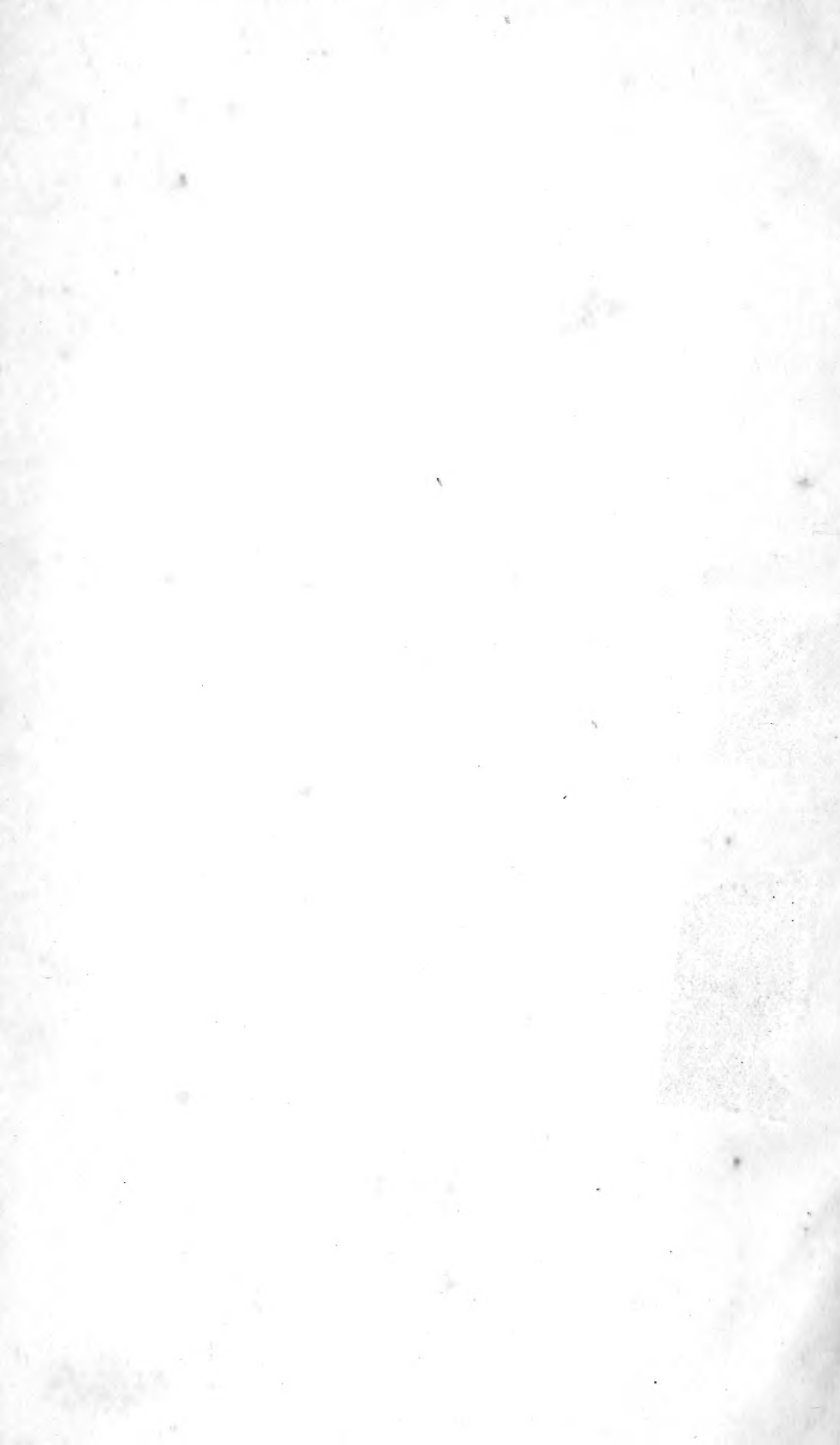




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THE SECOND REPORT
UPON THE
FAUNA OF LIVERPOOL BAY
AND THE
NEIGHBOURING SEAS.

WRITTEN BY THE MEMBERS OF THE
LIVERPOOL MARINE BIOLOGY COMMITTEE,

AND EDITED BY
W. A. HERDMAN, D.Sc., F.L.S.,
PROFESSOR OF NATURAL HISTORY IN UNIVERSITY COLLEGE, LIVERPOOL.

WITH TWELVE PLATES AND A CHART.

PRINTED FOR THE
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CORRECTIONS.

In the First Report on the Puffin Island Biological Station, at page 48, last line, for "further on in the present volume," read "in Proc. Biol. Soc. L'pool, vol. ii., p. 78."

In same article, p. 57, for "*Scaphosoma*" read *Cymbasoma*.

Dr. Hanitsch wishes to state that the new Sponge described in his report on p. 43, and figured in plate vii., under the name of *Seiriola compacta*, really consists of two separate Sponges, a Stellettid and an incrusting Suberite. The former is, however, the type of a new genus closely allied to *Stryphnus*, Sollas, and for it the name *Seiriola* may be retained. The family Seiriolidæ must lapse. A revised description of the genus and species will be given in the next report.



INTRODUCTION.

THE first volume of this series of L.M.B.C. Reports upon the Fauna and Flora of Liverpool Bay* was published in the summer of 1886, as an Appendix to vol. xl. of the Proceedings of the Literary and Philosophical Society of Liverpool, and also separately as a volume of 372 pages, ten plates and two maps.† Later on in the same year the Liverpool Biological Society was founded, chiefly as an outcome of the L.M.B.C. investigations and through the instrumentality of the members of that committee, and it was then felt that this would in future be the proper scientific society before which to lay all reports upon the biology of the district. The various papers bound up in the present volume have therefore been duly read before the Liverpool Biological Society, during the last two sessions (1887-88 and 1888-89), and have been, or are now being, published in the "Proceedings" (vols. ii. and iii.).

The L.M.B.C. have to thank the Council of the Liverpool Biological Society for allowing extra copies of these reports to be printed in order that they might be collected and issued as the second volume of "The Fauna of Liverpool Bay." It is proposed to continue this arrangement, and to issue succeeding volumes of collected reports upon the fauna and flora of the district as they are ready, probably at intervals of a few years.

This statement of the method of printing of the present

* The L.M.B.C. district, or Liverpool Bay in a wide sense, is that quadrangular area in the eastern part of the Irish Sea which is bounded by the coast of Lancashire, the north coasts of Wales and Anglesey, and the Isle of Man.

† "Fauna of Liverpool Bay," Report I. London: Longmans, Green and Co., 1886.

volume will explain a certain amount of irregularity in the pagination and in the numbering of the plates, since the sheets and plates have been reprinted from two separate volumes of the "Proceedings." The absence of a continuous paging throughout the volume need not, however, cause any difficulty or confusion, since each article is independent of its neighbours; and exact references to the species described or figured in the volume can be made by quoting the title of the article as well as that of the book: e.g., the new Copepod described by Mr. I. C. Thompson as *Lichomolgus sabellæ*, may be referred to under "Fauna of Liverpool Bay, vol. ii., Second Report on Copepoda, p. 68."

The L.M.B.C. desire again to place on record their grateful appreciation of the assistance they have received from various gentlemen in Liverpool and the neighbourhood. Much of the work recorded in the following pages could not have been undertaken but for the ready subscriptions, the welcome loan of steamers, and the kindly encouragement with which the committee have been favoured. The Liverpool Salvage Association have been especially helpful in placing at the services of the Committee, year after year, for several days at a time, their useful steamer the "Hyæna," thus enabling us to explore some of the more distant parts of the district, to discover a number of rare and some new* animals, and to make many interesting observations.

The "Hyæna" is fitted up with the electric light, and has two Pilsen arc lamps (for deck or masthead) of 3000 candle power each, supplied by a Phoenix compound wound dynamo, which is worked by a Gwynne vertical engine of six horse power, and a number of smaller Edison-Swan submarine incandescent lamps of 50 to 100 candle

* One of these, a Copepod, dredged off the south end of the Isle of Man, has been named *Joncsiella hyænæ*, in honour of the old gunboat (see this vol., App. to third Rep. on Copepoda, p. 66).

power each, which can be lowered by means of a waterproof flexible cable to any required depth in the water. This fortunate circumstance has enabled us, on the expeditions to the Isle of Man, in May, 1888, and April, 1889,* to make a number of experiments with illuminated surface and bottom tow-nets at various depths from the surface of the sea down to thirty fathoms, which have convinced us that the electric light acts as an attraction to many of the free-swimming animals provided with eyes, such as the Copepoda, the Amphipoda, the Schizopoda, and especially the Cumacea, and may even bring them up to the surface from a depth of five fathoms.

The establishment of a small Biological Station on the uninhabited Puffin Island, off the N.E. coast of Anglesey, is certainly the most important event which has occurred in the history of the L.M.B.C. since the publication of the first volume. An account of the foundation of this seaside laboratory, and an outline of the work which has been carried on in it during the last two years, is given in the first two articles in this volume, while references to animals found around Puffin Island, and to observations made in the laboratory there, will be found scattered through nearly all the reports. Notwithstanding its distance from Liverpool, its almost complete inaccessibility except during calm weather, and the extreme and even forbidding plainness of its equipment, a number of the Committee and a few other biologists have paid periodic visits to the station, ranging from a few days to several weeks at a time, and have carried on investigations upon most of the groups of invertebrate animals found on the shores of the island. The establishment of this Biological Station on Puffin Island has not only been a great

* See the accounts in "Nature," for June 7th, 1888, and May 9th, 1889, and also further on in the present volume.

convenience to the Committee and a powerful incentive to work, but it has enabled us to make some series of continuous observations upon the rich fauna of that neighbourhood; for example, upon the Copepoda, and upon the Nudibranchiata and other moving Mollusca on the shores.

In the former volume of reports we recorded 913 species; with the additional species referred to in the present volume, this number is now brought up to 1456. Of these additions twenty-one have not been previously recorded in British seas, and nine (a Sponge, four Copepoda, two Amphipoda, a Polyzoon, and an Ascidian) are new to science.

Several reports which it was hoped would have been incorporated in the present volume have not yet been completed, and, along with certain morphological investigations which have been commenced upon the Nudibranchiata and the Tunicata and other groups, must stand over and form part of the subject matter of the next series of reports; amongst these are the Ostracoda, by Mr. W. S. McMillan, F.L.S., some of the Mollusca, by Mr. A. Leicester, and the Fishes, by Mr. T. J. Moore.

It only remains for me to express my indebtedness and cordial thanks to my friends and fellow workers who have taken part with me in the various dredging expeditions, in the exploration and colonization of Puffin Island, and in the preparation of these reports. All our thanks are especially due to our honorary treasurer, Mr. Isaac C. Thompson, F.L.S., who has taken a large share in the trouble and responsibility, and upon whose careful and judicious management of our slender resources the success of the Puffin Island establishment in a great measure depends.

