelis principis, Steenstrup (*15*).

This medusa is not nearly so abundant as *Margelis ramosa*. It may be easily recognised and distinguished from *M. ramosa* by the very large crescent or U-shaped tentacle-bulbs. It also has about twice as many marginal tentacles in each group and about three times as many branches on the oral tentacles. Steenstrup first described this medusa from specimens obtained off the Faröe Islands and Iceland. Hæckel describes and figures the original specimens taken by Steenstrup which are in the museum at Copenhagen.

In 1893 I met with a single specimen of this species. It was taken in Fleshwick Bay, near Port Erin, on May 21st.

The Manx specimen agrees with Hæckel's description except in some minor details. Hæckel figures the tentacle-bulbs with a dark horizontal line at the top and under it an ornamental wavy line. The Manx specimen has in place of the wavy line a series of longitudinal lines, one opposite each tentacle. At the base of each tentacle there is a black ocellus. About 25 tentacles in each group and about 25 terminal branches to each oral tentacle. Umbrella 4 mm. in length and width. On May 5th, 1894, I met with another specimen in Port Erin Bay. The umbrella 4 mm. in diameter. About 15 tentacles in each group, the outside ones being very small and evidently growing.

The compound tentacle-bulbs are curved, but not so much as in the adult. The upper portion of the bulb contains a dark brown pigment and from this mass longitudinal bands extend towards each tentacle. A black ocellus at the base of each tentacle. The oral tentacles with about 16 branches. Generative products not present. This is evidently a young specimen. It may be difficult to distinguish the early stages of *M. principis* from those of *M. ramosa*. There is a specimen of *M. principis* in the museum of the Mar. Biol. Assoc. at Plymouth. Romanes (*18*) has taken specimens in Cromarty Firth (= *Bougainvillea allmani* et *fruticosa*, Romanes).

Margelis britannica, (Forbes *9*).
Bougainvillea britannica, Forbes (*9*).
Margelis ramosa, Hæckel (*15*).

Forbes first discovered and described this medusa in 1841, from specimens taken off Bute. Since then it has been recorded from many places along our coasts. Clubb (*7*) found specimens in Port Erin Bay during August, 1885.

The umbrella is about as long as wide, 4 to 6 mm. Four perradial groups of tentacles with 8 to 16 tentacles in each group. The tentacles are united at the base and form a compound tentacle-bulb. Near the base of each tentacle there is a conspicuous ocellus. The oral tentacles are usually three times dichotomously divided, and each of the eight terminal branches ends in a cluster of nematocysts.

During May, 1893, I collected many specimens in Port Erin Bay. The compound tentacle-bulbs are yellowish, and the tentacles, when expanded, about twice the diameter of the umbrella. A specimen taken on June 5th was beyond the average size. It measured 8 mm. in length and $6\frac{1}{2}$ mm. in width. About 12 marginal tentacles in each of the four groups. The oral tentacles five times dichotomously divided. During March and April, 1894, I took with a tow-net some early stages of this medusa. The earliest stage was taken on March 29th. The umbrella about 1 mm. in diameter, with a broad velum. Four marginal groups of tentacles; two of which have three tentacles and the others have only two. At the base of each tentacle there is a crimson ocellus. The compound tentacle-bulbs with two tentacles have also three ocelli. The extra ocellus belongs to the third tentacle which has not yet developed. The oral tentacles also show an early stage of development, only three branches, each terminating with a cluster of nematocysts. Another specimen shows a further development of the marginal and oral tentacles. There are three tentacles in each of the marginal groups, but they are unequal in length, one of the outside ones being about half the length of the other two. At the base of each tentacle there is a red ocellus. The compound tentacle-bulbs yellowish brown. The oral tentacles have four branches.

A specimen taken on March 31st has the central tentacle of the three marginal tentacles the shortest, which shows that the third tentacle in each group may either develop on the outside of the two primary tentacles, or between them.

A specimen taken on April 3rd, about 2 mm. in diameter, with five tentacles in each marginal group. The three central ones large and about equal in length, and two, one on each side of the central three, just beginning to develop. The oral tentacles have five terminal branches, each ending in a cluster of nematocysts. On May 9th a specimen was taken, about 4 mm. in diameter, with eight tentacles in each group. Black ocellus at the base of each tentacle. The oral tentacles have eight terminal branches, each tentacle being three times dichotomously divided.

These specimens illustrate very well the increase in number both of the marginal tentacles and of the branches of the oral tentacles. The young medusa usually leaves the hydroid with two tentacles in each group, and the oral tentacles are either simple (unbranched) or with a single branch.

On April 28th I captured two specimens, which are certainly an early stage of a *Margelis*. The umbrella about $\frac{3}{4}$ mm. in diameter. The umbrella cavity is almost obliterated by the thickness of the umbrella. Three marginal tentacles, unequal in size, in each of the four groups. One specimen has one oral tentacle unbranched, and the other three with one branch. I think these are probably the young stages of *Margelis ramosa*, with an abnormal growth of the umbrella.

The medusa *Bougainvillea britannica*, Forbes, is the adult stage of the medusa which is liberated from the hydroid *Bougainvillia ramosa*, Van Beneden. Wright (*22*) in 1857 succeeded in rearing medusæ from the hydroid colonies of *Atractylis ramosa* (=*Bougainvillea ramosa*, Van Beneden). The young medusæ first had four simple oral tentacles, and eight marginal tentacles, two in each group. Stomach and tentacle-bulbs of an orange colour. A black ocellus at the base of each tentacle. Wright was able to keep his specimens alive and saw further development. The oral tentacles became first once, and afterwards, twice dichotomously divided. Additional tentacles also developed in the marginal groups. The greatest number observed was six, and each one had a black ocellus at its base. At the same time the generative products began to develop on the stomach and also to extend for a short distance along the radial canals. Wright obtained young medusæ from his colonies in the spring and autumn.

Distribution.—Belgium, Heligoland, Shetland, Cromarty Firth, St. Andrews, Firth of Forth, Plymouth, Bute, Ballycastle Bay, Dalkey, Kingstown.

Margellium octopunctatum, (Sars *15*).
Cytæis octopunctata, Sars (*19*).
Lizzia octopunctata, Forbes (*9*).
Rathkea octopunctata, Hæckel (*15*).

Sars first discovered this medusa on the Norwegian coast, and described the species with three tentacles in each of the perradial and interradial groups, and with medusa-buds upon the manubrium. The young medusæ on leaving their parent have 3 tentacles in each perradial group and four single interradial tentacles.

Forbes first added the species to the list of British Medusæ and captured the specimens off the Shetland Isles. He observed that all his specimens had three tentacles in each perradial group and either two or three tentacles in the interradial groups. Forbes considered his specimens to belong to the same species as those described by Sars. Hæckel has divided the specimens taken by Sars and Forbes into two different genera, on account of some of Forbes's specimens having only two tentacles in each interradial group. Medusæ with an equal number of tentacles in the perradial and interradial groups belong to the genus *Rathkea* and under *R. octopunctata* Hæckel places *Cytæis octopunctata*, Sars. Medusæ with more perradial than interradial tentacles belong to the genus *Margellium*, and as some of Forbes's specimens have only two tentacles in the interradial groups Hæckel has removed *Lizzia octopunctata*, Forbes, to the genus *Margellium*.

During May, 1893, I found in Port Erin Bay medusæ which belong undoubtedly to the same species as those described by Forbes as *Lizzia octopunctata*. Some of the specimens correspond exactly with the descriptions given by Sars and Forbes, and others are without doubt other stages, showing earlier and later forms, of the same species. The oral tentacles of all the specimens taken have four clusters of nematocysts. Each oral tentacle bifurcates near its extremity and each branch terminates with a cluster of nematocysts. The two other clusters are on a short branch, one on each side of the main stem of the tentacle.

The umbrella of the smaller specimens is from 1 to 2 mm. in diameter, and of the larger specimens about 3 to $3\frac{1}{2}$ mm. in length and slightly less in width. The colour of the tentacle-bulbs varies, being either yellowish brown, dark brown, or black. The great difference in the specimens is in the number of tentacles in each group, and it is upon the number of tentacles that Hæckel mainly bases his classification. Twenty specimens are sufficient to show the change of number of the tentacles in each group, and in the following list I have arranged 20 specimens so as to show the increase in the number of tentacles in each group. This increase is not a variation, but simply shows stages in development.

Number of specimens.	*Number of tentacles in each group.*		
1. Perradial—3333	*Margellium* stage (Hæckel).		
Interradial—2222	*Lizzia* stage (Forbes).		
4. Perradial—3333	3333	3333	3333
Interradial—3332	3233	3233	3233

3.	Perradial—3333	*Rathkea* stage (Hæckel).			
	Interradial—3333	*Lizzia* stage (Forbes).			
5.	Perradial—3334	4333	4333	3434	3444
	Interradial—3333	3333	3333	3333	3333
2.	Perradial—4444				
	Interradial—3333				
4.	Perradial—5443	5444	4354	4554	
	Interradial—3333	3333	3333	3333	
1.	Perradial—5555	? *Margellium gratum,*			
	Interradial—3333	Hæckel.			

Sars states that the young medusa leaves its parent with 1 interradial and 3 perradial tentacles. This stage I did not meet with, but found the next stage with 2 interradial tentacles. The interradial tentacles never exceed three in each group, but the perradial tentacles increase until five is reached, which is the maximum. Agassiz (*1*) describes an American species *Lizzia grata*, (*Margellium gratum*, Hæckel), which has five perradial and three interradial tentacles in each group. These tentacles develop in the following order. At first there is in each perradial group one long median tentacle, and on each side of it a small tentacle. Next, the median tentacle of the interradial group appears, followed by a pair, one on each side of it. At this stage the medusa has 3 tentacles in all the groups. Finally the two remaining tentacles of the perradial groups appear to complete the set of five. Agassiz also describes the development of the oral tentacles. In the young medusa there are four simple, unbranched, oral tentacles terminating in a cluster of nematocysts. Each tentacle branches near the extremity and each branch terminates with a cluster of nematocysts. Next the lateral clusters appear, one on each side of the original tentacle. Then arises a cluster midway between the bases of the four tentacles, and finally, a cluster between the branches at the end of the tentacle.

The Port Erin specimens with 5 perradial and 3 interradial tentacles in each group, are very much like the American species except that the oral tentacles have fewer groups of nematocysts. The other groups of nematocysts may have yet to appear, if so, there will be no reason for separating the English and American species. It is best however, for the present, to keep them apart until more is known about the English species. On my arrival at the Plymouth Laboratory in September, 1893, I found that Mr. Garstang had also been collecting specimens of *Lizzia octopunctata*, Forbes, during March and April in the Sound. He believes that *Rathkea octopunctata* and *Margellium octopunctatum* are the same species, and has recently published his notes (*11*) which show the development of the marginal tentacles. In the museum of the Marine Biological Association at Plymouth there are two dozen specimens of *Margellium octopunctatum* collected by Mr. Garstang, all the specimens, except two, have 3 tentacles in all the groups. The two exceptions have their tentacles arranged thus:

Perradial	3333	3222.
Interradial	2323	3111.

As none of Garstang's specimens have more than three tentacles in each group, he regards *M. octopunctatum* as an early stage of *Rathkea octopunctata*, and the former name is done away with. But the specimens taken at Port Erin show that a further increase does take place in the perradial tentacles, and that there are more perradial tentacles than interradial, which is the characteristic feature of the genus *Margellium*. Therefore I retain the name of the genus *Margellium*.

On Feb. 24th, 1894, I received from Mr. Garstang seven specimens, alive, of the early stages of *Margellium* *octopunctatum.* The number of tentacles in each group is as follows:

3 specimens—Perradial 3333.
Interradial 1111.

The oral tentacles are without the lateral clusters of nematocysts, but one specimen has a few nematocysts which mark the position and origin of these clusters:

3 specimens—Perradial	3333	3333	3333.
Interradial	1112	1312	2232.

The second tentacle in the interradial groups is very small compared with the other, and has just commenced to grow.

All the specimens have medusa-buds upon the manubrium. Tentacle-bulbs yellowish brown. Diameter of the umbrella about one millimetre.

At Port Erin on the 22nd March, 1894, the first day of tow-netting, I found early stages of *Margellium octopunctatum*, and on every occasion on which the townet was used specimens of this medusa were taken. At the end of April it was very abundant and the specimens had reached the *Rathkea*-stage, with three tentacles in all the groups. As I left Port Erin at the beginning of May I did not meet with the later stages which I obtained at the end of May and the beginning of June in the previous year. Mr. Garstang obtained his specimens at Plymouth during February and March, and the medusa disappeared in April, which probably accounts for his not obtaining specimens with more than three tentacles in each group. I took many specimens similar to those taken in the previous year, showing a similar arrangement in the groups of tentacles. There is no need to repeat the list again. One specimen however, is exactly like one taken at Plymouth on Feb. 24th, with the tentacles arranged thus—perradial 3333, interradial 2111. I think that the

Plymouth and Port Erin specimens belong to the same species.

The budding of medusæ from the manubrium is not the sole means of reproduction. The sexual method comes on later in life, and the sexes are separated. The asexual method of budding takes place first and is followed by sexual reproduction.

The same thing occurs in *Amphicodon fritillaria*, which at first buds off medusæ from the base of the tentacles and then usually ceases to reproduce asexually as soon as the sexual cells begin to appear upon the manubrium. It is quite possible that some of the Sarsidæ which are now regarded as distinct species on account of their budding off medusæ may only be stages of other species which are described as sexual.

An abnormal specimen of this species was taken in Port Erin Bay on May 10th, 1893. It has six radial canals instead of the normal four. The additional canals run down to two adjacent interradial groups of tentacles, which possess an abnormal number of tentacles, four being present, while in normal specimens the number never exceeds three. The number of tentacles in each group is as follows:—Perradial 3353, Interradial 2441. There are five oral tentacles. Four of these have four clusters of nematocysts, two terminal and two lateral. The other has a single terminal cluster and two lateral clusters. An abnormal number of radial canals is very rare among the Hydromedusæ.

Distribution.—Norway, Shetland, St. Andrews, Falmouth, Plymouth.

Thaumantias hemisphaerica, (Müller).

Thaumantias punctata, Forbes (*9*).

Clubb reports (*7*) that *T. hemisphaerica* was abundant in Port Erin Bay in August, 1885. This species has been recorded in nearly every list of British medusæ. Up to this time I have not met with a single living specimen of this common medusa. Every specimen taken, which has any resemblance to description and figure of this species, possesses marginal vesicles between the tentacles. Hæckel has placed *T. hemisphaerica*, Müller, among the Thaumantidæ, a family which is characterised by the absence of marginal vesicles between the tentacles.

I may here say that specimens preserved in spirit are not to be relied upon for the absence of marginal vesicles. The otolith usually disappears and the vesicle shrivels up.

Forbes obtained specimens of *T. punctata* off the Isle of Man in June, 1839. Hæckel considers this species to be a form of *T. hemisphaerica*.

Laodice cruciata, L. Agassiz (*15*).

Thaumantias pilosella, Forbes (*9*).

Garner (*10*) found this species abundantly in Douglas Bay.

Laodice cruciata is recorded by me in the Seventh Annual Report (1893) of the L.M.B.C. amongst the species taken at Port Erin. I regret to say this is an error on my part, as the specimens have since been identified as *Mitrocomella polydiadema*.