W. A. HERDMAN.



L.M.B.C. BIOLOGICAL STATION, ON PUFFIN ISLAND.

The FOUNDATION and FIRST SEASON'S WORK
of the LIVERPOOL MARINE BIOLOGICAL
STATION on PUFFIN ISLAND.

By W. A. HERDMAN, D.Sc., F.L.S., F.R.S.E.,

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OF THE LIVERPOOL MARINE BIOLOGY COMMITTEE, AND DIRECTOR OF THE
PUFFIN ISLAND STATION.

[Read, in part, before the Liverpool Biological Society, 12th November, 1887.]

A FULL and detailed account of the constitution and objects of the Liverpool Marine Biology Committee having been published last year, as an Introduction to the first volume of Reports upon our local Fauna and Flora,* it is unnecessary now to do more than state that this committee was appointed in the spring of 1885, for the purpose of investigating thoroughly the animals and plants inhabiting Liverpool Bay.

During the summer of 1885 various expeditions were organised by the committee for the purpose of collecting specimens and making observations. Mr. George Holt, Sir James Poole, and the Liverpool Salvage Association gave most welcome aid by placing steamboats at the service of the committee for one or more days. By this means dredging and trawling expeditions to the neighbourhood of Hilbre Island, to Point of Ayr, to Llandudno, and to the neighbouring coasts of North Wales and Anglesey were successfully carried out; while, when steamers were not available, shore expeditions were made to examine Hilbre Island and other points in the estuaries of the Mersey and Dee at low tides.

* First Report on the Fauna of Liverpool Bay and the Neighbouring Seas. Longmans, 1886.

Hilbre Island is certainly one of the most interesting spots in the immediate neighbourhood of Liverpool, from a biological point of view, and has long been well known among local naturalists on account of its comparatively rich marine fauna.* The rocks at the northern end of the island are covered at and about low water mark by a large and varied assemblage of invertebrate animals, and form a particularly favourable locality for certain Hydroid Zoophytes, Actiniæ, Polyzoa, and Nudibranchs. Among the rare animals which have been found on the shores of Hilbre Island may be mentioned *Garveia nutans*, a zoophyte first found in this neighbourhood on the 9th May, 1885, on the first L. M. B. C. expedition; *Cylista undata*, var. *candida*, a new variety of sea-anemone, found by Dr. Ellis on the 11th July, 1885, and described by him in our First Report,† and the rare Nudibranchs *Doris proxima*, *Doris subquadrata*, *Eolis concinna*, *Embletonia pallida*, and *Antiopa hyalina*.‡

The interesting reef-building Annelid, *Sabellaria alveolata*, is found in abundance round some parts of the shore at Hilbre Island, usually near where the sand and rock join. It sticks the sand grains together to form the tubes in which it lives, and so produces a porous, crisp, but brittle rock, which crumbles to a certain extent when walked upon, but which is constantly being renewed and has its injuries repaired by the living worms within, and must therefore have a very considerable effect in protecting the rocks from the erosive action to which all sea coasts are exposed.

The masses, hummocks, plateaux, ledges and small

* See Byerley's "Fauna," Proc. Lit. and Phil. Soc., Liverpool. Appendix to vol. viii., 1853-54.

† See "Fauna of Liverpool Bay," Report on the Actinaria, p. 126.

‡ See Dr. Collingwood's lists in Ann. and Mag. Nat. Hist., 1859-61.

reefs of this gregarious rock-building Annelid have a curious external resemblance—superficial only, as in structure and mode of formation they are of course utterly different—to the forms produced by coral masses in lagoons and amongst coral reefs and islands. It might be possible by a continuous study, on the spot, of this *Sabellaria* at Hilbre to determine what part the various factors—food, currents, muddy water, presence of sand and rock, exposure to waves, and the arrangement of the animals in the mass—take in producing the various shapes and in promoting or retarding growth.

Another interesting piece of work which could be carried out at Hilbre, or at Puffin Island, would be to determine the various heights above low water mark at which the different kinds of marine animals and plants are able to exist. Many of the Zoophytes and other animals living about half-tide are found to be in a very dry and shrivelled up condition before the tide reaches them, but they revive and expand instantly on being placed in water. I have found the Polyzoon *Flustrella hispida*, at Hilbre Island, in a living and healthy condition only about a yard below high water mark. In such a position the animal must be exposed to the air during about five-sixths of its existence, and since its tentacles can only be expanded when covered with water the entire food supply must be taken in during the remaining one-sixth, at and about the time of high tide. The short opportunity of feeding will therefore only occur twice in each twenty-four hours, and during the long intervals the animal must remain in a contracted and possibly a somewhat dormant condition. It would be important to determine the precise nature of the food of *Flustrella hispida* at Hilbre, and whether it varies with different tides, winds and seasons; and an interesting series of experiments might be made by some

one living on the spot as to the greatest amount of periodic exposure to air which the animal can stand, and also as to what its habits would be if kept continually immersed in water.

So many lists of animals from Hilbre Island, and notes on habits and times of occurrence and other matters have now been collected, that the committee will soon be justified in drawing up from these materials a comprehensive account of the fauna of this isolated mass of rock surrounded on all sides by sand banks. This list when made out will be of considerable scientific interest, for comparison with the notes on the fauna of the island thirty to forty years ago, as recorded by Price and Byerley, and with lists which may be drawn up by other naturalists in the future. There is no doubt that some animals are now found at Hilbre which were not there formerly, and I fear some of the rarer Nudibranchs, which the late Mr. Price discovered, and sent to Alder and Hancock for incorporation in their well-known monograph, have now disappeared from the neighbourhood.

The animals which were collected during 1885 were preserved and stored in the Zoological Laboratory of University College, Liverpool, until the end of the summer. They were then roughly arranged into groups, such as sponges, zoophytes, sea-anemones, worms, molluscs, &c., and sent to those members of the committee and other naturalists who had undertaken to work up and report upon the specimens. This laboratory work went on during the winter 1885-86, and in the spring of 1886 the committee published their first volume of Reports,* containing twenty-nine articles, written by twenty-one authors, and illustrated by ten plates and two maps of the district. These reports record the occurrence of 913

* Fauna of Liverpool Bay, Report I. Longmans, 1886.

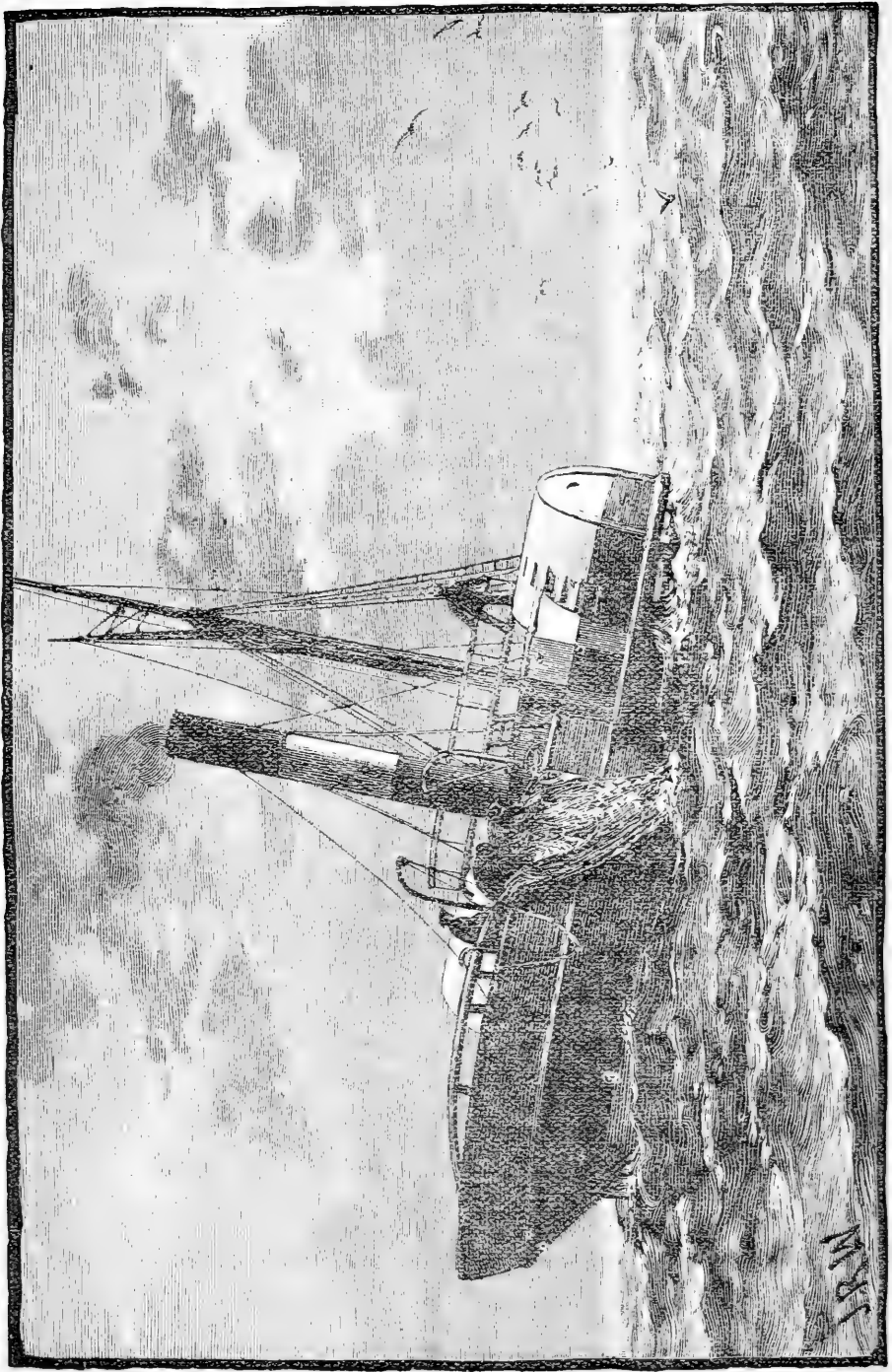


Fig. 1. Dredging in Liverpool Bay—Hauling up the beam-trawl.*

species,† of which at least 235 had not been found before in this neighbourhood. Sixteen of these species have not been previously discovered in British seas, and at least seven species and three varieties are new to science.

Field work was re-commenced in the spring of 1886. Dredging and other collecting expeditions were organized and new parts of the district explored. The steamer "Hyæna" was a second time lent by the Salvage Association for three or four days, and a series of dredgings along the north and west coasts of Anglesey was successfully carried out. The committee was aided financially by a small grant of £25 from the Government Grant Committee of the Royal Society.‡ This along with other funds received was employed in hiring steamers and other boats for expeditions, and in paying fishermen and others for assistance in collecting specimens.

During this second year's work it became obvious to the committee that in order to advance further in their work, so as to be able to make more minute explorations, and to carry on detailed investigations into the habits and life-histories of the animals, it would be necessary to establish a small sea-side laboratory or marine biological station at some suitable spot in the district. Such an institution would require to have a work-room where, say, four to six investigators could have light and room to carry on their researches, and some tanks or aquaria in which animals could be kept under observation in a living condition. If

* For the use of this woodcut, and of figures 2 and 6, I am indebted to the courtesy of Messrs. Cassell and Co. The original drawings were made in illustration of an article "On the Cruise of the Spindrift," by Mr. R. McMillan of Liverpool, which appeared in Cassell's Family Magazine for May, 1886.

† Since increased to over a thousand species.

‡ A second grant of the same amount has been received this year (1887), and employed in a similar manner.

only used in summer it might be made of wood, like the Dutch transportable station established in 1876 by Dr. Hoek, Professor Hubrecht and Dr. Hoffmann, and which was erected at some spot on the coast in summer, and taken to pieces and conveyed to Leyden in the winter; or like the marine station set up by Professor Cossar Ewart at Stonehaven, in 1879, and now at Tarbert on Loch Fyne. On the other hand, if observations are to be carried on all the year round, and if investigators are to live even for a few days at a time in the station, the building would have to be of a more solid and permanent nature.

At first Hilbre Island was thought by the L. M. B. C. to be the most suitable locality in the neighbourhood, and at such a spot a summer wooden station would probably have been sufficient. But further investigations showed that on account of the proximity to Liverpool, and of the constant muddiness of the water at the mouth of the Dee, Hilbre would not be a very favourable locality; while some spot in the centre of a still richer fauna—such as those of North Wales, Anglesey, or the Isle of Man—and in a part of the district which could not be investigated in a single day expedition would be more useful, and would do more to forward the objects which the committee have in view.

During the “Hyæna” expedition of June, 1886, while dredging in the deep water off the northern end of Puffin Island, some of the committee were impressed by the admirable position of the old Dock Board signalling station, on the seaward end of the island (see fig. 3), as a centre for investigating the fauna of the Menai Straits and of the coasts of Anglesey and North Wales. They decided to examine the island and the condition of the house, with the view of trying if possible to convert it into the much needed biological station.

On finding that the fauna on the shores and around the

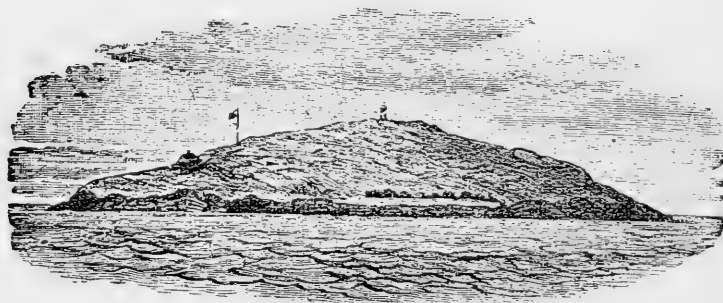


Fig. 2. Dredging in Liverpool Bay—Emptying the dredge on deck.

island was rich, and that the house, though destitute of doors and windows, was substantial, and could be easily put in good condition, the committee through one of their members, Mr. F. Archer, applied to the solicitor of the Dock Board for permission to convert the Puffin Island observatory into a biological station; and after some correspondence learned that the house had not been used by the Dock Board for over twenty years, and had now lapsed into the hands of the owner of the island, Sir Richard Williams Bulkeley of Baron Hill, Beaumaris. Mr. Archer now applied to Sir R. Bulkeley's agent, Mr. Laurie, through Mr. R. R. Rathbone, and found that the use of the building had been promised some years before to the towns of Bangor, Beaumaris, Conway and Carnarvon, for the purpose of a cholera hospital, if required. This led to further correspondence and a delay of some months; but,

finally, in the spring of 1887, Mr. Archer was able to report to the committee that Sir Richard Bulkeley had kindly consented to let the L. M. B. C. have the use of the house on Puffin Island, as a biological station, at a nominal rent. A few members of the committee went down to the island in March, 1887, in order to examine carefully the condition of the house, and decide what should be done in the way of repairs.

Puffin Island, or St. Seiriol's Isle, or Priestholm, as it is variously called, was then an uninhabited island, with two more or less ruinous buildings:—an old square tower with a pyramidal stone roof, near the centre of the island, and supposed to be the remains of an ecclesiastical building dating back to the twelfth century; and the former Dock Board observatory, a substantial brick and stone building, erected in 1841, and standing close to the cliff on the seaward or northern end of the island (see fig. 3).



Biological Station.

Old Tower.

Fig. 3. Puffin Island from the North.*

The island is about five-eighths of a mile in length and 300 yards in greatest breadth. It is separated from the

* For the use of this woodcut, and of figures 4 and 5, I am indebted to the courtesy of Messrs. Macmillan and Co. The original drawings were made as illustrations for my article on Puffin Island, which appeared in "Nature" for July 21st, 1887.

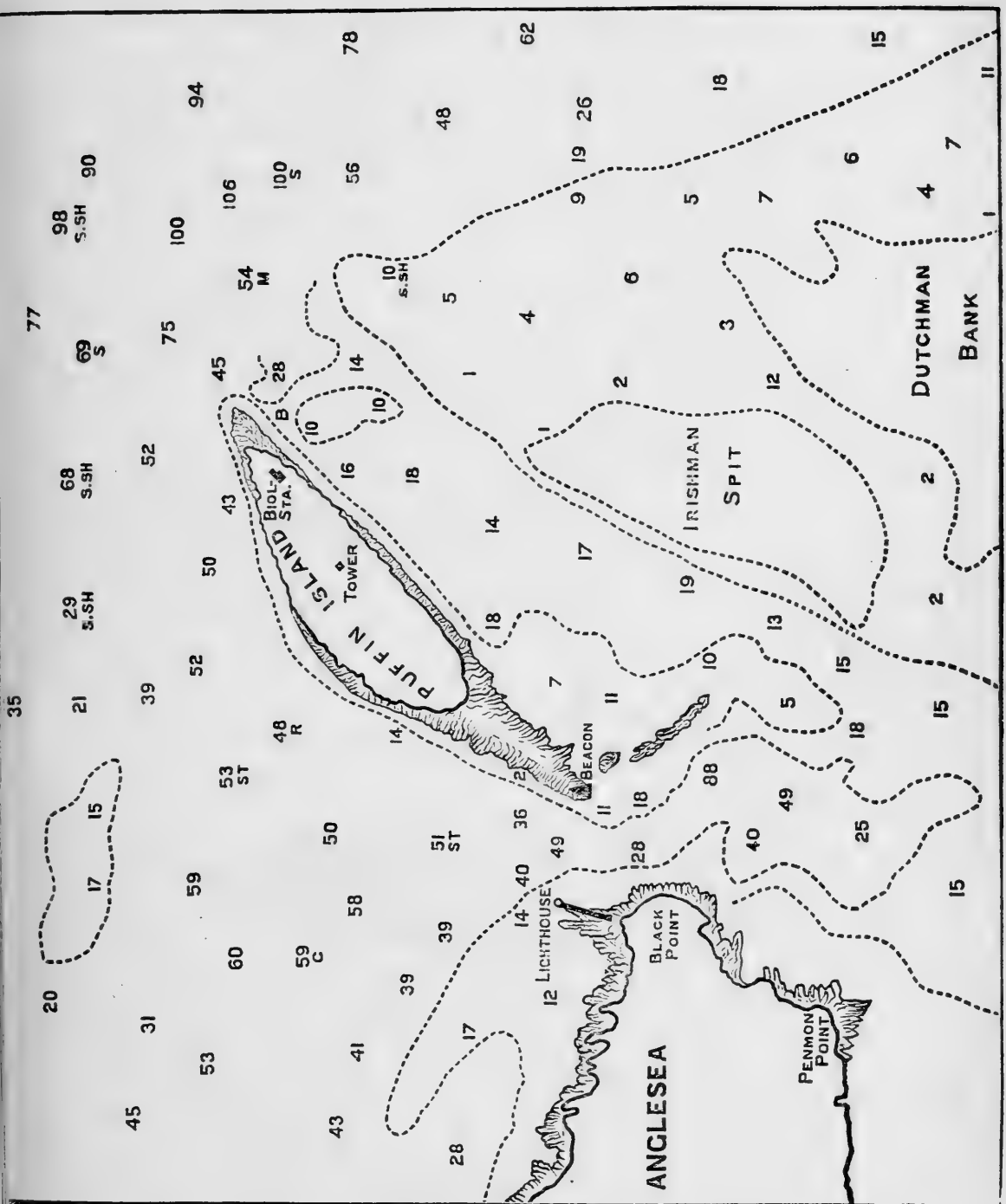


Fig. 4. Chart of the Neighbourhood of Puffin Island. Scale $\frac{1}{24300}$. Depths in feet.

nearest point of Anglesey* (Penmon) by a strait nearly a mile wide, through which the tide runs with considerable force. There are limestone† cliffs round the greater part of the shore, and between tide marks the rocks are considerably broken up and worn, so as to form numerous shore pools, caves and crevices, in which animals abound. The littoral area is rather narrow along the sides of the island, but at the two ends it is of considerable extent. At the south end especially (see Chart, p. 47) it runs out to form a long narrow curved spit, uncovered at low tide, and formed by fragments of rock, boulders and gravel. The larger stones are piled upon one another in such a way as to leave little crevices, nooks, and sheltered pools in which the most fragile organisms can live and flourish protected from the force of the waves and the scour of the sand. This is a rich collecting ground, and many of the rarer animals which have been found during this last summer on Puffin Island were obtained under the stones on this part of the shore.

The former Dock Board observing station was used from 1841 to 1863 for the purpose of watching outgoing and incoming vessels, and of signalling the news by semaphore to the next station on the Great Ormes Head. It consists of a one-storied square house (see fig. 5) of four rooms, with the chimneys in the centre, large lofts above, and a long observatory running out seawards from the northern end. There is a narrow flagged yard in front of the door,

* The nearest neighbours to the Biological Station are the inhabitants of the Lighthouse on this corner of Anglesey. The committee desire to express here their thanks to Mr. J. Steer, the head keeper, for the friendly interest he has taken in their work, and for his kindness in receiving letters and parcels for the Island and for helping in various other ways.

† For an account of the Geology of the Island, see a paper by Mr. Gregory, F.G.S., of the British Museum, further on in the present volume.

and a couple of small outhouses. The walls are unusually thick, and the roofs and floors are in excellent condition.