This species is widely distributed, Naples and other places in the Mediterranean, Holland, Shetland, St. Andrews, Plymouth, Falmouth.

Laodice calcarata, L. Agassiz (*2*).

Lafoea calcarata, (A. Agassiz *1*).

On May 5th, 1894, I took in Port Erin Bay a single specimen of a medusa which I believe to be an early stage of *Laodice calcarata*, an American medusa which so far as I know has not been recorded for Europe. A. Agassiz gives an excellent description of the life-history of this species and also a description of its hydroid.

Umbrella flatly-arched, about twice as broad as long, stomach flat; mouth with crenate lips. Four radial canals. The gonads extend nearly along the whole length of the canals, starting from stomach and reaching nearly to the margin, forming in the adult specimens a folded band. On the margin of the umbrella 100 to 200 tentacles. Between these tentacles there are short filiform cirri, and also club-shaped cirri. No marginal vesicles. In the basal bulb of the large tentacles there is a black ocellus. The largest specimens are about an inch in diameter. Umbrella and tentacles colourless. Ovaries yellowish. The Port Erin specimen is only 5 mm. in diameter, with about 30 tentacles, and cirri of both shapes. It corresponds to the description given by Agassiz. It is certainly not *Laodice cruciata*.

Agassiz obtained his specimens in Buzzard Bay, North America, 1861.

Melicertidium octocostatum, (Sars *15*).

Stomobrachium octocostatum, Forbes (*9*).

Two specimens taken at Port Erin on May 27th, and one on June 2nd, 1893. Forbes describes the tentacles as being uniform, but Ehrenberg and Romanes (*19*) have seen a small tentacle between two large ones. The Port Erin specimens have also one small tentacle, sometimes two, between every pair of large tentacles.

This species may easily be identified by the eight radial canals.

Distribution.—Norway, Cromarty Firth, Ireland (N. W. Coast), Bute, Arran, St. Andrews.

Family EUCOPIDÆ.

Clytia johnstoni, Alder (*16*).

Several colonies of the hydroid stage were dredged off Port Erin on March 24th, 1894. They were placed in a vessel of sea-water, and for many days medusæ were budded off in large numbers. The young medusa corresponds exactly to the description and figure given by Hincks. I tried to rear the medusæ, but failed to get them to live beyond a few days. I also obtained a few specimens with the tow-net in the bay at the end of March. One specimen taken on March 25th had a single adradial tentacle-bulb, and the interradial tentacle-bulbs showed signs of budding out tentacles.

Eucope octona, (Forbes *15*).

Thaumantias octona, Forbes (*9*).

Clubb (*7*) records this species as fairly common off Port Erin, August, 1885.

Distribution.—St. Andrews, Cornwall, Oban, Arran, Tarbert (Loch Fyne).

Obelia lucifera, (Forbes *15*).

Thaumantias lucifera, Forbes (*9*).

I have taken specimens in Port Erin Bay during August, 1892; May, 1893; and April, 1894. Professor Herdman obtained specimens off Port Erin in August, 1885.

Distribution.—Heligoland, Shetland, St. Andrews, Dartmouth, Plymouth, Lizard Point, Hebrides.

Tiaropsis multicirrata, (Sars *15*).

Thaumantias melanops, Forbes (*9*).

Three specimens taken in Port Erin Bay on May 6th, 1893. The largest 7 mm. in diameter, with about 180 tentacles. 8 marginal vesicles, with a black ocellus at the base of each.

At the end of March, 1894, I took with the tow-net some early stages. One specimen taken on March 30th. Umbrella bell-shaped, about $\frac{3}{4}$ mm. long. 24 tentacles—6 in each segment. 8 adradial marginal vesicles, each containing 3 otoliths. Tentacle-bulbs of a brownish colour. Another specimen taken on March 31st about 30 tentacles present. A black ocellus at the base of each marginal vesicle. A specimen taken on April 18th with 80 tentacles.

Distribution.— Norway, Heligoland, Shetland, St. Andrews, Cromarty Firth.

Epenthesis cymbaloidea, (Slabber *15*).

Thaumantias thompsoni, Forbes (*9*).

Clubb (*7*) records that this species was obtained in fairly large numbers, during August, 1885, off Port Erin.

Distribution.—France, Holland, Cornwall, Roundstone (Ireland).

Mitrocomella polydiadema, (Romanes *15*).

Tiaropsis polydiademata, Romanes (*18*).

Romanes first gave a correct description of this medusa from specimens taken in Cromarty Firth in 1875; and it has not been since recorded. Romanes describes the species as follows:—The umbrella resembles a deeply shaped bowl. Manubrium so small as to be almost invisible. Tentacles 45 in number and arranged in two series, in one of which the tentacles are long and in the other short. Four radial canals. Sixteen marginal vesicles, 4 in each quadrant, and each contains about 30 otoliths. The medusa is brilliantly luminous when stimulated, the light being confined to a narrow and continuous line round the margin of the umbrella. The manubrium, radial canals, ovaries and tentacles of a rich rose colour. Umbrella about 1 inch in diameter.

During May, 1893, I captured many specimens in Port Erin Bay. On May 30th many dozens were left by the tide upon the sandy beach, and amongst the weeds in the rock pools. The largest specimens were about 30 mm. in diameter.

At the end of April, 1894, I obtained specimens of some early stages. The smallest measured 4 mm. long and 4½ mm. wide. Umbrella bell-shaped. Sixteen large tentacles, 4 in each quadrant, and between every two of them either 3 or 4 smaller tentacles. Sixteen marginal vesicles, some with otoliths arranged in two rows, others with scattered otoliths. The gonads just commencing to develop along the radial canals. When the gonads are ripe, the genital band is folded.

Another specimen 12 mm. wide and 8 mm. long. Umbrella globular. Manubrium very short; mouth with four lips. The genital band folded along the radial canals. Sixteen marginal vesicles, each with 15—20 otoliths arranged in two rows, the largest being in the centre. About 35 large tentacles and from 3 to 6 smaller tentacles between every two large ones. The large tentacles when fully expanded are about twice the length of the umbrella. Mouth and tentacle-bulbs of a purplish colour. Genital bands yellowish brown, sometimes purple.

This medusa may be distinguished by the presence of 16 marginal vesicles, which are usually hidden by the small tentacles.

Phialidium variabile, Hæckel (*15*).

At the beginning of May, 1894, I captured two specimens of a medusa which I believe to be *Phialidium variabile*. The first taken on May 5th. Umbrella bell-shaped, 10 mm. long and 13 mm. wide. 29 tentacles, eight in three of the quadrants and five in the other. Two or three marginal vesicles between every two tentacles, with a single otolith in each. Stomach very short, and mouth with four lips. Reproductive organs occupying the lower half of the four radial canals, and slightly folded into a longitudinal wavy line. Tentacle-bulbs and reproductive organs yellowish brown.

The second specimen taken on May 9th. Umbrella 11 mm. long and 21 mm. wide. 38 tentacles, ten in three of the quadrants, and eight in the other. Two or three marginal vesicles between every two tentacles with a single otolith in each. Reproductive organs occupying the lower half of the radial canals. Tentacle-bulbs and reproductive organs yellowish brown.

On May 19th, 1893, I took a medusa in Port Erin Bay which I also believe to be *Phialidium variabile*. Umbrella about 9 mm. long and 12 mm. wide. 32 tentacles, nine in two of the quadrants, and seven in the other two, a single marginal vesicle between every two tentacles, with a single otolith in each. Reproductive organs occupying the lower half of the four radial canals, long and oval in shape, and of pale greenish colour. Tentacle-bulbs yellowish. This medusa corresponds with Forbes's description and figure of *Thaumantias inconspicua* which appears to be a somewhat earlier stage, about 18 mm. in width, 16—20 tentacles and between each pair "a rudimentary marginal tubercle" (marginal vesicle). Ovaries long and linear, and of a faint lilac or greenish hue, occupying more than half the length of each radial canal. Tentacle-bulbs yellowish. Hæckel, however, regards *Thaumantias inconspicua*, Forbes, as a stage of *Thaumantias hemisphærica*, Eschscholtz (= *T. hemisphærica*, Forbes). Hæckel has placed *T. hemisphærica* amongst the *Thaumantidæ* a family distinguished by the absence of marginal vesicles. M'Intosh (*17*) appears to regard

T. inconspicua, Forbes, as a variety of *Phialidium variabile*, which was abundant at St. Andrews in June, 1889. None exceeded a quarter of an inch in diameter, and all were immature.

Clubb (*7*) records *Thaumantias convexa*, Forbes (*9*) which was found by Mr. I. C. Thompson, off Penmaenmawr, in July, 1885. Hæckel considers *T. convexa* to be identical with *Phialidium variabile*.

Eutima insignis, (Keferstein *15*).

Keferstein first described this medusa from St. Vaast, Normandy, 1862. In 1893 I took an adult specimen at Plymouth. It is a rare medusa and has not been recorded from other localities.

In the adult the umbrella is hemispherical, about 7 mm. wide and $3\frac{1}{2}$ mm. high. The manubrium is very long, about 9 mm. Mouth with four large lips. The gonads are on the radial canals, along the lower half of peduncle. On the margin of umbrella there are four very long perradial tentacles, about 20 mm. long when fully expanded. At the base of each tentacle there is a pair of cirri. About 30 bulbs are also evenly distributed upon the margin, each with a pair of cirri. Eight adradial marginal vesicles, each with 2—5 otoliths. The medusa is perfectly colourless.

An early stage of this medusa was taken in Port Erin Bay, 1893. Umbrella about $1\frac{1}{2}$ mm. in diameter. Four large perradial tentacles, four interradial and eight adradial bulbs. A pair of cirri at the base of each tentacle and bulb.

Saphenia mirabilis, (Wright *15*).

First taken by Strethill Wright in 1858 near Queensferry, Firth of Forth.

The umbrella of an adult specimen is about one inch in diameter. Two large, colourless tentacles on the margin of the umbrella, when fully expanded about $2\frac{1}{2}$ inches long, and also about 100 small bulbs each with two minute cirri, armed with nematocysts. Eight marginal vesicles, each with four otoliths. The stomach is on a peduncle about $1\frac{1}{2}$ inches long. Four radial canals. At Port Erin in 1893, I captured 3 specimens of the early stages. One specimen about 1 mm. in diameter. Two long opposite perradial tentacles. Two perradial, four interradial, and four adradial bulbs, all with a pair of cirri. The two other specimens slightly larger, with a few more bulbs.

Distribution.—Queensferry, Plymouth.

SCYPHOMEDUSÆ.

Order STAUROMEDUSÆ.

Family TESSERIDÆ.

Depastrum cyathiforme, (Sars *19*).

Beaumont (*5*) found this species at Port Erin, in 1892, and at Poyllvaaish, in 1893. It is fairly abundant in both localities, attached to the under surface of stones near the Laminarian zone.

Beaumont believes that *Carduella cyathiformis*, Allman, *Depastrum cyathiforme*, Gosse, and *Lucernaria cyathiformis*, Sars are one and the same species.

Hæckel places *Carduella cyathiformis* in another genus, as a synonym of *Depastrella allmani*, Hæckel.

Family LUCERNARIDÆ.

Haliclystus auricula (Rathke).

A specimen taken by M. Chopin, in 1891, near Port St. Mary. Mr. Beaumont has seen this specimen and believes it to be *H. auricula*, Rathke. Mr. Beaumont (*5*) also gives a description of another species of *Haliclystus*, which may possibly be new.

Order DISCOMEDUSÆ.

Family Pelagidæ.

Chrysaora isosceles, (Linnaeus *15*).

Byerley (*6*) states that this medusa is rare, seen mostly during July and August. Walker (*7*) states it is frequently very common in the L.M.B.C. district.

Family Cyaneidæ.

Cyanæa capillata, (Linnaeus *15*).

Byerley (*6*) states that it is a very common medusa during the summer.

I took a small specimen in Port Erin Bay, on May 26th, 1893. Umbrella $1\frac{1}{4}$ inches in diameter. Larger ones were seen at the beginning of June.

On April 30th, 1894, I captured a late Ephyra-stage showing the commencement of the long tentacles. On May 9th, I caught a small adult specimen about 10 mm. in diameter.

Family Ulmaridæ.

Aurelia aurita, (Lamarck *15*).

Aurelia aurita suddenly appeared in Port Erin Bay, on June 2nd, 1893, and in a few days became abundant. But throughout the whole of May I never saw a single specimen. Diameter of the umbrella about 2 to 5 inches.

In 1894, on March 22nd, the first day of tow-netting, I captured one specimen of the Ephyra-stage and a few at the beginning of April. At the end of April a few of the adult stage were taken; the largest 18 mm. in diameter. The Ephyræ are certainly scarce at Port Erin and the large adults which are plentiful in the bay during the summer probably come from far off breeding grounds.

Mr. Beaumont and I once dredged the scyphistoma-stage near Bay Fine, August 1892; a few specimens on an old Pecten shell.

Family Pilemidæ.

Pilema octopus, (Linnaeus *15*).

Rhizostoma pulmo, Forbes (*9*).

During April, 1894, several large specimens of this medusa were taken. Three were left by the tide on the beach. Prof. Weiss found one which measured 23 inches in diameter, and had arms 15 inches in length. The margin of the umbrella has a purplish border. On the external side of the genital membrane many parasitic amphipods (*Hyperia galba*) were found. This large medusa has been recorded by Byerley. Mr. Walker states (*7*) that he has seen many hundreds in a day.

References.

1. Agassiz, A., 1865; "North American Acalephæ."
2. Agassiz, L., 1862; Monograph on Acalephæ. Contrib. Nat. Hist., U.S. Vol. IV.
3. Alder, J., 1861; Trans. Tynes. Field Club. Vol. V., p. 225.
4. Allman, G. J., 1871; Ray S. "Mon. Gymn. Hydroids,"
5. Beaumont, W. I., 1893; Trans. Liverpool Biol. Soc. Vol. VII., p. 253; and "Fauna," Vol. IV.
6. Byerley, J., 1853; Liverpool Literary and Philosophical Soc. Vol. VIII., p. 125.
7. Clubb, J. A., 1886; Fauna of Liverp. Bay. Vol. I., p. 114.
8. Crawford, J. H., 1891; Ann. Mag. Nat. Hist., Ser. 6. Vol. VIII., p. 296.
9. Forbes, E., 1848; "British Naked-Eyed Medusæ."
10. Garner, 1867; "Holiday Excur. of a Naturalist," p. 82.

11. Garstang, W., 1894; Journal Mar. Biol. Association, Plymouth. Vol. III., p. 213.
12. Gosse, P. H., 1853; "Devonshire Coast."
13. Green, J. R., 1857; Nat. Hist. Rev. Vol. IV., p. 242.
14. Haddon, A. C., 1885; Fauna of Dublin Bay. Proc. Roy. Irish Acad., Ser. 2. Vol. IV., p. 523.
15. Hæckel, E., 1879; "System der Medusen."
16. Hincks, T., 1868; "British Hydroid Zoophytes."
17. M'Intosh, W. C., 1890; Notes from St. Andrews Laboratory. Ann. Mag. Nat. Hist. Ser. 6, Vol. V., p. 296.
18. Romanes, G. J., 1876; Journ. Linn. Soc. Zool. Vol. XII., p. 524. Vol. XIII., p. 190, pl. XV—XVI.
19. Sars, M., 1846; Fauna Littoral. Norveg., Tom. I.
20. Sars, 1877; Fauna Littoral. Norveg., Tom. III.
21. Steenstrup, 1845; "Alternations of Generations," Ray Soc.
22. Wright, T. S., 1858; Proc. Roy. Physical Soc., Edin. Vol. I., p. 447.