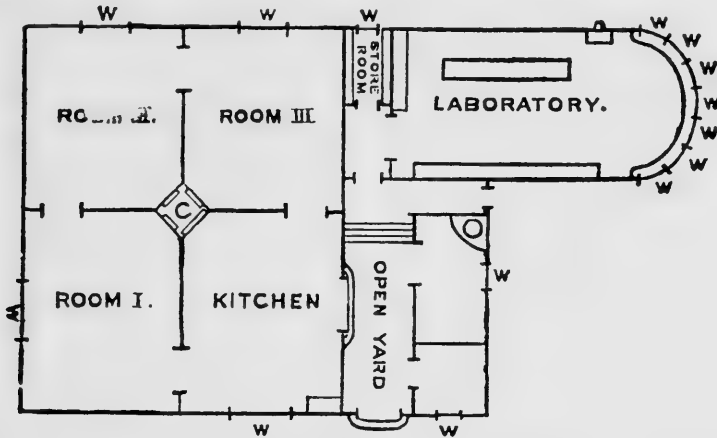


Fig. 5. Plan of the Biological Station. w, w, windows; c, chimneys.

The small party of naturalists who visited the island in March, 1887, for the purpose of inspecting the house, and deciding upon the repairs and changes necessary in order to convert it into a biological station, were most favourably impressed with the surroundings in every respect. Fortunately, perhaps, for the success of the scheme, the weather was perfect. The sea was calm, and during the row of seven miles from Bangor several casts of the tow-net which were taken showed the presence of a large amount of surface life; while a few hauls of the dredge* made near the island proved that the fauna at the bottom was also abundant, and was interesting in its character. The view of the surrounding land and sea was peculiarly charming. The bright sparkling spring day, the cloudless sky, the snow-clad Welsh mountains glistening in the sun, and the calm blue sea encircling the solitary little island, with its old grey tower rising from the summit, formed altogether a picture never to be forgotten, and perhaps contributed not a little, along with our zoological captures, to the energy

* Fig. 6, on p. 60, shows the dredge.

and unanimity of our determination to report favourably of Puffin Island, and push on the establishment of the biological station without further delay. After a rapid inspection of the island, and a careful examination of the house, all the necessary plans and measurements were made, and we returned in our boat to Bangor.

A joiner was kept hard at work during the next three weeks, in the workshop of the zoological department of University College, making the necessary doors, windows, shutters, shelves, tables, and other fittings for the station; while the committee purchased a few camp beds, hammocks, sailors' mattresses, chairs, kettles and pots, dishes, and other household necessaries for the equipment of the station. When all was ready, the Liverpool Salvage Association again placed their useful steamer, the "Hyæna," at the service of the committee, and a party of about twenty naturalists, with two workmen and all the fittings and furnishings, were conveyed on 27th May, 1887, to the Menai Straits, where they anchored for the night, near Beaumaris.

On the morning of 28th May, the "Hyæna" made an early start, and reached the neighbourhood of Puffin Island about six a.m. To the great disappointment of the whole party, a heavy sea was breaking on the rocks, and after a cruise round the island, in the vain attempt to find a piece of lee shore, Captain M'Lellan decided that it would not be safe to land in the boats. The naturalists being very unwilling to lose the day, the "Hyæna" was kept in the neighbourhood of the island for some time, and fortunately as the tide ebbed sufficient amounts of the "Dutchman" and "Irishman" sandbanks were exposed to form a break-water protecting the gravel beach at the southern end of the island from the force of the waves. On this spot, at nearly low tide, on the very opposite end of the island

from the house, the tables, chairs, planks, shelves, doors, shutters, windows, beds, packing cases, barrels, tins of paint, sixteen large sacks of coals, and innumerable smaller objects and packages were landed in boat loads, and had to be carried against a strong wind up one end of the island, along the top, and down the other end.

This work kept the whole party hard at work till dark; while the joiners were engaged in putting in doors and windows, so as to have at least one room of the house weather tight before night. A large fire was then lit; camp-beds, hammocks, and shake-downs on reversed tables, doors, shutters and packing cases were prepared, and the party encamped for the night. During the two following days the work went on vigorously, and when, on the 30th May, the committee and their friends returned to Liverpool, the house was in a habitable condition, and the shelves and tables were being fixed in their places. The two joiners were left on the island for a couple of weeks, to complete the fittings, and repair the observatory, which was to be in future the biological laboratory (see fig. 5, p. 49). This room is lit by a continuous series of seven windows, forming a semi-circle round the northern, seaward end; in these there were over a hundred broken panes to be replaced.

The committee engaged as keeper of the station one of the sailors of the "Hyæna," and he was sent down to the island on 3rd June, in charge of a small boat, which had been bought for use at the island. He relieved the joiners, who had then finished their work, but after staying at the station for two weeks, he resigned his post. The committee then chose, from a large number of candidates, the present energetic young keeper, Mr. Alexander Rutherford, who commenced work at the station on 18th June. During the rest of the summer, up to the end of September, a lad

was also engaged to assist the keeper in the work of looking after the station and boat, and of attending to the biologists who visited the island.

The biological station was now fairly established, and during the remainder of the summer work of various kinds was going on steadily. Members of the committee and other scientific men visited the station for periods varying from a day or two to a week or two at a time. During these visits the shores of the island were explored at low tides, tow-nettings and dredgings were taken in the neighbourhood when practicable, and the animals collected were examined and classified in the laboratory. At other times the keeper, when his other duties and the weather permitted, collected specimens by dredging and tow-netting, and on the shore. These he preserved and labelled with locality and date, and either stored in the laboratory or sent to University College, Liverpool, as required.

Shore collecting on Puffin Island on a summer morning, with a low ebb tide, is most delightful work. The naturalist explores the deep crevices and pools in the limestone reefs, lifts up or turns over the smaller of the detached fragments of rock and creeps under the larger ones, peering curiously into all the corners and crannies, and probably oblivious of the pool in which he has placed his knees and of the stream of drops which is trickling down the back of his neck. He sees covering the lower surface of the stones and festooning the rock delicate sprays of beautifully shaped Zoophytes, elaborately sculptured Polyzoa, and masses of incrusting Sponges with gorgeous colouring. He sees strange looking masses of Ascidians, which if incautiously touched suddenly emit two tiny jets of water, thus vindicating their claim to the title of "sea-squirts." These and various other marine animals—especially the sea-anemones and the Nudi-

branches—almost defy description; they must be seen to be appreciated.

It is proposed to divide the littoral zone of the island into several regions or sub-zones, and investigate the Fauna and Flora of each separately, so as to determine their characteristic animals and sea-weeds, and the relative capacities the different species possess for withstanding exposure to air and sunshine. At the northern end of the island, close to the Biological Station, some of the larger rock-pools might be easily converted into natural aquaria, enclosed with wire netting, so as to exclude stones and sea-weed and prevent the animals placed in the pools from escaping at high tide. The water in these aquaria would be renewed at every tide, and the animals would be under natural conditions and yet could be easily watched, and caught when necessary for closer examination. Many of the Zoophytes and Polyzoa seem to adhere in greater numbers and grow to a larger size on fragments of water-logged wood from wrecks than on the stones. Such pieces of wood, as well as other suitable substances, and also various glass vessels could be readily suspended in these rock-pool aquaria, and so be available when required for examination. These and various other methods for facilitating the study of the shore Fauna we intend to carry out during the coming summer.

The following biologists have worked at the station since its establishment in the beginning of June, 1887:—

Mr. J. A. Clubb, Assistant in the Zool. Lab., Liverpool.

Dr. Ellis, Liverpool.

Mr. Harvey Gibson, Lecturer on Botany, Liverpool.

Mr. Gregory, F.G.S., British Museum, London.

Dr. Hanitsch, Demonstrator of Zoology, Liverpool.

Professor Herdman, Liverpool.

Mr. Leicester, Liverpool.

Mr. Lomas, Liverpool.

Dr. Paul, Liverpool.

Mr. I. C. Thompson, F.L.S., Liverpool.

Mr. A. O. Walker, F.L.S., Chester.

Various other scientific men have visited the station without doing any special work, and on the 3rd September a party of biologists from the Meeting of the British Association at Manchester—including Professor Fritsch, Prague; Prof. Giard, Paris; Prof. Julin, Liège; Prof. Howes, London; Prof. Parker, Cardiff, and others—visited the island for a short time, and inspected the biological station, while on a dredging expedition in the steamer "Gamecock."

Besides the collecting and identifying of specimens, work which we have all of us been engaged in more or less, various pieces of research have been commenced and are partially or wholly completed. Mr. Lomas has been investigating the Polyzoa, and has found some rare forms new to the locality. He has also been working at some points in the structure of *Alcyonidium gelatinosum*, a large fleshy Polyzoon which is very common attached to the rocks near low water. He has found calcareous spicules in the outer jelly-like part of the colony, and has also made observations upon some other points in the minute structure of this interesting animal (see his papers read before the Biological and Geological Societies of Liverpool).

Mr. Leicester has been collecting and examining the land Mollusca of Puffin Island (see paper read before the Biological Society), and is also working at the marine Rotifera.

Mr. Gregory, of the British Museum, besides preparing a report upon the geology of the island, has been investigating the Annelids (see papers read before the Biological Society), and will take charge of this group in future.

Dr. Hanitsch has commenced some researches upon the minute structure of some of the Mollusca.

Mr. Thompson has taken charge of the surface life of the sea, and has been specially investigating the Copepoda, a group of small Crustacea.

These animals and many others, including the larval stages and other young forms of vast numbers of animals which are fixed or live at the bottom of the sea when fully developed—such as barnacles, crabs, molluscs, annelids, polyzoa, star-fishes, sea-urchins, and zoophytes—are found swimming at or near the surface of the sea, and form a most important part of the marine Fauna. They are captured by means of the tow-net, a long conical bag of canvas, silk-gauze or strong muslin, attached to an iron hoop about a foot in diameter, and tapering to a closed end, into which a small glass bottle or tube may be inserted if required. The tow-net is let down over the stern of the steamer when going slow, and is dragged along just below the surface of the water for half an hour or so. It is then pulled on board and turned inside out into a glass vessel of sea-water, when the minute organisms which have been captured become detached from the inner surface of the net and float about in the water, from which they can then be removed by a fine glass dipping tube and placed in a watch-glass of sea-water under the microscope.

Generally the contents of the tow-net are very largely composed of Copepoda, small Medusæ or jelly-fishes, and larval stages in the development of other animals; but at certain times Mr. Thompson has noticed* the presence of an extraordinary number of small spherical gelatinous

* See "Nature," for 23rd July, 1885, under heading "Foul Water." Mr. Shrubsole has noticed the same condition off Sheerness, and Professor McIntosh describes it also as occurring in St. Andrew's Bay (Ann. and Mag. Nat. Hist., Aug., 1887).

bodies, which are apparently lowly developed plants, in the surface waters round Puffin Island and at the mouth of the Dee. Associated with these are found large quantities of *Noctiluca*, the organism which causes a great deal of the phosphorescence of the sea round our coasts, but as a rule when the gelatinous Algæ are present very few of the ordinary surface animals such as Copepoda are found in the tow-net.

Besides discovering a large number of species of Copepoda, including various rare forms (see his papers in Proc. Biol. Soc.), Mr. Thompson has found four species new to British seas, and two others which have not been found for fifty and thirty years respectively, while the following three species are new to science : *

1° *Cyclops puffini*, n. sp. (I. C. T.)

This form was first found in a tow-netting by Mr. Thompson, taken from the steamer "Gamecock," during the visit of the British Association to Puffin Island, on 3rd September, 1887. It has since been found in tow-net gatherings taken by the keeper round the shores of the island.

2° *Lichomolgus sabellæ*, n. sp. (I. C. T.)

This is an exceedingly interesting parasitic species, which was found by Mr. H. C. Chadwick adhering to the tentacles of an Annelid, *Sabella penicillus*, obtained on the shore near Beaumaris. The posterior antennæ of the Copepod are remarkably modified, and are provided with powerful hooks by means of which it attaches itself so firmly to the tentacles of the Annelid, that even after being killed and preserved in alcohol it is only with difficulty that it can be removed from its host.

* For detailed descriptions and figures, see Mr. Thompson's paper further on in this volume.

3° *Scaphosoma herdmani*, n. sp. (I. C. T.)

A very remarkable form, with a long narrow body. It was first found in a tow-net gathering taken off Puffin Island, on an autumn night this year, and was at once recognised as being an interesting new species belonging to the new genus *Scaphosoma*, founded by Mr. Thompson, in a paper on the Copepoda of the Canary Islands, read before the Linnean Society of London, on 17th November, 1887, for the reception of the new species *Scaphosoma rigidum*, which he had found on the surface off Teneriffe. Curiously enough, another specimen of *Scaphosoma herdmani* has since been found in a tow-net gathering taken in the Mediterranean, off Malta, by Dr. D. Bruce, and sent to Mr. Thompson for examination. So that single specimens belonging to the new genus *Scaphosoma* have been found lately in such far distant localities as Puffin Island, Teneriffe, and Malta.

Some of the more interesting Copepoda found round Puffin Island have been taken in the night. The distribution of these surface organisms, both according to the time of the day and season, and also according to the depth, is still very imperfectly known. There is great need of some simple yet efficient contrivance by which a tow-net could be let down closed to a certain depth, then be opened and used at that depth, and then be closed again and hauled up, so as to ensure that all its contents were really obtained from a certain stratum of water. The "Turbyne" tow-net, devised and used at the Scottish Marine Station, Granton, seems but a rough and imperfect form of the desired instrument, and would probably give only approximately correct results.

In the beginning of October, a meeting of the L. M. B. Committee was held at University College, to receive a

report upon the work that had been done during the summer, and to decide upon future plans. Altogether nearly £140 had been received during the summer, in the form of donations,* and the greater part of this had been expended in repairing and fitting up the station, and in paying the wages of the keeper and his assistant. A small steam-launch, the "Puffin," twenty-six feet in length, had also been obtained, but as stormy weather had already set in, it was thought best not to take the little vessel down to the island till spring. She is now in dock, and it is hoped that she will be of great service next summer in keeping up communication from the station with Beaumaris and Bangor, and for dredging round the island.

One of the most important matters to be settled by the committee was whether or not the station should be closed up during the winter. For several reasons it was thought very desirable to keep it open all the year round—so as to be able to obtain specimens in various stages of development, and so that observations could be made upon the winter as well as the summer fauna of the shores and of the surface waters of the sea—and as Mr. Rutherford, who had recently married, offered to carry on his duties as keeper during the winter without an assistant, the committee decided it should not be closed, so long as the funds at their disposal sufficed to pay the working expenses.

Since the beginning of October there have been few visitors at Puffin Island. Although in summer the island is easily reached from Liverpool by means of the fast steamers from the landing stage to Beaumaris, in winter it is rather difficult of access and the journey is long and troublesome. One has to take train by Chester and North Wales to Bangor, and then either proceed by coach round by Menai Bridge to Beaumaris, or walk to Garth Ferry,

* See list, p. 63.

cross the Straits and then walk or drive two miles to Beaumaris. If the weather is favourable the boat from Puffin Island can come up to Beaumaris, but when that cannot be managed a further walk or drive of four miles to Penmon Point is necessary.

During the gale of 1st November, the flat "Myra," of Runcorn, was wrecked upon the rocks near the south end of the island, and our keeper, with the assistance of two rabbit-catchers, succeeded in lowering a rope to the vessel and hauling two men up the cliff—a boy was unfortunately drowned. The men were kept at the station until the gale was over, and were then taken in the boat to the mainland.

At the beginning of December I visited the island for a few days, with the object of examining the fauna on the rocks in winter, and also in order to see that all was going on well at the station. I found that Mr. and Mrs. Rutherford had been working hard to improve the condition of the house and the laboratory, and were performing their duties with energy and with an intelligent interest in the work. When the weather permitted, tow-net gatherings were taken, sometimes in the daytime and sometimes at night. These were carefully preserved and labelled, with the locality, date, and other conditions, and were forwarded to Mr. Thompson, for examination. The dredge was also used when possible, and the shores were explored at low tides. During the late autumn and winter the phosphorescence in the sea has sometimes been exceedingly brilliant. It appears to be always due in this neighbourhood to *Noctiluca miliaris*, which is frequently present on the surface in great abundance.

This work will be carried on systematically during the remainder of the winter, and the specimens so collected will form a most valuable mass of material for detailed investigation and for comparison with the marine fauna

found in summer. A good deal of what has been collected at Puffin Island during the summer, autumn, and early part of winter, has already been separated into groups and sent to the various specialists to be worked up.

One or two of our Liverpool naturalists may possibly be working at Puffin Island during the Christmas vacation, and several biologists and students have already intimated their intention of making use of the station during Easter. About that time the steam-launch will probably be taken down, and the dredging expeditions of the committee will be resumed.

From this account of the first season's work at our biological station it is evident that the institution has already begun to be of service to science, and may be confidently expected in the future—if the committee are properly supported in their efforts—to be a great boon to students of natural science in this neighbourhood. In addition to the support which the members of the committee can give in money, apparatus, and other supplies, a small fixed income of about £100 a year will be sufficient to meet the bare working expenses on the present modest scale. This might be provided (1) by raising a permanent endowment; (2) by a sustentation fund for, say, five years; or (3) by yearly subscriptions. The committee have not yet decided upon a definite plan of action for next year, but in the meantime subscriptions or donations will be gladly received by the Hon. Treasurer, Mr. Thompson, 19, Waverley Road, Liverpool.

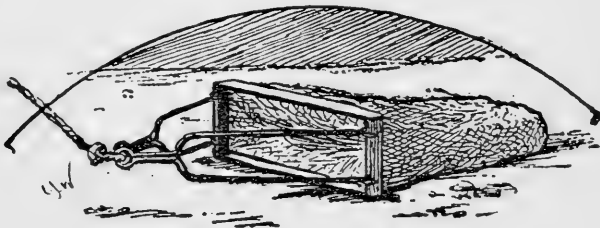


Fig. 6. The dredge.

LIST OF DONATIONS.

Mr. George Holt	£50	0	0
Duke of Westminster	5	0	0
Earl of Derby	5	0	0
Dr. Drysdale	5	0	0
Mr. H. Rees Davies.....	5	0	0
Mr. I. Roberts, F.G.S.....	5	0	0
Mr. A. O. Walker, F.L.S.	5	0	0
Sir James Poole (Mayor)	3	3	0
Prof. Mitchell Banks	3	3	0
Mr. H. W. Gair.....	3	3	0
Mr. Malcolm Guthrie	3	3	0
Mr. W. G. Scott	3	3	0
Mr. F. Archer	2	2	0
Prof. Herdman	2	2	0
Mr. T. D. Hornby.....	2	2	0
Mr. C. W. Jones	2	2	0
Mr. E. K. Muspratt	2	2	0
Mr. W. S. McMillan.....	2	2	0
Mr. W. Rathbone, M.P.	2	2	0
Mr. T. Rathbone, F.L.S.	2	2	0
Mr. A. Norman Tate	2	2	0
Prof. Campbell Brown.....	2	0	0
Mr. W. B. Halhed	2	0	0
Mr. F. Massey	2	0	0
Dr. Bark.....	1	1	0
Mr. Nath. Caine	1	1	0
Mr. T. Holder	1	1	0
Mr. A. Leicester	1	1	0
Mr. T. J. Moore	1	1	0
Mr. W. Nicol.....	1	1	0
Mr. I. C. Thompson, F.L.S.	1	1	0
Dr. Weightman.....	1	1	0
Dr. Caton	1	0	0

Rev. H. H. Higgins	1	0	0
Mr. R. R. Meade-King.....	1	0	0
Miss Lushington	1	0	0
Mr. R. R. Rathbone.....	1	0	0
Mr. D. W. Main	0	10	6
Mr. H. K. Smith	0	10	6
Mr. Seth Wrigley.....	0	10	6
Dr. Barron.....	0	10	0
Mr. Cedric Boulton	0	10	0
Mr. A. Fergusson	0	10	0

The following pieces of apparatus or furniture have also been given to the station:—

Stove for laboratory.....	Sir James Poole.
Microscope with three Hartnach objectives, some dissecting instruments, and other laboratory necessities ...	Prof. Herdman.
Dissecting microscope	Dr. Weightman.
Tables, chairs and chest of drawers ...	Mr. A. Leicester.
Paraffin stove.....	Mr. Harvey Gibson.
Large filter.....	Salvage Association.
L. M. B. S. flag.....	Mrs. Ellis.
Pennington's "British Zoophytes."	Mr. J. Lomas.
Four large iron fenders	Mr. J. Vicars.
Sprit sail for boat	Mr. A. Rutherford.
Large screen	Mr. I. C. Thompson.

SECOND ANNUAL REPORT of the LIVERPOOL
MARINE BIOLOGICAL STATION on
PUFFIN ISLAND.

BY W. A. HERDMAN, D.Sc., F.L.S., F.R.S.E.,

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

[Read 9th November, 1888.]

THE Report upon the foundation and first season's work of the Puffin Island Marine Biological Station which was read before this society at the corresponding meeting to this one in last session, brought the account of the affairs of the station up to December, 1887. Since then the usual work has been carried on steadily during the past year, without break and without any very striking feature. The committee are glad to be able to report that the station has been largely taken advantage of during some of the spring and summer months, and that as a result a great mass of material has been collected, and a good deal of practical work has been carried on.

The following biologists have visited and worked at the station since the opening in the end of May, 1887 :—

DATE.	NAME.	WORK.
1887.		
May.	A. O. Walker, F.L.S., Chester	Amphipoda and higher Crustacea.
..	Dr. Ellis, F.E.S., Liverpool	Actiniaria.
...	R. J. Harvey Gibson, M.A., F.R.S.E., University College, Liverpool	Algæ.
...	Prof. Herdman, D.Sc., F.L.S., University College, Liverpool	Tunicata and general.
...	J. Lomas, A.N.S.S., Liverpool	Polyzoa.
...	J. A. Clubb, University College, Liverpool...	General.
...	J. Vicars, Bootle	Nudibranchiata.
...	Prof. Reginald W. Phillips, B.Sc., University College, Bangor	Algæ.