[WORK FROM THE PORT ERIN BIOLOGICAL STATION.]

REVISION of the AMPHIPODA of the L. M. B. C. DISTRICT.

By Alfred O. Walker, F.L.S.

With Plates XVIII. and XIX.

[Read April 5th, 1895.]

The completion of that portion of Prof. G. O. Sars' invaluable work on the Crustacea of Norway which deals with the Amphipoda, has enabled me to name our collection in accordance with it, and at the same time to correct a good many errors that had occurred in our former lists. As Prof. Sars' work is likely to be the standard for many years I have throughout adopted his nomenclature for species described by him and would refer any student of this class to it for descriptions. In the case of species not described by him I have given references to the best descriptions with which I am acquainted. If I have occasionally ventured to differ as to the validity of species with Prof. Sars I do so with the full conviction that his knowledge of the Amphipoda is so vastly greater than mine that in all probability he will prove to be right. Many of these differences of opinion depend upon the solution of the very difficult question whether the Amphipoda, or some species of them, can become sexually mature before they are full-grown. My own opinion is that they can, and in support of this view I have given various instances below of small females with ova. If this be proved (and it can only be done by rearing them through successive stages in aquaria—a difficult and generally impossible process) it will enormously increase the difficulty of defining species, but it ought to be attempted at the Port Erin Biological Station. It might probably be tried with success on *Bathyporeia pilosa*, Lindström, (the form called *B. pelagica*, Bate, by Sars), which is common in the harbour and appears to remain in shallow water. If young specimens were kept in small aquaria with sand at the bottom it would be seen what changes they undergo. Very small females with ova were dredged by Mr. I. C. Thompson, in June, in the harbour and, if again taken, would form good subjects for the experiment.

With regard to the new species described, the first, *Nannonyx spinimanus*, is not only very distinct from the only other species (*N. goësii*) but might be thought to require a new genus. It agrees, however, so well with the rather peculiar external characteristics of *Nannonyx*—a genus so distinct that the points on which my species differs might well be omitted and yet leave the definition quite satisfactory—that I have preferred to include it, at the same time pointing out the differences. On the other hand *Amphilochus melanops* and *Photis pollex* are so near to other species that were geographical sub-species permissible, I should have preferred to rank them as such.

I have given the lengths of the largest specimen of each species in my possession for comparison with those of other localities—the length including the uropods but not the antennæ. These measurements must, however, be taken for what they are worth as it is impossible to be certain that the specimens have reached their full size.

The specimens in the list have all been taken by dredging except where otherwise stated. The initials to some of the species mean that the specimen was collected by the gentlemen indicated, as follows:

W. A. H., Prof. W. A. Herdman, F.R.S.

I. C. T., Mr. Isaac C. Thompson, F.L.S.

F. A., The late Frank Archer, Esq.

The specimens from Galley Head, which is in the Irish Channel but not in the L.M.B.C. district, were taken by Mr. R. L. Ascroft in trawl refuse or in a tow-net attached to the trawl beam.

Of the species recorded the following are new to science, viz., *Nannonyx spinimanus*, *Amphilochus melanops*, *Photis pollex*, and *Podocerus herdmani* (*P. odontonyx*, Sars). The following are, or were when I first published them, new to the British Fauna: *Orchomenella ciliata*, *Nannonyx goësii*, *Harpinia lævis*, *H. crenulata*, *Metopa bruzelii*, *M. pusilla*, *Paratylus falcatus*, *P. uncinatus*, *Gammaropsis nana*, *Ischyrocerus minutus*, and *Siphonœcetes colletti*; the last, however, has probably been recorded as *S. typicus*, Kröyer which Sars considers to be distinct.

It must be understood that the present list supersedes all previous records of Amphipoda in the L.M.B.C. Reports both as to species and localities.

In the notes on the species I make use of the following abbreviations:—

acc. app. = Accessory appendage of upper antennæ; *ant.*^{1} = upper or first antennæ; *ant.*^{2} = lower or second antennæ; *carp.* = carpus, wrist, fourth joint; *dact.* = dactylus, finger, sixth and last joint; *fl.* = flagellum of ant.; *Gn.*^{1} = first gnathopods, first pair of feet; *Gn.*^{2} = second gnathopods, second pair of feet; *Mdl.* = Mandible; *Max.*^{1} = first maxillæ; *Max.*^{2} = second maxillæ; *Mxps.* = maxillipedes; *ped.* = peduncle; *per.* = peræon, mesosome; *prp.*$^{1-5}$ = first to fifth peræopods, third to seventh pairs of feet; *pl.* = pleon, metasome; *prop.* = propodos, hand, fifth joint; *post.* = posterior; *seg.* = segment; *t.* = telson; *up.*$^{1-3}$ = first to third pair of uropods.

Hyperiidæ.

Hyperia galba (Montagu).

Females common in the bell of *Rhizostoma pulmo* throughout the district: males rather scarce. Mr. R. Newstead who collected some large ovigerous females from lobster pots at Bull Bay, Anglesea, says that the large eyes were very luminous. Length 10 mm.

Hyperoche tauriformis (Bate, 1868) = *H. kröyeri*, Bovallius, 1885.

One young male in a tow-net attached to a buoy at Puffin Island. An examination of the remains of the specimens labelled as above in Sp. Bate's Collection, at Plymouth, has satisfied me of the identity of the above two species which were separated by Bovallius.* Bate's name of course should have priority. Length 3 mm.

[*Parathemisto oblivia* (Kröyer).

A few taken in a tow-net attached to a trawl beam by Mr. R. L. Ascroft, off Galley Head, Co. Cork. Length 5 mm.]

Orchestiidæ.

Talitrus locusta (Pallas).

Abundant under drift-weed about high water mark, at Colwyn Bay. Length 18 mm.

Orchestia littorea (Mont.) = *O. gammarellus*? (Pallas).

Under stones above high water mark. Tal y Cafn, Conway River; Burton Rock, Dee; Fleshwick Bay and Port Erin, Isle of Man; at the latter place it is very abundant and sometimes invades the laboratory in great numbers. One specimen taken at dead low water at Colwyn Bay. Length 18 mm.

Hyale nilssonii (Rathke).

Among stones and algæ on shore at Hilbre Island,

* Monograph of the Amphipoda Hyperiidea, pt. II., p. 115.

Puffin Island, Porthwen Bay, Anglesea, and Port St. Mary. One young 10 to 17 m. N.W. of Mersey Bar 10 to 14 fath. 27/9/90 (I. C. T.). Length 5 mm.

LYSIANASSIDÆ.

Lysianax longicornis (Lucas) = *L. ceratinus*,* Walker.

Little Orme; Puffin Island; Menai Straits; 5 to 12 fath. I have never taken a male with fully developed lower antennæ. An old female taken off the Little Orme had these organs rudimentary and the eyes imperfectly developed. Colour dull yellow, eyes large, dark. Length 9 mm.

Socarnes erythrophthalmus, Robertson.†

Port Erin 15 to 20 fath., 24/3/94; Menai Bridges 5 to 7 f. Common April and May, 1894. Length $4\frac{1}{2}$ mm.

Perrierella audouiniana (Bate) = *Lysianax audouiniana*, Bate.

22 m. S.E. Isle of Man, 21/5/88, 30 fath. on sponge; on *Pecten maximus*, 1/4/93 (I. C. T.); Menai Bridges, 2/4/94, 5 to 12 f. rocky ground; off Fleshwick Bay, 8/7/94, broken shells and gravel, Pectens, &c., 22 f. Having succeeded in cleaning the type specimen, in Bate's Collection at the British Museum, I have no hesitation in saying that it is this species.‡ Length $2\frac{1}{2}$ mm.

Callisoma crenata, Bate.

7 m. W. of Bradda Head, 31 f., 25/4/95. One female. [One male with adult antennæ, length 4 mm., from trawl off Galley Head, Co. Cork, 24/10/94 (R. L. A.)]. Length 4 mm.

Hippomedon denticulatus (Bate).

* Fauna of Liverpool Bay, Vol. II. Third Report on Higher Crustacea.

† Second List of Amphipoda and Isopoda of the Firth of Clyde, &c. Trans. Nat. Hist. Soc., Glasgow, Vol. III., p. 200, 1892; also Bonnier, Bull. Sci. de France, Vol. XXIV., p. 183, Pl. VI.

‡ Bonnier, l.c., p. 181, Pl. V.

Port Erin, electric light, 20/5/88. One young. [Galley Head, one adult male. Length 14 mm.]

Orchomenella ciliata, Sars = *Tryphosa ciliata*, Sars.

Between Isle of Man and Liverpool, 30 fath.; Puffin Island, 15 f.; Colwyn Bay, $2\frac{1}{2}$ f., 1/2/90; off Port Erin, 15 to 20 f., 24/3/94. [Galley Head, one male. Length $3\frac{1}{2}$ mm.]

Nannonyx goësii (Boeck) = *Orchomene goësii*, Boeck.

Puffin Island, low water spring tide, 8/8/88. Length $2\frac{1}{2}$ mm.

N. spinimanus, n.sp.* (Pl. XVIII., figs. 1—11).

Menai Bridges, 2/4/94 and 31/5/94, rocky bottom, 5 to 8 f.

This species falls into the genus *Nannonyx*, G. O. Sars, except as to the maxillæ, maxillipedes, gnathopoda and pereiopoda. In these there are more or less important differences but not sufficient in my opinion to constitute a new genus.

Body short and thick. Head as long as first segment of per. lateral angles produced and rounded. Anterior coxal plates about as deep as the body, angles rounded. Third pl. seg. with hind margin straight, serrate, hinder angle rather acute with the point blunt; fourth seg. with a prominent rounded hump, fifth very short.

Ant.[1] with first joint of ped. longer than the two next, fl. seven-jointed, the first as long as the remaining six, second short and wide, acc. app. four-jointed the first longer than the remaining three and as long as first joint of fl. which is very hairy.

Ant.[2] slender, fl. in both sexes five-jointed and shorter than ped.

* Walker, A. O., Rep. on Marine Zool. of Irish Sea. Brit. Ass., 1894, p. 327.

Mandibles long; cutting edge longer than in *N. goësii*, yellow and strongly refractive.

Max.[1] with outer lobe much longer and broader than inner which has two setæ at the tip.

Max.[2] with the inner lobe twice as wide as the outer.

Mxp. with the base moderate sized, not setose; the masticatory lobe large and armed with strong triangular tooth-like spines at the tip and nearly half way down the inner side, reaching to the middle of the second joint of the palp; basal lobe narrow and only half as long as the masticatory; palp with third joint longer than first or second, last joint of the usual claw form. Eyes very large, oval, dark brown.

Gn.[1] Strong, first joint nearly as long as last three; carp. more than half the length of prop.; prop. in male tapering to base of dact., armed with five or six short stout spines along the hinder margin; the female has the margins almost parallel, the postero-distal extremity rounded and provided with three spines placed close together, not setose; dact. rather short with three spinules close together in the middle of the hind margin.

Gn.[2] Prop. subchelate, rather shorter and nearly as wide as carp.

Prp. First and second with first joint about the same width as third (merus) which is longer than fourth, and about the same length as fifth; the last three prp. increase in length successively but slightly; first joints dilated, hind margins entire; the third joint in third and fourth prp. is wider and more produced posteriorly than in the fifth; dact. of moderate size.

Up. First and second with rami shorter than ped. spinous; third with inner ramus much shorter than outer, styliform; in the male the outer is rather shorter than the ped. and furnished at the tip with a tuft of long plumose setæ; in the female the outer is about half as long as the ped. very stout and with two short spines near the base of the nail, the inner ovate with two or three minute spinules at the tip and one spine lower down.

Telson erect, convex, as broad as long, distally rounded with two spines on the outer margin, and a setule behind each. Colour brown. Length $4\frac{1}{2}$ mm. Easily distinguished from *N. goësii* by the longer, more rectangular, glabrous and spinous prop. of first gnathopoda and by the smaller coxal plates of the per. Four specimens were taken in the deep holes near the Menai Bridges on a very rocky bottom.

Tryphosa nana (Kröyer) = *T. hörringii*, in third Report on Higher Crust.

Puffin Island, 10 to 15 f., 24/3/88; Menai Bridges, 31/5/94. Length 4 mm.

Tryphosa hörringii, Boeck.

Bull Bay, Anglesea, "from ambulacral grooves of common Starfish" (F. A.).

[*Tryphosites longipes* (Bate).

Galley Head, two males. Length 14 mm.]

Hoplonyx similis, Sars.

Laxey Bay, 8 fathoms, 24/9/92, one sp. The red eyes lost their colour in a mixture of meth. spirit, glycerine, and water in a few days, becoming very pale yellow. Length 10 mm.

[*Lepidepecreum carinatum*, Bate.

Galley Head, two males, 7 mm.]

Euonyx chelatus, Norman.

Puffin Island, off the lighthouse; between Holyhead and Isle of Man, 50 f. on *Echinus sphæra* 20/7/89; 10 to 17 m. N.W. of Mersey Bar on Echinus 27/9/90; Length 8 mm.

PONTOPOREIIDÆ.

Bathyporeia norvegica, Sars.

Llanfairfechan, dug out of sand between tide marks 1/9/83; Port Erin, electric light; Colwyn Bay; off Garwick Head, Isle of Man 24/9/92. Length $8\frac{1}{2}$ mm. A small one from the same locality measuring $4\frac{1}{2}$ mm. had the characteristic acute and up-turned post. angle of the third pleon seg.

Bathyporeia pelagica, Bate = *B. pilosa*, Lind., in Rep. III.

Port Erin Harbour, abundant; Colwyn Bay; Llanfairfechan; Menai Straits. Length of ovigerous females from 2 mm. to $4\frac{1}{2}$ mm. Males with fully developed antennæ from 3 mm. to $4\frac{1}{2}$ mm. from the same locality.

This is the commonest form of what with all deference to Prof. Sars' superior knowledge I cannot but consider with Mr. Stebbing to be but one species, viz., *B. pilosa*, Lindström. The differences that Sars indicates between *B. pelagica*, *B. robertsonii*, *B. gracilis* and *B. pilosa* depending mainly on the colour of the eyes and the presence or absence of the small spines on the first urus-segment appear to me insufficient for specific distinction. I have known the red eyes of *B. pelagica* turn white in some specimens (and not in others) after two days in weak spirit and glycerine while in other specimens they become dark. The eyes of the specimen marked *B. pelagica* in the Sp. Bate Collection in the British Museum are large and dark—this is an adult male. In the same collection are eleven specimens in one tube marked *B. pilosa* (Lind.) some of which have, and others have not the spines on the first urus-segment. One large female has a rudimentary tooth on the lower margin of the third pleon segment. *B. pelagica* (or *pilosa*) becomes sexually mature at a very early period, specimens only two mm. long containing one to three ova having been dredged by I. C. Thompson on June 19, 1892.

Haustorius arenarius (Slabber).

Llanfairfechan, shore; Colwyn Bay, shore 31/7/90. Length 8 mm.

Urothoë brevicornis, Bate.