DATE.	NAME.	WORK.
1887.		
<i>June.</i>	Prof. F. T. Paul, University College, Liverpool.	General.
...	I. C. Thompson, F.L.S., Liverpool	Copepoda and other surface animals.
...	Prof. Herdman, Liverpool	Tunicata and general.
...	J. A. Clubb, University College, Liverpool...	General.
<i>July.</i>	J. Lomas, Liverpool.....	Polyzoa.
...	Prof. Herdman, Liverpool	Tunicata, &c.
...	R. J. Harvey Gibson, Liverpool.....	Algæ.
...	J. A. Clubb, University College, Liverpool ...	General.
<i>August.</i>	J. W. Gregory, F.G.S., British Museum	Annelids, &c.
...	Dr. R. Hanitsch, University College, Liverpool.	Mollusca, &c.
...	Alfred Leicester, Liverpool	Mollusca and Rotifera.
...	J. A. Clubb, University College, Liverpool ...	General.
<i>Sept.</i>	J. W. Gregory, F.G.S., British Museum	Annelids, &c.
...	Dr. R. Hanitsch, University College, Liverpool.	Mollusca, &c.
...	Alfred Leicester, Liverpool.....	Mollusca and Rotifera.
...	I. C. Thompson, F.L.S., Liverpool	Copepoda, &c.
...	A. O. Walker, F.L.S., Chester	Amphipoda, &c.
...	Prof. Herdman, Liverpool	Tunicata, &c.
...	J. A. Clubb, University College, Liverpool ...	General.
[On September 3rd, a party of biologists, from the meeting of the British Association at Manchester, visited the station.]		
<i>Dec.</i>	R. McMillan, Liverpool	General.
...	Prof. Herdman, Liverpool	Tunicata, &c.
1888.		
<i>March.</i>	R. J. Harvey Gibson, Liverpool.....	Algæ.
...	W. R. Melly, University College, Liverpool...	Hydroida.
...	Prof. R. W. Phillips, Bangor.....	Algæ.
...	W. H. Gardner, University College, Liverpool.	General.
...	Dr. R. Hanitsch, University College, Liverpool.	Odontophores of Gastro-poda and general.
...	Prof. Herdman, Liverpool	Tunicata, &c.
<i>April.</i>	Prof. R. W. Phillips, Bangor, and two students from University College, Bangor	Algæ.
...	W. R. Melly, University College, Liverpool...	Hydroida.
...	Dr. R. Hanitsch, University College, Liverpool.	Odontophores of Gastro-poda and general.
<i>June.</i>	I. C. Thompson, F.L.S., Liverpool	Copepoda, &c.
...	R. McMillan, Liverpool	General.

DATE.	NAME.	WORK.
1888.		
<i>June.</i>	Prof. Herdman, Liverpool	Tunicata.
...	Dr. Thomas, Llandudno	General.
<i>July.</i>	F. Victor Dutton, Chester	Algæ.
...	C. Timmins, Runcorn	Dredging.
...	C. Herbert Hurst, Owens College, Manchester.	Polyzoa, Nudibranchs, and general.
...	Prof. Herdman, Liverpool	Tunicata and general.
<i>August.</i>	C. Herbert Hurst, Owens College, Manchester.	Polyzoa, Nudibranchs, and general.
...	S. Nowell, University College, Liverpool	General.
...	J. A. Clubb, University College, Liverpool ...	General.
...	Prof. Reginald Phillips, Bangor.....	Algæ.
<i>Sept.</i>	C. Herbert Hurst, Owens College, Manchester.	Polyzoa, Nudibranchs, and general.
...	Prof. Herdman, Liverpool	Tunicata and general.
...	A. O. Walker, F.L.S., Chester	Amphipoda, &c.
...	H. Horrocks, Owens College, Manchester ...	General.
...	J. A. Clubb, University College, Liverpool...	General.
...	Prof. Reginald Phillips, Bangor.....	Algæ.
...	A. T. Allen, Owens College, Manchester	General.

There are two important functions which a biological station like ours may be expected to perform. The first is to afford opportunity to the younger biologists and students of the neighbourhood of making themselves acquainted with marine animals and plants, alive and in their natural conditions, and of learning how to investigate a fauna, and how to conduct research work in general. Looked at from this point of view, although the Puffin Island Station has been fairly successful during the past year, there is room for considerable improvement. We have had a few students from University College, Liverpool, a couple from the Owens College, Manchester, a couple from the North Wales College at Bangor, and one from the Grosvenor Museum, Chester; but still, during a considerable part of the fine weather of summer, the best time of the year for work at such an institution, there was frequently accommodation for

more workers, and sometimes the laboratory was unoccupied. The committee would be glad to see the station taken advantage of to the fullest extent by the students of the neighbouring colleges.*

The second important function of such a biological station is to procure supplies of specimens of the various groups of animals required by the specialists who are engaged in working up the Fauna and Flora of Liverpool Bay. And it is in this direction that the Puffin Island institution has done most service to science. It is a singular and most encouraging circumstance that on, I believe, every visit of members of the L. M. B. Committee to the island their dredging and tow-netting operations have been rewarded by the capture of one or more species new to the district, and in many cases new to the British Seas; while several species new to science have been found during the past year.

Mr. A. O. Walker, F.L.S., who has charge of the higher Crustacea of the district, and who is now engaged upon a report which we shall have before us at a future meeting of the society, informs me that twenty-two species new to our fauna have been added in his department, including one or two new to the British seas, two Amphipods probably new to science, and three species of Cumacea, all new to our district.

Mr. I. C. Thompson, F.L.S., reports, in regard to the Copepoda, that since his last paper (written in November, 1887) in our recently published volume of Proceedings, the tow-net gatherings made by members of the committee, or by the curator of the station, Mr. Rutherford,

* Students of any of the above-mentioned colleges are offered lodging and the use of the laboratory at the station at the rate of ten shillings per week. Four simple meals—breakfast, dinner, tea, and supper—are provided by the curator at about cost price, averaging three shillings a day.

have yielded—two species new to science, one (*Pontella kroyeri*) new to British seas, and eight other species new to the district. Of the two new to science, the one is a Lernæan, while the other belongs to the interesting new family of the Cymbasomatidæ which has been lately established by Mr. Thompson. The first known species of *Cymbasoma* was *C. rigidum*, found at the Canary Islands in 1887 by Mr. Thompson, and shortly afterwards in the Mediterranean by Dr. Bruce, of Malta. Then a second species of the same genus, *Cymbasoma herdmani*, was described last year by Mr. Thompson from specimens found round Puffin Island. Since then this species has been found in large numbers by Mr. Sinel at Jersey, and by Mr. W. S. McMillan at Torbay. Lastly, a recent tow-net gathering sent by Mr. Rutherford from Puffin Island contains a specimen of what must be regarded as a third species of the genus *Cymbasoma*. For all of these discoveries and additions to our fauna we are indebted to the Puffin Island Biological Station.

The chief events of the year have been as follows:—The small steam launch, which was referred to in our last Report as having been acquired for the station, has, unfortunately, proved a total failure. It was taken down to Puffin Island early in the year, but met with a series of mishaps, such as running on a reef of rock, filling, and sinking near the lighthouse on Penmon Point, and finally developed a leak in the fire hole, which would have rendered extensive repairs necessary. It soon became evident to the committee that on account of the numerous reefs and sand-banks around the island, the strong currents, and the total absence of any shelter along the coast line, the launch was quite unsuitable for the situation and beyond the powers of the very limited staff and appliances at the station. She has now been taken up to Beaumaris,

and the committee are endeavouring to dispose of her, with the view of obtaining in her place a small sailing boat.

During the gale of last week the station met with a serious mishap in the total loss of the very useful rowing boat, which has been in constant service since June, 1887. The boat was carried away from her anchorage on the night of 1st November, and was washed ashore in pieces at Penmon Point on the following day. Although the very limited amount of the funds in the Treasurer's hands did not warrant any such expenditure, still on an island a boat is, of course, indispensable, so a new one has been purchased and sent down to the station.

Turning now to the more scientific part of the year's record, we find that, during Easter, Mr. Harvey Gibson, Dr. Hanitsch, Mr. W. R. Melly and Professor Herdman visited the station, and although they were occasionally driven into the laboratory from the rocks by a biting north-east wind and showers of sleet, and on one day had the whole island covered by a layer of snow, still a good deal of shore and laboratory work was carried on, and one good day's dredging off the north end of the island (see chart,* Turbot Hole) was obtained, which yielded, amongst other things, twenty-one species of Amphipoda and Isopoda, of which seven are new to our fauna.

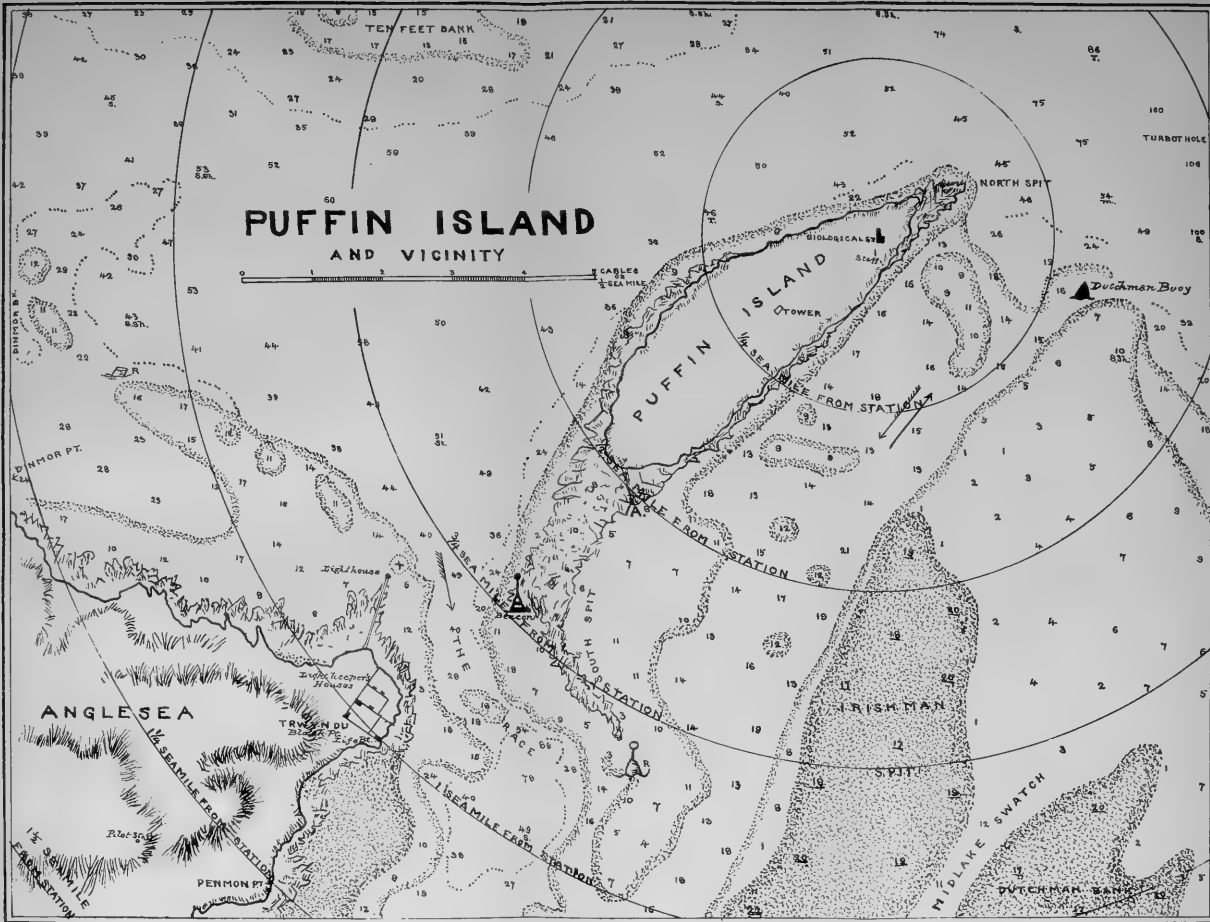
In June, Mr. Thompson, Mr. McMillan and Professor Herdman visited the station, and collected, amongst other things, *Calliopius norvegicus*, an Amphipod which is new to the British lists.