Llanfairfechan, shore, Sept., 1883. Dug out of sand between tide marks. Length 6 mm.

Urothoë elegans, Bate = *U. marinus*, Rep. III., p. 205.

Puffin Island (I. C. T.); Menai Straits between Beaumaris and Garth 5 to 10 f., 16/5/91 and 17/9/94; Little Orme 4 to 7 fathoms, 14/9/94; length $3\frac{1}{2}$ mm. The above two species are very difficult to separate and it is possible that the latter is only the young of the former. Mr. Stebbing has treated the genus exhaustively in Trans. Zool. Soc. (London), Vol. XIII., part 1, 1891, Pls. I—IV.

Urothoë marinus, Bate.

2 miles S.E. of Kitterland 17 f., 27/5/94.

Several specimens including adult male and female: these have been examined by Mr. Stebbing who considers them to be this species. Length 5 mm.

PHOXOCEPHALIDÆ.

Phoxocephalus fultoni, T. Scott, (see Eighth Ann. Rep. of Fishery Board, Scot., 1890, p. 327, Pls. XII., and XIII., for female and young male; and Robertson, D., second list of Amphipoda, &c., of Firth of Clyde, for adult male) = *P. chelatus* Della Valle, Gammarini of the Gulf of Naples.

Port Erin, electric light, 1888 and dredged 15 to 20 f., 24/3/94; Menai Bridges 5 to 12 f., 30/5/94; length $2\frac{1}{2}$ mm. I have also taken it off Jersey and Guernsey. The large eyes would seem to place this species in *Paraphoxus*, Sars, but the gnathopoda are distinctly unequal.

Paraphoxus oculatus, Sars.

7 miles W. of Bradda Head 31 f., 25/4/95, one specimen.

Harpinia neglecta, Sars = *H. plumosa* (Kr.), in Rep. III.

Between Isle of Man and Mersey Bar, 10 to 20 f., 3/9/87; Colwyn Bay, 2½ f.; Menai Straits, 16/5/91; 5 m. W. of Dalby, Isle of Man, 30 f. sandy mud, 8/7/94. Length 3½ mm.

None of the specimens had the pleon hairy as described by Sars, and as the character of the post antennal angle is very difficult to see I have great hesitation in determining whether they should be referred to this species or to *H. plumosa* (Kröyer). As, however, the latter appears not to have been met with south of the Arctic circle it is safer to call them *H. neglecta*.

Harpinia crenulata, Boeck.

7 m. N.W. of Bradda Head, Port Erin, 39 f., 29/1/93. Three adults and one young. Length 2½ mm.

Harpinia lævis, Sars.

7 m. W. of Niarbyl, Isle of Man, 45 f., mud, 8/7/94. Length 2½ mm.

AMPELISCIDÆ.

Ampelisca typica, Bate = *A. tenuicornis*, Rep. III., 207.

Port Erin, electric light, 21/4/89. Length 9½ mm.

Ampelisca tenuicornis, Lilljeborg.

Port Erin; 5 m. W. of Dalby, 30 f., sandy mud, and 6 m. W. of Contrary Head, 38 f., mud, Isle of Man, 8/7/94. Length 9 mm.

Ampelisca brevicornis (Costa) = *A. lævigata*, Lilljeborg.

Between Isle of Man and Orme's Head, 20 to 30 f., 28/8/86; Colwyn Bay, 3 f., 24/5/87; Bull Bay; Port Erin—electric light; off Southport, 10 to 20 f., June '91. Eyes crimson with a scarlet line behind them and five black stellate spots behind that. Lower part of head having a scarlet cloud extending to the first epimere. Remainder of body transparent white with scattered black stellate spots. Length 13 mm.

Ampelisca spinipes, Boeck = *A. tenuicornis*, Rep. III., 207.

Throughout the L. M. B. C. district in 20 to 50 fath. Length 17 mm. This is the commonest species in the district, the preceding one being the next commonest. I have little doubt that the species figured as *A. gaimardii* (Kr.) in the British Sess.-eyed Crust. is this species and not as Sars supposes, *A. typica* (Bate). I have examined Bate's specimen, in the British Museum, and find both it and the figure to confirm this view. The relative proportions of the upper and lower antennæ which are correctly drawn, are alone sufficient to show that it cannot be *A. typica*.

Ampelisca macrocephala, Lilljeborg.

Port Erin, Aug., 1893 (W. A. H.). Length 10 mm. Resembles *A. brevicornis* in the form of the hind margin of the third pleon segment, but may be distinguished most readily by the greater length of the upper antennæ, and by a long spine near the tip of the outer ramus of the second uropods.

Haploops tubicola, Lillje.

One specimen between Isle of Man and Orme's Head, 20 to 30 f., 28/8/86. Length 8 mm.

AMPHILOCHIDÆ.

Amphilochus manudens, Bate.

Little Orme, Aug. and Sept., '89; Gt. Orme, 8 f., 1/4/90; Puffin Island; Menai Bridge, 5 to 12 f., April and May, '94; 2 m. S.E. of Kitterland, Isle of Man, 17 f., 27/5/94. Colour generally brownish, sometimes almost black; one specimen from Gt. Orme bright scarlet. Eyes red, rather small. Length $2\frac{1}{2}$ mm.

Amphilochus melanops, n.sp.* (Pl. XVIII., fig. 12; Pl. XIX., figs. 13—15).

Little Orme, 5 to 7 f.; Menai Straits near Beaumaris, 5 to 10 f., 17/9/94.

* Walker, Rep. on Mar. Zool. of Irish Sea, Brit. Assn., 1893, p. 535.

Head much curved, about as long as the two first per. segs., lateral angle rounded. Eye round with large dark brown centre. First coxal plate small oval, second rounded at lower margin, which is minutely crenate; third less deeply crenate; fourth and fifth entire or smooth; per. segs. increasing successively in length, the last equal to the first pl. seg. Pl. segs. all somewhat produced but rounded at the post. angle. Ant.[1] in female shorter than ant.[2], fl. 7—8 jointed as long as ped.; ant.[2] with last joint of ped. longer than preceding, a small tooth on the lower margin of the distal end of second and third joints; fl. slender 7—8 jointed shorter than ped.

Gn.[1] much smaller than gn.[2], first joint as long as the next four combined, merus and carp. having the ends truncate and setose the carp. prolonged to half the length of the post. margin of the prop., anterior margin of prop. slightly convex and not produced into a tooth. Dact. serrate on the proximal two-thirds of its length the serration ending in a secondary tooth.

Gn.[2] of the same general form as gn.[1] but the carpal process reaches almost to the post. angle of the palm; the anterior margin of the prop. is slightly concave.

Prps. There is nothing distinctive about these.

Up. First "æque-attinent," (*i.e.*, reaching as far back) as the third, extremity of longest ramus of up.[2] not quite reaching to the end of ped. of up.[3]. It is rare to find a specimen which has not lost its third uropods.

Telson concave forming a triangle of which the sides are little longer than the base reaching about one-third of the length of the ped. of up.[3]

This species is undoubtedly very near both to *A. marionis*, Stebbing ("Challenger" Amphipoda, 1888), and to *A. brunneus*, Della Valle (Gammarini, Fauna des Golfes v. Neapel, 1894). From the former it differs in its conspicuously large and dark eyes and in the less convex palm and greater relative length of the prop. of the gnathopods. From the latter the principal difference is in the much shorter telson. The eyes also differentiate it at once from *A. tenuimanus*, Boeck, and from *A. manudens*, (Bate), with which I have found it associated. From this species it is also distinguished by the rounded lateral angle of the head, and by (as also from *A. oculatus*, Hansen) the absence of the distal tooth on the anterior margin of the prop. of the gnathopods. Males of this species are scarce. Colour brown. Length 2½ mm.

Amphilochoides odontonyx (Boeck).

8 m. W. of Fleshwick Bay, 33 f., 5/6/92. Length 2 mm.

Gitana sarsii, Boeck.

Little Orme; Menai Straits, 5 to 10 f., 17/9/94; 8 m. W. of Fleshwick Bay, 33 f. Length 2¼ mm.

Cyproidia brevirostris, T. and A. Scott (Ann. and Mag. N. H., 1893, Vol. XII., p. 244, Pl. XIII.).

8 m. W. of Fleshwick Bay, 33 f. Length 2 mm. Very near *C. damnoniensis* (Stebbing) from which its most obvious difference is the concave lower margin of the first joint of the last peræopods. In *C. damnoniensis* the lower margin is convex.

Stenothoidæ.

Stenothoe marina (Bate).

Common from the mouth of the Dee to Menai Straits, 2 to 15 f.; off Fleetwood and Blackcombe. Two specimens 6 m. S.E. Calf of Man, 34 f., 25/4/95. Colour white or stained with red especially about the head. Length 4 mm.

Stenothoe monoculoides (Montagu).

Abundant in tidal pools Port Erin, Fleshwick Bay, and Port St. Mary, Isle of Man; Menai Straits, April and May, '94, 7 to 12 fath., rocky ground, common. Length 3½ mm.

This species seems to prefer rocky ground while *S. marina* is found on sand, I have not met with it E. of Menai Straits.

Metopa alderi (Bate).

Menai Bridge, April and May, '94, 7 to 12 f.; Turbot Hole, Puffin Island. Colour white with red blotches on second, third, and fourth epimeres and first joint of corresponding legs, also on the urus. Length $4\frac{1}{2}$ mm.

Metopa borealis, Sars.

Little Orme, 5 to 10 f., common; Menai Straits; Puffin Island, 14 f. Colour uniform white or grey. Length 2 mm.

Metopa pusilla, Sars.

Rhos Bay just below tide mark, 13/5/93; Menai Bridge, 7 to 12 f., 2/4/94. White, tinged with red on the back and limbs. Length 2 mm.

Metopa rubro-vittata, Sars.

Little Orme, 4 to 7 f.; Colwyn Bay, $2\frac{1}{2}$ f.; Menai Bridge. One specimen was beautifully and uniformly speckled with bright red. This species is best distinguished by the spine on the posterior margin of the propodos of the first gnathopods. Length $2\frac{1}{4}$ mm.

Metopa bruzelii (Goës).

Colwyn Bay and Little Orme, common; off Port Erin, 24 f., 5/6/92; Port Erin harbour, Nov. '92 (I. C. T.). Colour white with large blotches of brilliant red on front segments and epimeres. Length $2\frac{1}{4}$ mm.

Cressa dubia (Bate).

Great and Little Ormes; Colwyn Bay; Menai Straits; 10 to 17 m. N.W. of Mersey Bar; 2 m. S.E. of Kitterland, Isle of Man, 27/5/94, 17 fath. Colour pale yellow clouded with red on fifth, sixth, and seventh segments of peræon. Length 2 mm.

Leucothoidæ.

Leucothoe spinicarpa (Abildgaard).

S.E. coast of Isle of Man, in branchial sac of *Ascidia venosa* and *A. mentula*; off Port Erin, washed out of Pectens (I. C. T.); Towyn, Anglesea, 5 f. Length 12 mm. Generally speaking only one or two individuals are found in each Ascidian.

Leucothoe lilljeborgii, Boeck = ? *L. imparicornis*, Nor.

Off Port Erin, "Lady Loch," 24/3/94, "washed out of dredged material from several hauls" (I .C. T.). Length 2¼ mm. Of the above two species the latter (indicated by the up-turned hinder angle of the third pleon segment and other characters) had the upper and lower antennæ of the same length, while in the former the upper were much longer than the lower, showing how fallacious characters derived from the relative length of these organs are. My specimen was doubtless immature.

Ædiceridæ.

Monoculodes carinatus, Bate.

Port Erin, outside harbour, 21/8/92 (I. C. T.) [Galley Head, 24/10/94] 7. m. W. of Bradda Head, 31 f., 25/4/95. Length 3 mm.

Perioculodes longimanus (Bate).

Port Erin Harbour; Colwyn Bay; Menai Straits. Shore to 39 fathoms, sandy ground. Eyes generally red but sometimes dark. An abundant species where it occurs. Length 4 mm.

Pontocrates arenarius (Bate) = *P. norvegicus* in Rep. II.

Rhos and Colwyn Bays; Menai Straits; Port Erin Harbour, common; Garwick Head; in stomach of *Agonus*, Morecambe Bay; a female 6 mm. long, 1 m. S.E. of Kitterland 20 f., average length of females with ova from Port Erin Harbour 3 to 4 mm. Colour white.

Synchelidium haplocheles (Grube, not G. O. Sars) = *S. brevicarpum*, Sars.

Little Orme; Port Erin and Ramsey Harbours at electric light; off Port Erin, "John Fell," 8/7/94. 22 f. Length 3 mm. The dark markings on the body segments is the most easily seen distinction between this species and the preceding.

PARAMPHITHOIDÆ.

Paramphithoë bicuspis (Kröyer).

Dee to Menai Straits, shore to 17 f.; between Holyhead and Isle of Man 40 to 60 f., 20/7/89; Towyn, Anglesea; 10 to 17 m. N.W. of Mersey Bar, 27/9/90. Length 12 mm.

A common species on the N. coast of Wales but not met with hitherto on the Isle of Man coast. It is variable in colour, generally closely freckled with brown but sometimes almost pure white. I cannot regard *P. monocuspis*, Sars, as anything but the young of this species, as I have constantly taken them together and always observed that only the largest specimens have a dorsal tooth on the first pleon segment and this varies in length in proportion to the size of the specimen.

Paramphithoë assimilis, Sars. (*Pleustes glaber*, Rep. IV., p. 241.)

Puffin Island, shore; Great and Little Orme's Heads; 10 to 17 m. N.W. off Mersey Bar; Calf Sound; Menai Straits 10 to 12 f., 2/4/94; off Blackcombe. Colour greenish white sparingly mottled with brown. Length 5½ mm.

Stenopleustes nodifer, Sars.

Little Orme and Rhos Bay, 4 to 7 f., April and July, 1893; 7 miles W. of Bradda Head, 31 f., 25/4/95.

The "nodiform projections" in the specimens taken were reduced to a mere emargination of the hind margin of the two anterior segments of the pleon. The limbs and greater part of the body are speckled with dark red of which colour there is a dark cloud on the fourth, fifth and sixth peræon segments. The immense reniform eyes are very characteristic. Length 3 mm.

Epimeridæ.

[*Epimeria cornigera* (Fabricius).

Galley Head, 24/10/94. Length 10 mm.]

Iphimediidæ.

Iphimedia obesa, Rathke.

Throughout the district 2 to 15 f. Length of large female taken about 17 miles N.W. of Mersey Bar, 27/9/90); 11 mm.

Iphimedia minuta, Sars.

Colwyn Bay, 22/1/92, &c.; Little Orme, 14/9/94; Menai Straits, 17/9/94, 10 to 12 f., abundant; Port Erin, 15 to 20 f., 24/3/94. Generally lighter coloured than *I. obesa*, sometimes almost colourless (Menai Straits). Length 5 mm.

Laphystiidæ.

Laphystius sturionis, Kröyer.

One specimen from underneath the pectoral fin of a Cod from Liverpool Bay (Lancashire Fisheries Laboratories, November, 1893). Length 8 mm.

Syrrhoidæ.

Syrrhoe fimbriatus, Stebbing and Robertson (Trans. Zool. Soc., London. Vol. XIII., part 1, 1891, p. 31, Pl. V).