At the end of July, Mr. Hurst, of Owens College, Mr. Dutton, of Chester, and Professor Herdman did a good deal of collecting, and obtained *Calliopius norvegicus* again, an undetermined *Lysianassa*, and other species

* The chart of Puffin Island and the neighbourhood which accompanies this report was very kindly drawn for me by Mr. S. Nowell, Junr.

PUFFIN ISLAND AND VICINITY

0 1 2 3 4 5
CABLES
1/2 SEAMILE



not yet worked out. Mr. Hurst continued his work at the station during the greater part of August.

During the very low tides of September, Mr. Walker joined Mr. Hurst and Professor Herdman at the island, and a large amount of material was collected on the long South Spit and the Beacon Rocks (see chart). On this occasion a considerable area not usually uncovered at low tides was exposed, and many magnificent Compound Ascidiæ which have not yet been identified were obtained, along with fourteen species of Amphipoda, five of which are new to our fauna.

The attempt was made during September, with what success is not yet known, to introduce at Puffin Island the large Nudibranch *Dendronotus arborescens*, which is sometimes so abundant at Hilbre Island. The first batch of specimens was collected at low tide on Hilbre by Mr. Clubb, and sent down to me at Puffin Island. They were unpacked at once, but were all apparently dead or dying, having probably been asphyxiated on the journey. However, they were immediately placed in pools on the two sides of the South Spit at low tide, and possibly some of them may have recovered. A second supply of specimens from Hilbre was brought down to Puffin on the 22nd September, by Mr. Clubb, and, as they were carefully looked after during the journey, they arrived in good condition, and were set free, along with some of their spawn, close to the landing place (A, on chart) at the south end of the island. They have not been seen since, and Mr. Rutherford reports that he looked for them at low tides recently without success. Still they may very possibly have migrated out into deeper water, and will appear on the shore again later on when spawning.

During the summer the committee commenced a system of daily observations upon the weather and the tem-

perature of the sea, to be taken by the curator of the station and recorded in a series of weekly reports, which give, in addition, a statement of the work being carried on from day to day. These reports have been made with regularity: a specimen week is shown on the opposite page.

It is interesting to be able to record that the American Clam (*Venus mercenaria*) specimens of which, it will be remembered, were laid down nearly twenty years ago, and then again in 1883, by Mr. F. Archer and Mr. T. J. Moore,* on several spots in Liverpool Bay, and have not since been heard of in the neighbourhood, has turned up this summer living near Beaumaris. Mr. C. H. Chadwick, of Manchester, found a living specimen, and reports that dead shells are not uncommon.

On an excursion of the Biological Society last June to Hilbre Island, while crossing the great stretch of wet sand which lies in the estuary of the Dee, it was pointed out by Mr. F. Archer that the surface of the sand was covered in some places with vast numbers of the small mollusc *Hydrobia ulvæ*. Some of these were brought back to the laboratory in their wet sand; and, on being put into a dish of sea-water, the molluscs were found next day to have crawled out of the sand, and I then noticed that nearly every specimen had several little rounded excrescences scattered over the surface of its shell. On examining these under the microscope it was found that each was a little mass of small sand-grains in the centre of which was a clear jelly containing several segmenting ova or young embryos. These were undoubtedly molluscan eggs, as I kept them alive until one or two had reached a "veliger" stage, but did they belong to the *Hydrobia* or to some other mollusc? No other mollusc was, however,

* See Mr. Moore's paper in the First Report of the Fauna of Liverpool Bay, 1886, p. 368.

PUFFIN ISLAND BIOLOGICAL STATION.

RECORD OF WORK FOR THE WEEK ENDING 15TH SEPTEMBER, 1888.

Days.	Wind.	Weather.	Sea.	Temperature of Sea.	Workers at Station.	Work done.	Remarks.
SEPTEMBER, 1888. 9th, Sunday	East, then North, then East; strong breeze.	Dull and cold.	Rough.	57.5° F.	Mr. C. H. Hurst. Mr. H. Horrocks. Mr. A. O. Walker. Prof. W. A. Herdman.	Laboratory work. Dredging off south end. Shore collecting on Spit, at low tide, until dusk.	Obtained large numbers of Compound Ascidians near Beacon rocks.
10th, Monday . . .	East; fresh breeze.	Bright.	Moderate.	57° F.	Mr. C. H. Hurst. Mr. H. Horrocks. Mr. A. O. Walker. Prof. W. A. Herdman.	Laboratory work.	Prof. Herdman took several bottles of specimens (chiefly Ascidians) up to Liverpool.
11th, Tuesday . . .	West; fresh breeze.	Dull.	Moderate.	57.5° F.	Mr. C. H. Hurst. Mr. H. Horrocks.	Boat to Beaumaris with Mr. Hurst, and for coal and stores.
12th, Wednesday.	South-west; light breeze.	Fine.	Smooth.	57° F.	Tow-netted off West Spit for Mr. I. C. Thompson (No. 29).
13th, Thursday ...	North-east; light breeze.	Fine.	Smooth.	57° F.	Mr. A. F. Allen.	Took night tow-netting in "race," for Mr. I. C. Thompson (No. 30).	Large numbers of Ctenophora in tow-net.
14th, Friday	East; fresh breeze.	Bright.	Moderate.	57.5° F.	Prof. R. W. Phillips.	Miscellaneous station work.
15th, Saturday ...	East; light breeze.	Bright.	Smooth.	58° F.	Miscellaneous station work.

(Signed) ALEX. RUTHERFORD, Curator.

noticed in any abundance in the neighbourhood. Has, then, the *Hydrobia* in this locality acquired the habit of laying its eggs upon its neighbours' shells as being the only comparatively stable objects to be found in the fine shifting sands around it? A short note on the subject published in "Nature" caught the attention of Professor G. Lindstrom, of Stockholm, who has written to me, saying:— . . . "I think there cannot be the least doubt that they [the egg-masses] really belong to that mollusc [*Hydrobia ulvæ*]. Many years ago I isolated a number of them to see how they spawned and succeeded in finding oothecæ such as you describe fixed on stones, on seaweeds, on dead shells, etc., not only on the shells of *Hydrobia*." He refers me to a paper* in which he had figured an egg-mass surrounded by sand-grains very similar to those we found here. Consequently the explanation which I have suggested above may probably be regarded as correct. It is an interesting instance of local conditions giving rise to a peculiar habit.

Another case of curious distribution of young molluscs is to be seen in the myriads of young mussels (*Mytilus edulis*), about 1 mm. or less in length, which are sometimes found on Caldy Blacks and some parts of Hilbre Island in such abundance that all projecting objects such as shells, zoophytes, seaweeds, &c., are almost blackened by the adhering masses of molluscs. Very few of these reach maturity—in fact most of them disappear very soon, being probably eaten by larger animals. The interesting point is that the minute free-swimming larvæ, derived probably from the mussel beds on the Leasowe shore, are ready to settle down in large numbers upon any object projecting from or more stable than the surrounding

* "Om Gotlands nutida Mollusker," Wisby, 1868.

sands. Would it not be worth while to establish artificial mussel beds in the neighbourhood of Hilbre Island?

The Liverpool Salvage Association, with their usual liberality, placed their famous old steamer, the "Hyæna," once more at the service of the committee at Whitsuntide, for a three days dredging expedition. During the three former biological cruises of the "Hyæna," in 1885, 1886 and 1887, the region explored has been the southern part of the L. M. B. C. district around the coasts of North Wales and Anglesey. (See fig. 1, over page.)

On the present occasion the committee decided to run a couple of lines of soundings and dredgings between the Mersey and the Isle of Man, and to spend some time dredging round the southern end of that island, the general objects being (1) to get some knowledge of the depths, bottom, and animals, across the eastern half of the Irish Sea, and (2) to investigate the rich fauna living around the "Calf" and south end of the Isle of Man.

About seven a.m. on Saturday morning, 19th May, the "Hyæna" left the Liverpool Landing Stage with a party of nearly twenty biologists on board, including Mr. I. C. Thompson, Mr. W. S. McMillan, Mr. A. Leicester, Mr. J. Lomas, Mr. A. O. Walker, Dr. R. Hanitsch, Mr. J. A. Clubb, Dr. F. C. Larkin, Mr. C. H. Hurst, Mr. Hill, Mr. R. McMillan, Professor Denny, Mr. Watson, Professor Miall, Mr. N. Caine, Professor Herdman, and Captain Young, of the Salvage Association; and provided with dredges, trawls, tow-nets, sounding line, deep-sea reversing thermometer,* microscopes, and the other necessary instruments, dishes, bottles and reagents.

After the well-known sand-banks round the mouth of the Mersey had been passed, soundings and bottom

* This very important instrument was kindly presented to the committee by Mr. Isaac Roberts, of Maghull.

temperatures were taken occasionally, and several times during the day a stop was made for trawling, dredging and tow-netting.