Two miles S.E. of Kitterland, Isle of Man, 17 fathoms 27/5/94 (I. C. T.); 7 miles W. of Bradda Head, 31 f., 25/4/95; four specimens. Length of female with ova $1\frac{1}{2}$ mm.

Eusiridæ.

Eusirus longipes, Boeck.

Off Port Erin, August, 1893 (W. A. H.). Length 5½ mm.

Calliopiidæ.

Apherusa bispinosa (Bate).

In tidal pools and shallow water throughout the district generally abundant. Very variable in colour—sometimes black. Length 6 mm. A small female with ova measured only 3½ mm.

Apherusa jurinii (M. Edwards) = *Calliopius norvegicus*, (Rathke).

Common in tidal pools throughout the district. Colour whitish mottled with red. Length 8 mm.

Calliopius leviusculus (Kröyer).

Another common shore species. Generally greenish white and without markings but sometimes mottled with red. It is a question whether *C. rathkei* (Zaddach) is not the young of this species. A large female with ova from Colwyn Bay measures 13 mm., another only 6½ mm.; no doubt Sars would call this *C. rathkei*, which form was common at Puffin Island in tidal pools September 9, 1888. It differed from the commonest form of *C. leviusculus* in being spotted with red.

Atylidæ.

Paratylus swammerdamii (M. Edwards).

Abundant throughout the district, shore to 20 fathoms. Adult males and females reach 9½ mm. in length but males with the ciliated antennæ characteristic of sexual perfection and females with ova, both only 4 mm. long, were taken in tidal pools at Colwyn Bay and in 4 to 7 f. off the Little Orme in July, 1893. One of the small females had young ones escaping from the incubatory pouches.

Paratylus falcatus (Metzger).

Little Orme; Colwyn Bay. White with a red spot on the back of each segment except the fourth pleon. Length 5 mm.

Paratylus uncinatus (Sars, Oversigt af Norg. Crust., p. 102).

Red Wharf Bay, Anglesea, 20 f., 8/6/89. This species which has been accidentally united by Sars in his Norwegian Amphipoda with the preceding, differs from it only in not having the pleon segments furnished with dorsal teeth. The species figured in the above work is this form and not Metzger's. The difference does not appear to be one of age or sex. Length about 5 mm.

Paratylus vedlomensis (Bate).

Puffin Island—low water; Port Erin Harbour, electric light, &c.; 8 miles W. of Fleshwick Bay, 33 fathoms; 3 miles W. of Calf of Man, 19 f. (Galley Head). Length 8 mm.

Dexamine spinosa (Montagu).

Common throughout the district; shore to 10 fathoms. Length 15 mm.

Dexamine thea, Boeck.

Port Erin Harbour, 4/6/92, several. Length 4½ mm.

Tritæta gibbosa (Bate).

Colwyn Bay; Anglesea Coast; Puffin Island and Port Erin encysted in the outer integument of Ascidians; 16 miles N. of Holyhead 40 to 50 fathoms; Menai Bridge very abundant; adult males at electric light, Port Erin, 21/4/89. Length 5 mm. It is remarkable that the emargination of the ant. margin of prop. of the first gnath. in the adult males of this species which caused Nebeski to make a distinct species of it (*T. dolichonyx*) should have escaped the notice of so many carcinologists, including even so careful and accurate an observer as Prof. G. O. Sars. Canon A. M. Norman informs me that such males occur "among his Shetland specimens examined by Spence Bate when engaged on his work."

Guernea coalita (Norman, Ann. and Mag. N. H., Ser. 4, Vol. II., 1868).

Off Great Orme's Head, 1/4/90; 25 miles S.E. of Calf, 6/6/92; Off Port Erin 15 to 20 f., 24/3/94; 2 miles S.E. of Kitterland, 17 f., 27/5/94. Length $1\frac{3}{4}$ mm.

GAMMARIDÆ.*

Melphidippella macera (Norman).

8 miles W. of Fleshwick Bay, 33 f., 5/6/92; 7 miles W. of Bradda Head, 31 f., 25/4/95. Length 5 mm.

Amathilla homari (Fabricius)=*Amathilla sabini* (Leach).

The young of this species is one of the commonest Amphipoda on our coasts, in tidal pools during spring and early summer. I cannot doubt that *A. angulosa* (Rathke) is this young form. The large females measuring 26 mm. in length come to the shore in early spring to deposit their young and may then be taken among Algæ. The young at first have no dorsal carina which is only developed by degrees; in their earliest stage these are *Grayia imbricata* (Bate). The largest I have of the young form is 9 mm. long, nor have I ever seen one between these sizes.

Gammarus marinus, Leach.

Puffin Island; Hilbre Swash; Colwyn Bay; Port Erin Harbour. Length 16 mm.

Gammarus locusta (Linné).

Common everywhere on the shore under stones between tide marks. Length 25 mm.

Gammarus pulex (De Geer).

In brooks and springs up to 700 feet above the sea. Length 16 mm.

* For the Gammaridæ see a valuable paper by Canon A. M. Norman in Ann. and Mag. N. H., Ser. 6, Vol. 4 (1889).

Melita palmata (Montagu).

Colwyn Bay; Puffin Island; Port Erin; shore to 30 f. Length, excl. of third uropods, 9 mm.

Melita obtusata (Mont.).

Throughout the district: sometimes on Echinoderms, shore to 30 f. Length, excl. third uropods, 9 mm.

Mæra othonis (M. Edw.) = *M. longimana* [second Rep. L.M.B.C.] (Bate and West., male) *M. othonis* (Bate and West., female).

Bull Bay, Anglesea, 20 f., 8/6/89; off Port Erin and Fleshwick Bay, 15 to 24 f. Colourless or light brown. Length, excl. of third uropods, 12 mm.

Mæra semi-serrata, Bate.

Off Port Erin, 15 to 25 f., 5/6/92; 24/3/94. Light brown. Length 5 mm.

The fact of the above two species being found together and their resemblance in many points, coupled with the smaller size of *M. semi-serrata*, would seen to point to this species being the young of *M. othonis*. In my specimens of the latter the *lower* margin only of the third pleon segment is serrated, while in *M. semi-serrata* it is the *hind* margin which is so. But Bate and Westwood in their figure and description of *M. othonis* (female) show *both* margins serrate. This seems to indicate an intermediate age when the one form is passing into the other.

Mæra batei, Norman (Ann. and Mag. N. H., Ser. 4, Vol. II., Pl. XXII.).

M. multidentata (Bate and West., Vol. II., p. 515, male).

Gammarus tenuimanus (Bate and West., Vol. I., p. 384, female; Bate, Cat. Amph. Brit. Mus., p. 214).

Puffin Island, 15 f., April, '81; on *Spatangus*, 3 m. off Dulas Bay, 14 f., 8/6/89; Menai Straits, 10 to 15 f., 17/9/94; off Port Erin, 15 to 20 f., 24/3/94; 10 to 17 m. N.W. of Mersey Bar. Length 6 mm.

I have examined the specimen marked *Gammarus tenuimanus*, in the Sp. Bate Collection at the British Museum, and am satisfied it is this species. The description and drawing of the second gnathopod in the Brit. Sess. Eyed Crust. are very faulty; the description in the catalogue is much more accurate.

Megaluropus agilis, Norman (Ann. and Mag. N. H., Ser. 6 (1889), Vol. III., p. 446, Pl. XVIII.).

Common on the N. coast of Wales and the Isle of Man, 2 to 10 fath. Colouring when alive very beautiful. It has a bright crimson blotch on the head above the eye; telson and base of third uropods yellow—the latter with three or four opaque white spots on the outer edge of the outer ramus. Length 4 mm.

Cheirocratus sundevalli (Rathke).

Not uncommon on the N. coast of Wales and the Isle of Man, from 2 to 30 fath. Margins of the first joint of all the legs and both ant. scarlet; segments and epimeres spotted with the same colour. Length 8 mm.

Cheirocratus assimilis (Lilljeborg).

Port Erin Harbour, 28/1/93; 7 m. W. of Bradda Head, 31 f., 25/4/95. Colourless, by which, when fresh, the female may most readily be distinguished from the preceding species. See also Norman in Ann. and Mag. N. H., Ser. 6 (1889), Vol. IV., p. 131, Pl. XI. and XII. Length 7 mm.

Lilljeborgia pallida, Bate.

Bull Bay, Anglesea, 8/6/89, 17 f.; Port Erin, 22/8/93 (W. A. H.). Length 4¼ mm.

Lilljeborgia kinahani (Bate).

3 m. W. of Calf of Man, 29/1/93; Menai Straits off Rhianfa, 30/5/94, 7 f. Length 3¼ mm.

PHOTIDÆ.

Aora gracilis (Bate).

North coast of Wales, 2 to 15 fath., rather common; Port Erin; [Lambay Isle, 28/10/94, R.L.A.]. Length 8 mm.

Autonoe longipes (Lilljeborg).

Anglesea coast, "Spindrift," 8/6/89, one male; Laxey Bay, 4 to 12 fath., 24/9/92; 5 m. W. of Dalby, 30 f., 8/7/94; Calf Sound, 30/8/94; Menai Straits. Length 3 mm.

Leptocheirus pilosus, Zaddach.

Protomedeia pectinata, Norman (Final Rep. of Shetland Dredging, 1868).

Protomedeia pilosa (Zadd.) and *P. hirsutimana* Bate? Grube, Beitr. z. Kenntniss der Istrischen Amphipodenfauna.

Leptocheirus pilosus (Zadd.) Della Valle, Fauna des Golfes v. Neapel—Gammarini.

Menai Bridge, April and May, '94; washed out of dredged stuff, off Port Erin, many young, 24/3/94 (I.C.T.); 2 m. S. E. of Kitterland, 17 f., 27/5/94. Colour deep yellow with transverse brown lines on all the segments. Length of female with ova 2½ mm.

Leptocheirus hirsutimanus (Bate).

Protomedia hirsutimana, Bate.

Leptocheirus pilosus (Sars, not Zaddach).

One specimen 2 m. S. E. of Kitterland, 17 f., 27/5/94. Colour very pale yellow without markings. Length 5½ mm.

I regret that I am unable to agree with Prof. Sars in assigning the species described by him, and which he rightly identifies with *P. hirsutimana*, Bate, to *L. pilosus*, Zaddach. The latter author in describing his species entirely overlooked the secondary appendage, which, however, Fr. Müller subsequently stated to be one-jointed. This Zaddach could hardly have done had it been the long six-jointed appendage of Sars' species. In *L.*

pectinatus (Norman) which I consider identical with *L. pilosus* (Zadd.) this appendage is two-jointed and very small and the minute second joint might easily be overlooked by Müller, as indeed might the whole appendage by Zaddach. Again, the form of the propodos of the first gnathopods, described by Zaddach as somewhat swollen and broader towards the extremity, does not agree with Sars' figure; and the dactylus of the second gnathopods which is described by Zaddach as straight and feeble ("...ungue recto debilique terminatur") and which in *L. pectinatus* is a very characteristic thin narrow lamina terminated by a small tuft of setæ, is quite normal in *L. hirsutimanus*. Finally, Zaddach could hardly have failed to call attention to the powerful second uropods described by Norman (Shetland Dredging Rep.) under *P. hirsutimana* had they existed in his species.

Gammaropsis erythrophthalma (Lillje.).

Turbot Hole, Puffin Island, 15 f.; Anglesea coast, 20 f., 8/6/89; 16 m. of N. of Holyhead, 45 to 50 f.; between Mersey Bar and Isle of Man, 20 to 30 f., 28/8/86; 8 m. W. of Fleshwick Bay, 30 to 33 f. [off Blackcombe; Lambay Isle]. Length 7½ mm.

Gammaropsis nana, Sars.

My specimen differs slightly from Sars' description, the secondary app. of upper ant. being three-jointed (the last very small) and the dactylus of first gnathopods finely serrate on the proximal half. The eyes are oval—not round. Otherwise they agree. 5 miles W. of Dalby, Isle of Man, 30 f., sandy mud, 8/7/94; 8 miles off Fleshwick Bay, 30 to 33 f., 5/6/92. Length of female with ova 2½ mm.

Megamphopus cornutus, Norman.

Podoceropsis intermedia, Stebbing.

Protomedeia longimana, Boeck.

Off Garwick Head, 24/9/92; Little Orme, 28/7/93; 8 miles off Fleshwick Bay, 30 to 33 f., 5/6/92; Menai Straits off Beaumaris 10 to 15 f., 17/9/94. None of the specimens taken so far show the prolongation of the first epimere of the peræon described by Norman and from which this species takes its name. Apparently it only acquires its full development in northern seas. Colour transparent whitish sparingly freckled with dull red. Length 4 mm.

Microprotopus maculatus, Norman.

Colwyn Bay and Little Orme; Puffin Island, 15 fathoms; Menai Straits; Port Erin Harbour—abundant; tow-net 25 miles S. E. of Calf of Man 6/6/92. Colour brown. Length 3½ mm.

Photis longicaudata (Bate).

Puffin Island, 15 fathoms. 8 m. W. of Port Erin, 38 f., mud and 6 m. S.E. of Calf, 34 f., sand, shells, and gravel, 25/4/95. Length 6 mm.

Photis pollex, n. sp. (Pl. XIX., figs. 16—19).

= *P. reinhardi*, Rep. I., p. 216. Very near *P. tenuicornis*, Sars, from which it differs only in the second gnathopod of the male. In this the second joint is nearly half as long as the first and equal to the third. The prop. has the post. margin prolonged into a tooth or thumb having its base much nearer the carp. than in *P. reinhardi* (whence the specific name) the point of which exactly meets that of the dactylus. The palm, which is longer than the post. margin, is concave but expands distally into two tubercles so that this portion of the propodos is wider than the middle. The female is like that of *P. tenuicornis*. Length 2 mm. Colwyn Bay, shore to 2½ f.; Little Orme; Menai Straits, 5 to 10 f., 24/5/90.

Podoceropsis excavata (Bate) = *Nænia rimipalmata*, Rep. I., p. 217.

Rhos Bay; Puffin Island; Red Wharf Bay, 20 f., 8/6/89; Port Erin, outside harbour; off Southport. Length 8 mm.

PODOCERIDÆ.

Amphithoe rubricata (Montagu) = *A. podoceroides*, Rath.
= *A. littorina*, Bate.

North Coasts of Wales to Holyhead and Isle of Man, generally under stones between tide marks. Length 13 mm.

Pleonexes gammaroides (Bate) = *Sunamphithoe gammaroides.*

Moelfre Bay, Anglesea in rock pools among *Laminaria* August, 1889 (F. Archer). Length 8 mm.

Ischyrocerus minutus, Lilljeborg = *Podocerus isopus*, Walker, Rep. III. and IV.

Abundant in tidal pools in April, Rhos and Colwyn Bays; Great Orme; Puffin Island; Menai Straits. Colour whitish with broad transverse bands of reddish brown in the females, and numerous small spots of the same colour in the male. Length of adult male 5 mm. This species was erroneously united by Boeck with *P. anguipes* (Kröyer) which caused me to make a new species of it. Adult males are rare, and ovigerous females vary greatly in size. Dredging just below low water mark in Rhos Bay among stones on May 13, 1893 I took more individuals of this species than of all the other (*22*) species taken together; some of the ovigerous females measured $3\frac{1}{2}$ mm. and others only $2\frac{1}{2}$ mm.

Podocerus falcatus (Montagu) (Pl. XIX., fig. 20).

Rhos and Colwyn Bays; Puffin Island; Menai Straits; Port Erin Harbour; between Holyhead and Isle of Man, 50 f., 20/7/89, a very large male 10 mm. long—the prop. of second gnathopod being 4 mm. long—taken in a tow-net on the bottom. Colour yellow with brown transverse bars and spots which keep their colour in spirit. I have occasionally seen the markings reddish. Length of a large male from Port Erin Harbour 7 mm.

Podocerus pusillus, Sars, = *P. minutus*, Sars.

Off Port Erin 6/6/92, 1 male and 2 or 3 females with ova. Length 3½ mm.

Podocerus herdmani, Walker (Sixth Ann. Rep. L.M.B. Com., 1893, p. 37, fig. 13. Brit. Ass. Rep. 1893, p. 539). *P. odontonyx*, Sars, 1894.

Off Port Erin from Pecten, &c.; 8 miles W. of Fleshwick Bay, 33 f.; 4 miles N. W. of Bradda Head, 21 f., 29/1/93; Colwyn Bay, tidal pool, 29/1/93. Length 3½ mm. There is no doubt that the above species are identical as suggested by Prof. Sars, and as *P. herdmani* was published first, the name *P. odontonyx* must lapse.

It is difficult to say whether the two last species (*P. pusillus* and *P. herdmani*) are really distinct from *P. falcatus*. If it be admitted that Amphipoda may become sexually mature before they have attained their final moult I think these species can hardly be maintained. As regards *P. pusillus*, Sars bases his separation of it from *P. falcatus* on (1) the structure of the post. gnathopods (2) its inferior size and (3) (Oversigt af Norges Crust., p. 112) its occurrence in deep water, while *P. falcatus* is a littoral or sub-littoral form. As to (1) one need only compare Sars' figures of the 2 species (and the accuracy of his drawings is remarkable) to see how slight these differences are; as to (2) the variation in size of apparently adult individuals is so great that this cannot be properly used as a specific character; while as to (3) I have mentioned above the occurrence of a very large male of *P. falcatus* at a greater depth than we have taken *P. pusillus*.

The adult male of *P. herdmani* again closely resembles the immature male of *P. falcatus* (see Sars, Pl. 212 p.^{2} male ÷). The specimen from tidal pool, Colwyn Bay, 5 mm. long has all the appearance of a young male of *P. falcatus* but the lower antennæ have the last joint of the peduncle and the first of the flagellum densely clothed with the plumose setæ characteristic of the adult male. The tooth at the base of the palm of the second gnathopod is more pointed, and that on the dactylus scarcely so large as in the typical form but hardly two specimens are exactly alike in these points, especially the latter. As to the females of all three species, I confess that I am unable to see any difference between them except in size.

Podocerus variegatus (Leach) (Pl. XIX., fig. 21).

17 miles N. W. of Mersey Bar, 27/9/90; Menai Straits 7 f., 30/5/94. Whitish variegated with red. Length 7 mm. There has been much controversy about this species. Boeck (Crust. Amph. bor. and arct.) describes *Janassa capillata* (Rathke) under the name of *J. variegata*, Leach, while Nebeski (Beitr z. Kenntniss der Amph. der Adria) unites it with *P. falcatus* to the female of which it bears a considerable resemblance in the form of the second gnathopod. It may, however, be at once recognised by the more robust antennæ and the difference in the flagellum of the upper. In *P. variegatus* the flagellum is four-jointed, the first joint being nearly twice as long as the remaining three which are subequal. There is a distinct secondary appendage which is about $\frac{1}{8}$th the length of the first joint. In *P. falcatus* the flagellum is seven-jointed, the first joint rather shorter than the three following; the secondary appendage about $\frac{1}{4}$th the length of the first joint. In *P. variegatus* the second gnathopods do not differ materially in the two sexes except in size, those of the male proportionally much the larger.

From *Janassa capillata* (Rathke) this species may be at once distinguished by having two secondary teeth below the curved terminal nail of the third uropods, in which respect it resembles *P. falcatus*, and by the distinct, though small, secondary appendage of the upper antennæ, this in *Janassa* being so absolutely rudimentary that it is only visible as a minute tubercle under a very high power—say $\frac{1}{4}$ in. obj. All the limbs are proportionally shorter and stronger than in *P. falcatus* and the second joint of the palp of the maxillipedes is *more* than half the length of the first joint, while in *P. falcatus* it is *less* than half the length.

Podocerus ocius, Bate (female)—Della Valle, Fauna des Golfes v. Neapel—Gammarini.

From sponge débris, Port Erin. Bate's figure appear to have been taken from a female specimen; the male is figured by Della Valle. It has two pointed teeth or processes at the base of the palm in the second gnathopods the proximal one being the longer. The outer ramus of the third uropods has a curved but blunt nail and no secondary teeth. Colour brown. Length of adult male $2\frac{1}{2}$ mm.

Podocerus cumbrensis, Stebbing and Robertson (Trans. Zool. Soc., Vol. XIII., p. 38, Pl. VI.).

Rhos and Colwyn Bays; Puffin Island; Menai Straits. Colour brown. Length 3 mm. Not uncommon in the above localities. It has a strong superficial resemblance to *Microprotopus maculatus*, with which I have generally found it associated, and may easily be overlooked as being the latter species.

Janassa capillata (Rathke).

Puffin Island; Port Erin, breakwater, 2/8/94, common; 5 m. W. of Dalby, 30 f., 8/7/94. This species may be distinguished at a glance by the extreme hairiness of the antennæ; the flagellum of the upper is three-jointed, the first joint three times as long as the remaining two. The first joint of the second gnathopods and two first pairs of peræopods are conspicuously yellow. Colour grey with transverse bars of brown. Length 6 mm.

Erichthonius abditus (Templeton).

Point of Ayr; Puffin Island, 14 f.; Little Orme; Menai Straits; 16 m. N. of Holyhead, 50 f.; Port Erin Harbour, Length 8 mm.

Erichthonius difformis, M. Edwards.

Port Erin—electric light; Laxey Bay, 4 to 12 f., 24/9/92, very abundant in tubes on Zostera. Length 6 mm.

COROPHIIDÆ.

Siphonœcetes colletti, Boeck.

Off Garwick Head, 4 to 12 f., 24/9/92; Port Erin Harbour; Little Orme. Length 3 mm.

Corophium grossipes (Linn).

Mud banks in the estuary of the Dee; tidal ditch in Rhos Bay; Menai Straits. Occurs in immense numbers wherever there are mud banks left bare by the tide. There are hundreds of acres of such banks in the Dee closely perforated by its burrows. It forms an important part of the food supply of the various wading birds, and of fish. Length 7 mm.

Corophium crassicorne, Bruzelius.

C. spinicorne—Bate, Brit. Mus. Cat., female.

C. bonellii, M. Edw.—Bate and West., Brit. Sess. Crust., female.

C. crassicorne, Bruz.—Della Valle, Gam. des Golfes v. Neapel, female.

C. crassicorne, Bruz.—Bate and West., Brit. Sess. Crust., male.

Little Orme, 5 to 10 f., 5/10/93. The immature male has a row of spines on the penult. joint of the lower ant.

as in the female, but this joint terminates in a tooth-like process as in the adult male. Length 3 mm.

Corophium bonellii, Milne Edwards.

C. crassicorne, Bruz., *var.*, Hoek Tijdschrift Nederland. Dierkund Vereen. 4[de] Deel, 1879, Pl. VIII., figs. 9 and 10.

Little Orme; Puffin Island; Menai Straits; Port Erin; off Clay Head, 18 f.

Corophium crassicorne of Hoek, l.c. Pl. VIII., figs. 4 and 5 seems to agree with *C. acherusicum* (Costa) as described by Della Valle. Costa's description is too vague for identification. Length 3½ mm.

Unciola crenatipalmata (Bate).

Porthwen and Dulas Bays, 17 f., 8/6/89; off Llanfaelog, Anglesea, 24/5/90; Penrhos Bay.

For description and synonyms see "Bonnier, Les Amph. du Boulonnais." Bull. Scient. de la France, &c., 1889, Pls. XII. and XIII. This species is closely allied to *U. leucopis* (Kröyer) from which it differs in the colour of its eyes which are dark and very distinct, in the absence of the nodules on the sides of the pleon, and (according to Sars) of the transverse ridges of the peræon. This last feature is not mentioned by Kröyer or Boeck and may possibly have been produced (as it frequently is) by contraction after death. Length 5 mm.

U. planipes, Nor. = *U. leucopis* (Kr.) Bate & West., II., 517.

Red Wharf Bay, 20 f., 8/6/89; Dulas Bay; Little Orme, 28/7/93; off Southport, 10 to 20 f., June, '91 (I.C.T.) Length 5½ mm.

Colomastix pusilla, Grube, see Bonnier, l.c. Vol. XXIV., p. 197, Pl. VIII.

Cratippus tenuipes, Bate.

Exunguia stylipes, Norman (Ann. and Mag. N. H., Ser. 4, Vol. III., Pl. XXII., figs. 7 and 12).

Menai Bridge among sponges, 10 f., April and May, 1894. Sponge débris, Port Erin, 1894. Length 3 mm.

Cheluridæ.

Chelura terebrans, Philippi.

In posts of the old shipping stage, Penmaen, Colwyn Bay, with *Limnoria lignorum* (Rathke). Length 6 mm.

Dulichiidæ.

Dulichia porrecta (Bate).

Rhos and Colwyn Bays shore to 7 f., common; Menai Bridge, 10 f.; April and May, '94, common; from Pecten, 7 m. W. of Bradda Head, 38 f., 25/4/95. A large female with ova had the peduncles of the upper ant., the lower margins of the epimeres, and the peræopods (except the last which are variegated with white) dark red. Eggs white. Younger specimens are only speckled with red, as are generally the males which are comparatively scarce. Length 5 mm.

Caprellidæ.

Phtisica marina, Slabber=*Proto ventricosa* (Müller).

Little Orme; Puffin Island; Menai Straits; Port Erin Harbour. Length 7½ mm.

Protella phasma (Montagu).

Little Orme; Puffin Island; Menai Straits; Port Erin. Length 16 mm.

Pariambus typicus (Kröyer)=*Podalirius typicus*.

Throughout Liverpool Bay; Port Erin Harbour. On *Asterias rubens*. Length 5 mm.

Caprella linearis (Linné).

Abundant among Algæ throughout the district. Length 15 mm.

Caprella acanthifera, Leach.

Moelfre Bay, Anglesea, tidal pools, Aug., '89 (F. A.); Holyhead harbour, 12/9/89; Port Erin Harbour. Length 11 mm.

Explanation of Plates.

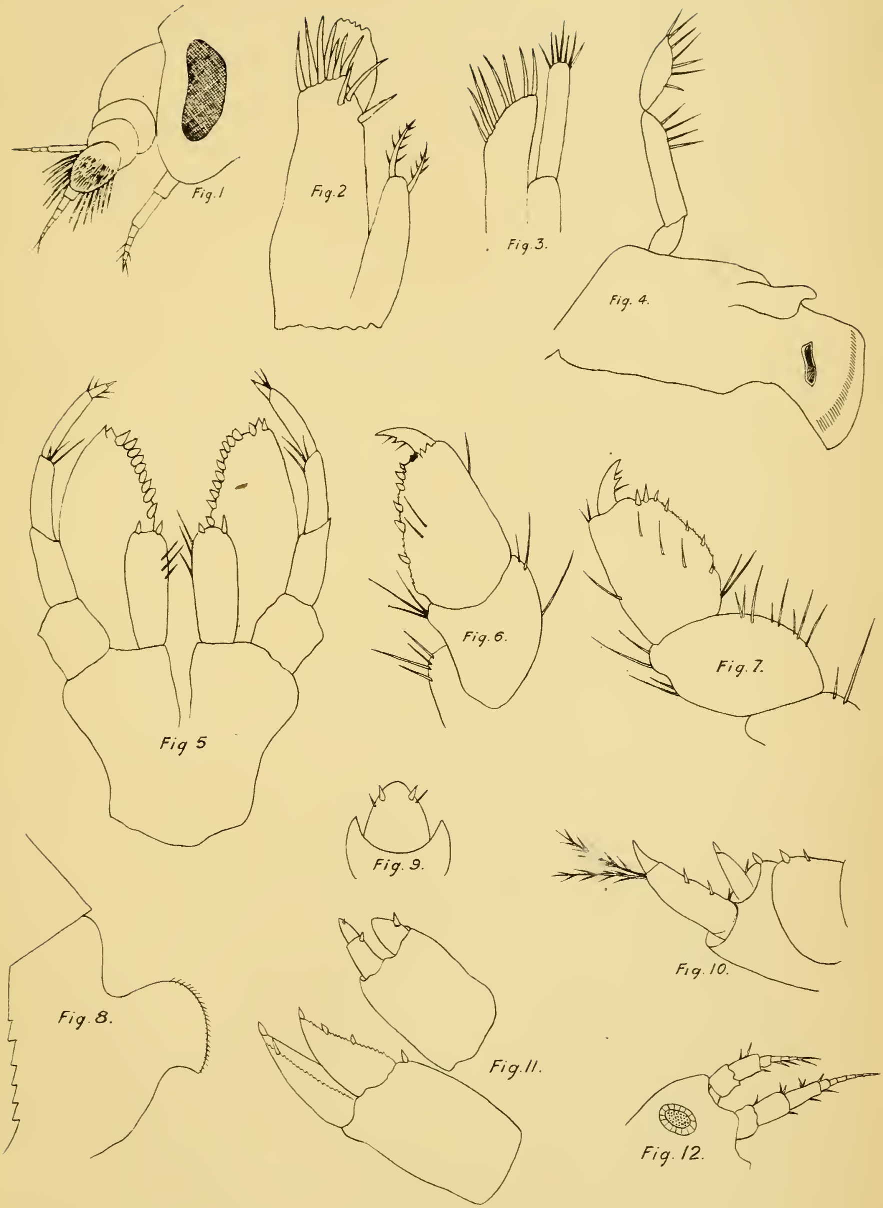
Plate XVIII.

Figs. 1—11. *Nannonyx spinimanus*, n.sp.

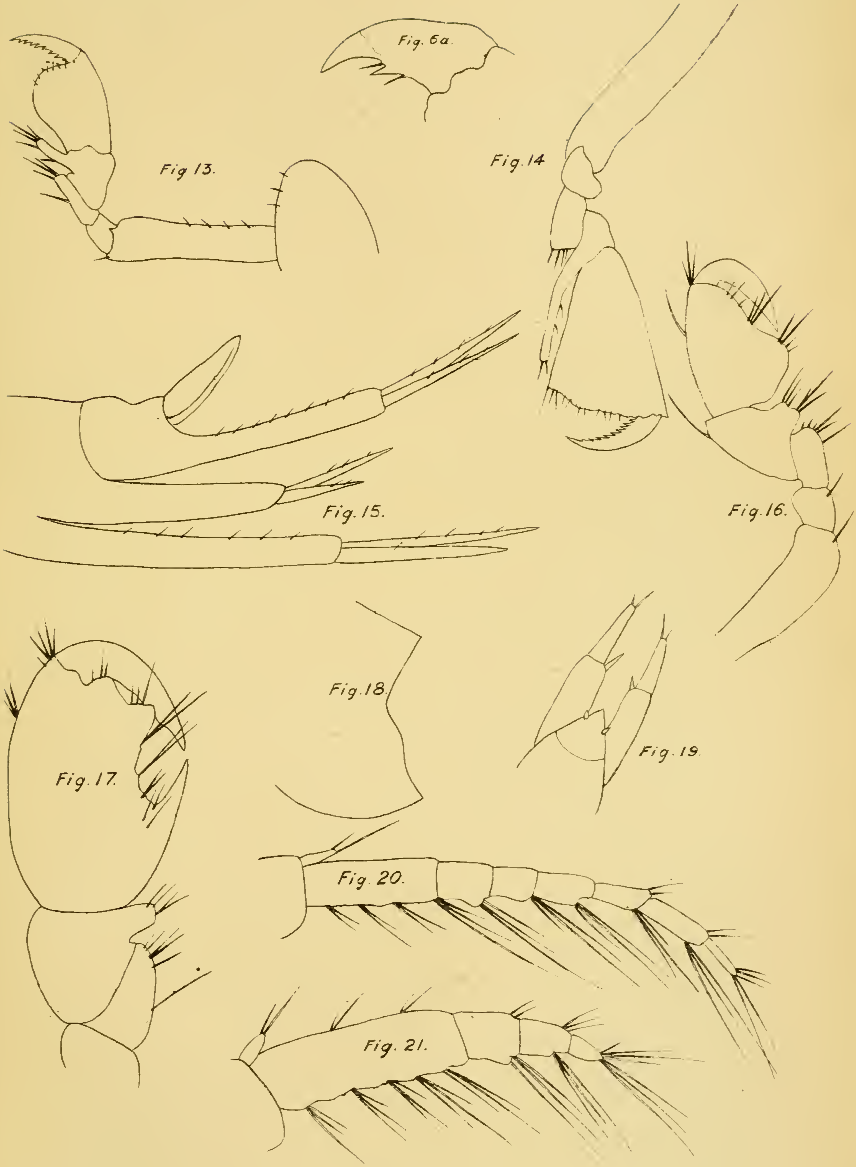
Fig. 1. Head.
Fig. 2. First Maxilla.
Fig. 3. Second Maxilla.
Fig. 4. Mandible.
Fig. 5. Maxillipedes.
Fig. 6. First gnathopod of male.
Fig. 6a. (on Pl. XIX.) Dactylus enlarged.
Fig. 7. First gnathopod of female.
Fig. 8. Fourth pleon segment with hind margin of third.
Fig. 9. Telson.
Fig. 10. Side view of telson and third uropods of male.
Fig. 11. Second and third uropods of female.
Fig. 12. *Amphilochus melanops*, n.sp., Head.

Plate XIX.

Fig. 13. *Amphilochus melanops*, n.sp., first gnathopod.
Fig. 14. ,, second gnathopod.
Fig. 15. ,, Telson and uropods.
Fig. 16. *Photis pollex*, n.sp., first gnathopod.
Fig. 17. ,, second gnathopod.
Fig. 18. ,, third pleon segment.
Fig. 19. ,, Telson and third uropods.
Fig. 20. *Podocerus falcatus* (Mont.), flagellum of upper antenna.
Fig. 21. *Podocerus variegatus*, Leach, flagellum of upper antenna.



L.M.B.C. AMPHIPODA.



L.M.B.C. AMPHIPODA

REPORT on NEMERTINES observed at PORT ERIN in 1894 and 1895.

By W. I. Beaumont, B.A.

EMMANUEL COLLEGE, CAMBRIDGE.

The observations on which the present Report is based were for the most part made during a stay of six weeks at Port Erin in June and the earlier half of July, 1895. A certain amount of attention had been previously devoted to the group during portions of March and April, 1894. My thanks are especially due to Prof. Herdman for placing at my disposal the resources of the Biological Station and for his ever ready help and encouragement, and to Mr. T. H. Riches of Caius College, Cambridge, for very useful assistance and advice.

In Mr. Vanstone's List (*6*) published early in last year thirteen species of Nemertines were definitely reported as occurring in the neighbourhood of Port Erin. With the possible exception of the form therein recorded as *Carinella annulata*, all of these have been observed by myself, while eight additional species appear in the present Report, viz.: *Amphiporus pulcher*, *A. dissimulans*, *Tetrastemma flavidum*, *Prosorhochmus claparedii*, *Micrura purpurea*, *M. fasciolata*, *M. candida*, *Cerebratulus fuscus*. The known Nemertine fauna of the district therefore numbers twenty-one, perhaps twenty-two, species; the uncertainty depending on the identity of the species appearing in the earlier Report as *Carinella annulata*, Montagu. On the assumption which I believe to be correct, that the name is there used with the connotation it bears in M'Intosh's Monograph, it is possible that the Nemertine so referred to is identical with that recorded in the present Report as *Carinella aragoi*, Joubin.

None of the parasitic species has yet been obtained in the district; no particular search was made for them by myself beyond examining a few specimens of *Galathea*. *Malacobdella* will probably be found; I had not, however, an opportunity of obtaining that curious Nemertine, as no living specimens of *Cyprina islandica* were dredged during my visit.

Two cases of abnormality in the number of marginal stylet sacs in the proboscis may be conveniently mentioned here. A specimen of *Tetrastemma candidum* (of the deeper water variety with white patch on head and dorsal white line) was observed having three marginal sacs, while a brownish yellow example of *Tetrastemma dorsale* had four marginal stylet sacs, two on each side.

Before proceeding to deal with certain of the species in detail it may be useful to give a complete list of the Nemertines hitherto observed in the district.

Carinella aragoi, Joubin.
? *C. annulata* (Montagu).
Cephalothrix bioculata, Oersted.
Amphiporus lactifloreus (Joh.).
A. dissimulans, Riches.
A. pulcher (Johnston).
Tetrastemma flavidum, Ehrenb.
T. dorsale (Abildgaard).
T. nigrum, Riches.
T. immutabile, Riches.
T. candidum (O. F. Müller).
T. vermiculatum (Quatrf.).
T. melanocephalum (Johnston).
T. robertianæ, M'Intosh.
Prosorhochmus claparedii, Kef.
Nemertes neesii, Oersted.
Lineus obscurus (Desor).
Lineus longissimus, Sowerby.
Micrura purpurea, J. Müller.
M. fasciolata (Ehrenberg).
M. candida, Bürger.
Cerebratulus fuscus (M'Int.).
? *C. angulatus* (O. F. Müller).

Order I.—PROTONEMERTINI, Bürger.

Family Carinellidæ.

Carinella aragoi, Joubin.

C. annulata (pars), M'Intosh, Hubrecht.

C. M'intoshii, Bürger, Riches.

This species has been dredged not infrequently this year in about 15 to 18 fathoms on the shelly ground to the north of the Halfway Rock, though it does not appear to be abundant. The ground colour in the half dozen examples taken during my visit varied from dark chesnut to chocolate. They were quite small, measuring only from 2 to 7 cm. in length, but an exceptionally large specimen over 20 cm. long in the preserved state was shown to me by Mr. J. C. Sumner who had obtained it in the same locality previous to my arrival. The Port Erin form is exactly similar in external characters to examples of this species seen by myself on the S.W. coast of Ireland and at Plymouth. It is readily distinguished from *Carinella annulata*, Joubin, Bürger, by the very characteristic pale curved ciliated grooves on the dorsal surface of the "neck," by the absence of a longitudinal white line on the ventral surface of the body, and by the shape of the head which is far less wide than in *C. annulata*; there is considerably more white on the snout too in *C. aragoi* and the proboscis pore is more anterior in position.

? *C. annulata* (Montagu).

Mention has already been made of the possibility of the species recorded as *C. annulata* in Mr. Vanstone's Report being identical with the last species. No example of the *Carinella annulata* of Joubin and Bürger has been met with by myself at Port Erin; there is, however, no reason why it should not occur in the district.

Order II.—MESONEMERTINI, Bürger.

Family Cephalothricidæ.

Cephalothrix bioculata, Oersted.

Besides being commonly found on the shore under stones and among weeds, this species was occasionally dredged near Port Erin in about 15 fathoms.

Order III.—METANEMERTINI, Bürger.

Family Amphiporidæ.

Amphiporus pulcher (Johnston), M'Intosh.

This well marked species was found to be fairly abundant on the shelly ground off Port Erin in 15 to 20 fathoms; it has also been dredged in the neighbourhood of Spanish Head on several occasions.

The average length was 3 cm., the largest specimen measuring 5 cm. All were of a uniform deep salmon colour; no example with conspicuous gonads like the one figured by M'Intosh being met with. They were frequently observed with the head telescoped into the anterior part of the body as described by M'Intosh, and the larger ones swam vigorously when irritated. *Amphiporus pulcher* is readily distinguished from *A. dissimulans* and *A. lactifloreus* not only by the possession of a reserve central stylet and by the different position of the side-organs but also by external characters: the broad oar-like shape of the posterior half of the body, the large distinct eyes not arranged in definite groups like those of *A. lactifloreus*, and especially the secondary grooves running forward from the anterior cephalic furrows; the course of the latter on the ventral surface is more transverse than in the other two species referred to, so that they meet in the middle line some distance behind the mouth-opening;

the secondary grooves are deep and well marked, far more so than is indicated in M'Intosh's figure (Pl. XIV., fig. 11), they are not confined to the ventral surface but extend some distance on to the lateral portions of the dorsal surface as well.

The figure and description of the cephalic furrows given by Joubin (*5*, p. 129) may refer to *Amphiporus dissimulans;* they certainly do not represent *A. pulcher*.

Amphiporus lactifloreus (Johnston).

Shore, common (see Vanstone).

Amphiporus dissimulans, Riches.

Numerous specimens of an *Amphiporus* closely resembling *A. lactifloreus*, yet readily distinguishable from that species on careful examination, were dredged in the same localities as *Amphiporus pulcher*. No mature example was taken; the length of the majority was only from 6 to 9 mm. while a few reached 2 to 3 cm. After the examination of adult specimens of *A. dissimulans* at Plymouth I have no hesitation in referring the Port Erin form to this species.

The larger specimens were brownish-yellow to dull orange in colour, depending largely on the colour of the alimentary tract and also on the presence of minute granules of yellowish brown pigment in the integument. The smaller ones were of a fairly deep salmon colour due entirely to the gut, no superficial pigment being as yet apparent. The brain was plainly visible as a translucent body of a pale yellowish tint.

The body was round and somewhat slender, and attained its maximum thickness a little in front of the middle point, diminution of size being very gradual in either direction.

In the structure of the stylet apparatus and in the position of the side-organs which open some distance in front of the brain this Nemertine agreed with *Amphiporus lactifloreus*, but on a careful comparison of the two, certain definite points of difference were invariably found. There was a marked difference in the shape of the head, which in *A. lactifloreus* is a rather long oval with the greatest width just *behind* the lateral notches where the anterior furrow passes from the dorsal to the ventral surface; in *A. dissimulans* the head is more lozenge shaped, there being a distinct angle at the widest part which is just *in front* of the lateral notches of the anterior grooves; thence the width decreases very distinctly as far as the lateral notches formed by the posterior furrows, so that there is a very distinct "neck." Another point of difference concerns the arrangement of the eyes, which is very characteristic in *A. lactifloreus*, where they are invariably broken up into two distinct groups on each side, the posterior group usually situated over the brain and separated by a considerable interval from the anterior series; while in *A. dissimulans* the eyes are arranged in a continuous series on each side of the head, a few usually extending inward towards the middle line in the region of the anterior cephalic furrow. The smaller specimens at Port Erin measuring 6 to 9 mm. in length usually had 8 to 10 eyes on each side; one 6 mm. long was noted having as many as 14 eyes on each side, but this number was generally found only in specimens of 2 to 3 cm. The most posterior eye of the series was generally situated a little in front of the brain, in no case were eyes observed actually over the brain.

The figure given by Joubin to represent the head of *Amphiporus pulcher* (5, p. 129) gives a fairly good idea of the arrangement of the cephalic furrows in *A. dissimulans*; the anterior furrows usually bend more forward on the ventral surface so as to run closer to and more nearly parallel with the margin of the head than is there indicated, and I have never been able to make out a branch groove uniting the anterior and posterior furrows; at the angle where the anterior groove bends forward, there is certainly a branch given off, as in *A. pulcher* and other Enoplous Nemertines, but it is quite short and ends abruptly.

In *A. lactifloreus* the arrangement is very similar; the grooves being perhaps less conspicuous, and the anterior grooves bending somewhat less forward on the ventral surface so that the mouth-opening, which is in the usual position close behind the tip of the snout, is a little in front of the furrows and not intersected by them. Joubin's figure on p. 132 (*5*) does not appear to me to be at all an accurate representation of the head of this species.

Whether the above characters are sufficient to entitle *Amphiporus dissimulans** to specific rank, or whether it should be regarded merely as a variety of *A. lactifloreus*, it is at any rate a well marked variety which appears to be as strictly confined to the infra-laminarian zone as *A. lactifloreus* to the littoral.

It remains to be mentioned that the small Port Erin specimens differ somewhat from the adults seen at Plymouth in respect to two features. In the former the brain is not pink (this may be a juvenile character) and secondly the head is less pointed and more distinctly notched in front than is the case in the Plymouth form.

Family TETRASTEMMIDÆ.

Tetrastemma flavidum, Ehrenberg.

This species appears to be well distributed in the

* It is almost needless to point out that Joubin is in error in assimilating this species with *A. pulcher*. The two are very distinct, yet the possibility of his having confused them is strongly suggested by the figure and accompanying description (*5*, p. 129) referred to above.

neighbourhood of Port Erin but to be nowhere very abundant. It has been obtained from the shore at Port Erin and Perwick where it inhabits the smaller weeds on reefs and in rockpools, and has also been dredged on shelly ground in about 15 fathoms. All the specimens taken were small, varying in length from 6 to 12 mm. No mature individuals were met with, one immature female being the only specimen in which genital organs were observed.

In addition to the other well marked characters of this species, the relative shortness of the proboscis may be noted. This organ extends back barely half the length of the body from the anterior end.

The colour of the Port Erin examples varied from peach-colour to fairly bright orange red, and being due almost entirely to the alimentary tract was much more marked in the posterior half of the body. The fluid in the proboscis-sheath had in some cases a pale yellow tint, as had also the blood vessels in some specimens, more especially in the posterior region of the body.

Tetrastemma dorsale (Abildgaard).

Two well marked colour varieties were found, apparently restricted to different habitats.

The common dark brown type marbled with irregular patches of reddish brown—narrow but of dark colour where they cross the pale median dorsal band, widening out but becoming paler on the sides of the body—is commonly found on the shore and in the Laminarian zone, but does not appear to extend into the deeper water outside. At all events on the shelly ground in 15—20 fathoms a much paler form of a brownish yellow colour was exclusively found. In the absence of much superficial pigment, the colour in these was due largely to the alimentary tract. Some examples had hardly a trace of the reddish brown pigment so abundant in the shore form, while others had obscure patches similar in disposition to those present in the latter but much paler in colour. Minute flakes of opaque yellowish white were scattered all over the surface of the body as in the shore form, and in many cases a concentration of these along the mid-dorsal line produced a pale longitudinal streak. The white flakes in this species are more superficial than the reddish brown pigment. The latter is in the form of much branched pigment cells whose processes run for the the most part in the direction of the long axis of the body.

Tetrastemma nigrum, Riches.

A few examples of this species were met with both in 1894 and 1895. They were found in weeds from Port Erin shore and from the Clets in the Calf Sound, and were from 5 to 15 mm. in length.

Joubin, who does not appear to have met with this form, expresses doubt as to its being specifically distinct from *Tetrastemma dorsale*. In shape, in the character of its stylet apparatus and other anatomical details, it does certainly agree with the latter, but so long as colour is relied on for the discrimination of the species of *Tetrastemma*, it must be regarded as a well marked species, much more so for example than are *T. candidum* and its allies.

In *Tetrastemma nigrum* the warm buff ground colour is in most cases almost entirely concealed by black, or almost black, reticular pigment, which is totally different in character from anything seen in *T. dorsale*; while on the other hand the branched reddish brown pigment and opaque white flakes so characteristic of the latter are entirely absent in *T. nigrum*.

Though *Tetrastemma nigrum* varies considerably, the variation met with merely concerns the extent to which the surface of the body is covered with black pigment, and in no way tends to bridge the gap between the type and *T. dorsale*. In a few individuals the ground colour is nowhere visible except along a narrow irregular strip of the ventral surface, usually, however, there is a longitudinal median dorsal band free from black pigment, varying much in width in different individuals and frequently interrupted by one or more bridges of pigment; while one or two examples have been met with in which the black pigment was confined to a series of isolated more or less rounded patches, the aggregate area of which was less than that of the intervening pale surface.

Tetrastemma immutabile, Riches.

Two Nemertines agreeing in shape and colour with the description given by Riches were found in 1894 in material from the Clets, and a couple more turned up in shore material from Perwick in 1895. They were from 3 to 6 mm. long.

No intermediate varieties connecting this form with *Tetrastemma dorsale* were met with. The median dorsal band consists of branched reddish brown pigment cells the processes of which tend to run longitudinally, and also of round granules of darker brown colour, a few of which are scattered over the rest of the dorsal surface. In none were genital organs observed.

Tetrastemma candidum (O. F. Müller).

This species was found in considerable abundance inhabiting the weeds between tide-marks at Port Erin, Perwick and Port St. Mary. Very few specimens exceeded 1 cm. in length; the majority were considerably less, yet many even of the smaller ones had well developed genital organs, one male not more than 4 mm. long having 6 pairs of testes containing ripe spermatozoa.

These littoral forms, though varying a good deal in colour and other details, agreed for the most part in having the head more rounded in outline than is the case in *Tetrastemma melanocephalum* and in this respect differed slightly from the deeper water form described below. In colour the majority were of various shades of yellow—from pale straw to deep apricot-yellow—flesh-coloured, yellowish brown and dull orange varieties were also observed while a few were of a greenish-yellow, the prevailing yellow tint being modified by the green colour of the alimentary tract, but no specimen was met with at all resembling the bright green type figured by M'Intosh.

No example of this shore form exhibited any trace of opaque white either on the head or in the form of a median dorsal line. Only two individuals were found showing a tendency by the development of brown pigment on the head to connect this species with the two following ones. Both were mature females agreeing in other respects with the more typical specimens of *T. candidum* from the same source. In one, about 1 cm. long, there was a band of brown pigment between the anterior and posterior eyes on each side but not quite reaching the latter; in the other an obscure brown patch extended across the head immediately behind the anterior pair of eyes, the colour being more pronounced between the anterior and posterior eyes on each side.

In the deeper water (15 to 20 fathoms) outside Port Erin, on shell and coralline bottom, a rather well marked form was found, which may be described here since it lacks the characteristic markings of the two following species. It is, however, quite a debateable point whether it ought not rather to be added to the series formed by Hubrecht's species *T. melanocephalum*, *T. coronatum* and *T. diadema* as an extreme variety of *T. melanocephalum*. It seems to come very close to *T. diadema* but in none of the many specimens examined was there any tendency to the development of brown pigment on the head.

Most of the specimens taken measured from 1 to 2 cm. in length; many had well developed genital organs. In shape they resembled *T. melanocephalum*, the more spathulate head distinguishing them from the littoral form dealt with above. The colouring was fairly constant; the majority were a more or less deep apricot-yellow, a few were of a rather more greenish or brownish tint and one flesh-coloured individual was noted. In all a conspicuous oblong patch of opaque white flakes was placed transversely between the anterior and posterior pairs of eyes, from which in most cases a median longitudinal line of similar white flakes extended back along the dorsal surface, generally the whole length of the body. The eyes were black, well defined usually and about equal in size, the posterior pair being often somewhat closer together than the anterior in the well extended animal.

In the character of the proboscis they agreed with the more typical *T. candidum* from the shore rather than with *T. melanocephalum*, the stylet of the central apparatus being on the whole longer in proportion to the handle than is the case in the latter. Much stress cannot, however, be laid on this point, for the stylet apparatus, especially the handle, varies so much in form as to be of little value in discriminating between such closely allied species as *T. candidum*, *T. vermiculatum* and *T. melanocephalum*, though sufficing as a general rule to distinguish these three as a group from other Enoplous Nemertines.

Mention may here be made of two or three brownish yellow Nemertines agreeing fairly well in general appearance with *Tetrastemma candidum*, but having the handle of the central stylet very long, its posterior border being straight with rounded corners, thus resembling in outline the central apparatus of some of the Port Erin specimens of Prosorhochmus. The examination of more specimens is desirable before forming any conclusion as to their relation with other forms.

Tetrastemma vermiculatum (Quatrf.), M'Intosh.

This usually abundant species does not seem to be at all common in the district. I have only met with three specimens. Two of a deep flesh-colour—the larger a mature female 12 mm. long—were found in weeds from between tide-marks at Perwick, the third came from the Clets in Calf Sound and was of a rich apricot-yellow colour. In all three the head was fairly oval in outline, a point which serves in some degree to distinguish this from closely allied species, but in none was there a trace of the dorsal white line which Joubin considers its most reliable character.

Tetrastemma melanocephalum (Johnst.), M'Intosh.

T. melanocephalum, Hubrecht.

T. coronatum, Hubrecht.

This species is fairly abundant and well distributed in the district, inhabiting the weeds between tide-marks and also the shell and coralline ground in 15 to 20 fathoms. At Easter, 1894, a few large greenish specimens were found (up to 3½ cm. long), but the numerous examples collected in June and July, 1895, were all immature, averaging only about 1 cm. in length. They presented a considerable range of colour-variation, different shades of flesh and salmon-colour and of yellow from pale greenish-yellow to deep apricot being noted as the ground colour.

A median dorsal white line was present in many specimens, and the majority had more or less opaque white on the head in front of, and immediately posterior to, the patch of dark pigment. The latter was reddish brown or chocolate in colour and very variable in shape.

In many cases it was a deep crescent, the horns barely touching the anterior pair of eyes and the convex posterior margin extending to about halfway between them and the posterior pair. This variety appears to correspond to Hubrecht's species *T. coronatum.* In others again an oblong band of pigment extended quite across the head (almost reaching its lateral margins) immediately behind the anterior pair of eyes and covering one-half to two-thirds of the space between them and the posterior pair. This seems to be Hubrecht's typical *T. melanocephalum.* With respect to these two forms, however, my experience both at Port Erin and elsewhere coincides with that of Riches, a complete series of intermediate varieties making it impossible to regard them as more than slightly divergent members of one variable species.

This opinion was at one time held by Joubin too, but in his later work (*5*) *T. coronatum* is separated from *T. melanocephalum* and united with *T. diadema*, Hubrecht. No Nemertine exactly agreeing with the latter has been met with by myself, but the Nemertine from the coralline zone described under the head of *T. candidum* seems to come very near it. That form, however, did not show any tendency to vary in the direction of *T. melanocephalum* so far as my observations went.

A character given for the present species by M'Intosh: "Marginal stylets-sacs placed considerably in front of the central apparatus"—has been repeated by other authors, though to what extent this point has been confirmed by their own observations does not appear. I have examined the stylet apparatus in many individuals and have so far failed to find a single case exhibiting this character, or any difference in this respect between *T. melanocephalum* and its allies.

A Nemertine having the form and general appearance of *T. melanocephalum* was observed, which resembled a specimen described by Riches in having the dark pigment patch broken into two by a space in the middle line free from pigment, and thus connecting the present species with *T. vermiculatum*.

Tetrastemma robertianæ, M'Intosh.

Two specimens of this rare species were dredged in 1895 on the shelly ground off Port Erin in about 15 fathoms. Lochmaddy and Bressay Sound where it was dredged by M'Intosh appear to be the only other localities where it has been found.

The two examples observed by myself agreed fairly well with M'Intosh's figures and description, though in neither was the head so pointed as he represents it in the woodcut on page 167 of the Monograph. The central stylet apparatus did not differ materially from his figure (p. 65).

The larger individual, about 1 cm. long, had the median dorsal white line, the reddish brown lateral stripes and collar, the latter not quite encircling the neck ventrally. There was a patch of opaque white flakes between and in front of the posterior eyes which were much smaller than the anterior pair. The smaller one was similar except that the brown collar was wanting.

A Nemertine from the same locality resembling the above in shape but differing somewhat in arrangement of colour and also in the character of its stylet apparatus may be conveniently described here. Like them it was exceedingly active. It measured about 8 mm. in length. The ground colour was apricot-yellow, a large patch of opaque white flakes extended across the dorsal surface of the head between the anterior and posterior eyes, a little behind the latter was a chocolate brown collar not quite complete ventrally, and from this a median longitudinal band of the same colour extended back the whole length of the dorsal surface. The anterior eyes were crescentic in shape and twice the size of the more rounded posterior pair.

The central stylet apparatus was very large, the stylet somewhat longer than was the case in the two typical specimens of *T. robertianæ*, and the handle very long, its posterior border straight with rounded corners.

Prosorhochmus claparedii, Keferstein.

The Nemertine referred here was met with not uncommonly among material dredged on the shell ground lying to the north of the Halfway Rock in 15 to 20 fathoms. There can be little doubt that it is identical with the Plymouth form described by Riches under this name, though I failed to make out a superior lobe on the head. Both differ very considerably in general appearance from the figures of *Prosorhochmus claparedii* given by M'Intosh, and ought very possibly to be regarded as a distinct species.

In the Port Erin specimens, which were from 8 to 12 mm. long, the body was stout and rounded, tapering from the middle towards either end. The head broad, rounded in outline and with pronounced notch in front, very convex dorsally, and well marked off by conspicuous cephalic furrows resembling those of *Tetrastemma candidum* in disposition. The colour was a dull brownish orange resulting from the deep apricot yellow colour of the alimentary tract modified by a sprinkling of minute granules of superficial reddish brown pigment all over the body but much more plentiful on the dorsal surface. In one or two specimens there was a slightly greater development of pigment between the anterior and posterior cephalic grooves, but to nothing like the extent seen in the Plymouth form. The greater portion of the dorsal surface of the head in front of the anterior furrows was covered with opaque white flakes; similar flakes were usually disposed as a fan on the posterior extremity of the body, while in one individual minute white grains superficial to the brown pigment appeared all over the body. In no case was there any tendency to the formation of a dorsal white line.

The eyes were reddish brown and crescentic in shape, the ragged concave side being directed outward. The anterior pair were much larger than the posterior, and the latter were much closer together than the former when the animal was well extended; the two pairs, however, were not approximated as represented in the figures of M'Intosh but on the contrary were separated by an interval quite as great as in the case of *Tetrastemma candidum* for instance.

The central stylet apparatus agreed precisely with the figure given by M'Intosh (Pl. XIII., fig. 1), except in two specimens wherein the handle of the central stylet was long and with a straight posterior border as in the others, but the corners were rounded off instead of sharp.

A number of females containing numerous large ova were seen but in no case was there any sign of commencing development.

Family NEMERTIDÆ.

Nemertes neesii (Oersted).

A young individual 3 cm. long dredged in about 20 fathoms off Peel on June 23rd, 1895, is the only example of this species which has so far as I know been taken below low water mark in the district. Large specimens were commonly found on the shore in all suitable localities.

Order IV.—HETERONEMERTINI, Bürger.

Family LINEIDÆ.

Lineus obscurus (Desor).

Shore, common (see Vanstone).

Lineus longissimus, Sowerby.

This species was not met with at all commonly; a few specimens were found at low tide at Port Erin in 1894, and it was dredged off Bay Aldrick in about 17 fathoms in 1895.

Micrura purpurea (Dalyell), J. Müller.

Two examples of this species were dredged in about 15 fathoms to the north of the Halfway Rock on shelly bottom. They were 6 to 7 cm. long, and in colour rich purple-brown with the characteristic patch of yellow on the snout. No eyes could be made out in either.

Micrura fasciolata, Ehrenberg.

This species was dredged not infrequently in 15 to 20 fathoms on the shell ground near Port Erin, but can hardly be considered abundant. Length 3 to 6 cm. In addition to specimens of the typical brownish red colour with conspicuous white bands, a few were met with resembling a variety described by M'Intosh; these were greenish and greyish brown in colour and the white bands were very obscure, or even entirely absent, so that, but for the possession of a caudal appendage, they bore a very close resemblance to similarly coloured varieties of *Lineus obscurus*.

An individual of this species, when accidentally dropped into a solution of picric acid, disgorged a Polychaete worm about half its own length.

Micrura candida, Bürger.

Cerebratulus lacteus, Hubrecht.

An opaque white Nemertine about 4 cm. long dredged in June, 1895, to the north of the Halfway Rock in about 15 fathoms, proved to belong to the above species. It was readily distinguished from pale examples of *Cerebratulus fuscus* by its rounder more attenuated body and less pointed head, and by the absence of eyes. The surface of the body was much wrinkled transversely, the intervening folds being densely crowded with flakes of opaque white, so that the brownish flesh-colour of the deeper tissues was only visible in the wrinkles. No granular brown pigment was present. The brain showed as an ill defined pinkish mass. A caudal appendage was present. A second specimen 6 mm. long was dredged on the same ground later. The ground colour was white with a yellowish tinge due to the gut, the wrinkling was less marked than in the larger individual, which it otherwise closely resembled. The single specimen taken by Riches at Plymouth is the only previous British record for this species.

Cerebratulus fuscus (M'Intosh), Hubrecht.

The posterior end of a large individual of this species was dredged in the neighbourhood of Spanish Head on the "Lady Loch" excursion of June 1st, 1895. The dorsal surface was somewhat profusely spotted with brown pigment; this and the very characteristic shape left no doubt as to its identity.

During the course of the same month one specimen about 2 cm. long and some half dozen smaller ones were obtained off Port Erin in 15 to 20 fathoms.

References.

1. M'Intosh.—*A Monograph of British Annelids.* Pt. I., Nemertines.
2. Hubrecht.—*Genera and Species of European Nemertines.* Notes from Leyden Museum, XLIV., 1879.
3. Burger.—*Zur Systematik der Nemertinenfauna des Golfes von Neapel.* Nachrichten v. d. K. Gesellschaft d. Wissenschaften zu Göttingen, 1892.

4. Riches.—*The Nemertines of Plymouth Sound.* Journal of the Marine Biological Association, 1893.

5. Joubin.—*Faune France :* Les Némertiens, 1894.

6. Vanstone.—*The Nemertines of Port Erin, Isle of Man.* Trans. Liverpool Biological Society, 1894.

4