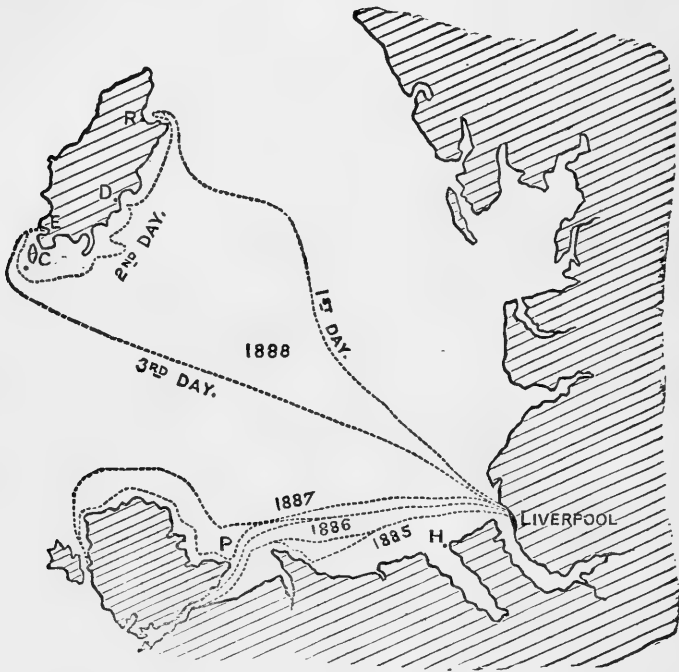


Fig. 1. Map* of the L. M. B. C. district, showing the course of the "Hyæna" in the cruises of 1885, 1886, 1887, and 1888. H, Hilbre Island; P, Puffin Island; R, Ramsey; D, Douglas; E, Port Erin; C, Calf of Man.

A fair amount of material, including *Ceratium tripos*, various Copepoda, and some interesting larval forms, was obtained, and for the most part preserved for further examination. No greater depth than 23 fathoms, with a bottom temperature of 47° F., was, however, met with. There was nothing specially noteworthy amongst the animals dredged; and although the shrimp trawl was used, it was probably very little on the ground owing to the strong tide running, consequently, with the exception of a

* For the use of this cut, which appeared in "Nature" for June 7th, 1888, in illustration of my article on the Cruise of the "Hyæna," I am indebted to the courtesy of Messrs. Macmillan and Co.

large colony of *Alcyonium digitatum*, and a few Amphipods, nothing was obtained.

It had been intended to anchor for the night in Douglas Bay, but during the dredging and trawling the vessel had drifted so far out of her course that when evening came it was found advisable to run for Ramsey. Here half the party went on shore for the night, the rest staying on board for the electric-light experiments, which will be described further on.

On the following morning an early start for the south was made, the rest of the party was picked up at Douglas, and then the work of the day commenced. The "Hyæna" steamed slowly round the east and south coasts of the island to Port Erin (see map, fig. 1, second day), dredging and tow-netting at intervals, with very good results. When a stop was made for collecting the fullest advantage was taken of it. The sounding-line and the deep-sea thermometer were over amidships, and two dredges, a large bottom tow-net, and one or more surface nets were put out astern. The deep tow-net, devised and worked by Mr. W. S. McMillan, was so weighted and buoyed as to work steadily at a distance of a foot or so above the sea-bottom, and it yielded a large amount of material, which was in some cases conspicuously different from the contents of the surface-nets, worked by Mr. I. C. Thompson, during the same time. The latter supplied very large numbers of *Anomalocera patersonii*, a Copepod which Mr. Thompson reports had been taken very rarely before, and never since, in our district. Some of these surface animals apparently exist in local shoals. This Copepod, although very abundant along the south-eastern coast of the Isle of Man, was not present in tow-nettings taken off Puffin Island during the same day.

A large area of the sea-bottom between Port Soderick and Port St. Mary is apparently covered by masses of *Melobesia calcarea*, and the numerous dead valves of *Pectunculus glycimereis*; and incrusting Polyzoa are especially abundant both upon the nullipore and the shells. Mr. J. Lomas, who has charge of the Polyzoa, informs me that amongst a number of other rare forms he has identified *Stomatopora johnstoni*,* and *S. incrassata*,* *Tubulipora lobulata*, and *T. flabellaris*, *Lichenopora hispida*, *Cellepora dichotoma*, *Membranipora aurita*, *M. craticula*, and *M. dumerilii*, *Schizoporella unicornis*,* *Hippothoa flagellum*,* *Diastopora suborbicularis*, and a peculiar variety of *Cellaria fistulosa*. Of these, the four species marked with an asterisk are new to our fauna. A single valve of *Pecten maximus* brought up in the dredge has been found by Mr. Lomas to be incrustated by colonies of no less than eleven species of Polyzoa, some of them rare forms; while a dead shell of *Buccinum undatum* similarly affords attachment to nine distinct species.

Towards evening three very successful hauls of the dredge were made, which covered practically all the ground in a line from the southern end of the "Calf" to the northern side of Port Erin Bay, just under Bradda Head. Amongst the material obtained in these hauls the following species were noticed:—*Asterias glacialis*, *Solaster endeca*, *Stichaster roseus*, *Porania pulvillus*, *Luidia fragillissima*, *Antedon rosaceus*, *Stenorhynchus longirostris*, *S. phalangium*, *Inachus dorsettensis*, *Hyas coarctatus*, *Eury-nome aspera*, *Xantho rivulosa* var. *tuberculata*, *Pinnotheres pisum*, *Ebalia tuberosa*, *Corystes cassivellaunus*, *Eupagurus cuanensis*, *Anapagurus hyndmanni*,* *A. lævis*, *Galathea intermedia*, *Munida rondeletii*,* *Caridion gordonii*,* *Pandalus brevirostris*, *P. annulicornis*, *Virbius varians*, *Pleuro-*

* Those species marked with an asterisk are new to the fauna.

branchus membranaceus, *Ascidia venosa*, *A. plebeia*, *Corella parallelogramma*, *Polycarpa* sp., *Leptoclinum* sp., and other Compound Ascidiæ.

In Port Erin Bay after dark the electric light was again used successfully in the bottom and surface tow-nets.

On the third day an early start was again made, with the object of leaving time to run down into the deep water lying to the south of the Isle of Man. Unfortunately, however, a thick fog was encountered, which hampered our movements during the morning and changed all the plans for the day. After passing the Chicken Rock, the "Hyæna" steamed slowly for Liverpool, and reached the Mersey about one a.m. on Tuesday. A few hauls of the trawl and dredge were taken on the way home with no great results, and the tow-nets both bottom and surface, were worked whenever practicable. It is noteworthy that although we passed not far south of where the great quantities of *Anomalocera patersonii* had been captured on the previous day, not a single specimen of that Copepod was obtained either on the surface or with the deep tow-net.

The important feature of this cruise, however, was the use which was made of the electric light for collecting after dark. On the first night, in Ramsey Bay, after the shore party had left and the ship was anchored for the night, an electric light of 1000 candle power was hoisted a few feet above deck, and this allowed work to be carried on almost as comfortably as during the day. Captain Young, of the Liverpool Salvage Association, who was in command of the "Hyæna," then kindly arranged for us a 60 candle power Edison-Swan submarine incandescent lamp in the mouth of a tow-net. This illuminated net was let down to a depth of three fathoms, and allowed to remain there for half an hour. At the same time, another

tow-net without any light was let down to the same depth over the other side of the ship. When the nets were being hauled in, as the one with the electric light approached the surface numerous small animals (Crustacea probably) were noticed accompanying it, and darting about in the bright light. This tow-net when emptied into a glass jar of sea-water was found to contain an abundant gathering, consisting mainly of Crustaceans; while the net in the dark on the other side of the ship had practically nothing.

The two nets were then put out again. The one had the electric light in its former position, but this time it was let down to the bottom at a depth of six fathoms; while the other net was placed in the dark at the ship's stern, and also reached the bottom. The tow-nets remained stationary, but were kept distended by the tide. The outline of the illuminated net could be made out indistinctly at a depth of six fathoms. After being out for three-quarters of an hour, both nets were hauled in, with the same result as before. The illuminated net contained abundance of Amphipoda (*Ampelisca lavigata*, and *Dexamine vedlomensis*) and some Cumacea (young males of *Cuma scorpioides*?), while the dark net again contained practically nothing.

These two experiments showed pretty conclusively the effect of the brilliant light in attracting the free-swimming animals, the difference between the contents of the two nets being on both occasions most marked. Consequently, on the second night, in Port Erin Bay, *both* nets were illuminated, and while the one was let down close to the bottom at a depth of five fathoms, the other was kept at the surface of the sea on the opposite side of the ship. This experiment was tried three times, with the same result each time: both the nets were found to contain

abundance of animals, but the bottom and surface gatherings differed greatly in appearance and in constitution. The net from the bottom contained mainly large Amphipoda, and some Cumacea, while the gathering from the surface was characterised by the abundance of Copepoda.

Mr. A. O. Walker has supplied me with the following list of Crustacea from the bottom net.

CUMACEA:—*Iphinoë trispinosa*,* *Cuma scorpioides*, and *Pseudocuma cercaria* (many).*

AMPHIPODA:—*Anonyx* sp.,* *Monoculodes grubei*,* *Pontocrates norvegicus*, *Phoxus holbolli*, *Metopa* sp., *Dexamine vedlomensis*, *Bathyporeia pilosa*, and a remarkable undescribed species provisionally named by Dr. Norman as *Megalonoura agilis*.

At first sight it seemed that the Amphipods from the illuminated deep nets were all red-eyed species, such as *Ampelisca lævigata* and *Bathyporeia pilosa*, and this suggested that possibly there might be a relation between the colour of the eyes and sensitiveness to the electric light. A detailed examination of the material has shown, however, that this will not hold good strictly as, although the red-eyed specimens are the most abundant and conspicuous, still others are present.

Mr. Walker points out that all the Cumacea taken both at Ramsey Bay and Port Erin were males, and that the probable reason is that the males of all the three species represented are provided with pleopoda (or swimming legs), while the females are not, and that consequently the males are no doubt more active swimmers, and therefore more likely to rise from the sea-bottom where they live.

Mr. Thompson has identified the following species of Copepoda from the illuminated surface nets:—*Calanus finmarchicus*, *Pseudocalanus elongatus*, *Dias longiremis*,

* New to fauna.

Idya furcata, *Centropages hamatus*, *Anomalocera pater-sonii*, *Isias clavipes*, *Oithona spinifrons*, *Harpacticus chelifer* and *Harpacticus fulvus*. The specimens of the last two species are remarkable for their unusually large size and their abundance. It has been suggested that as the Harpacticidæ are well known to be foul feeders and to act the part of scavengers in clearing away decaying matters from our shores, they may have possibly been attracted in numbers to the tow-net by mistaking the electric light for the phosphorescent glow of decomposing animal matters.

Apart from the considerable number of rare species added to our lists by this expedition, the "Hyæna" cruise of May, 1888, will stand out as a notable occasion on account of the successful application of the electric light to marine biology, as a bait or attraction in the tow-net worked after dark. The obvious extension of this illumination method to deep-water tow-netting and trawling during the day-time we hope, thanks to the kindness of the Salvage Association, to be able to experiment upon in a future expedition.

The committee have decided that so much new material has been collected during this last year, and so many supplementary reports have either been prepared or are now in course of preparation, that they are justified in proposing to issue the second volume of the Fauna of Liverpool Bay during the present winter. Mr. S. Nowell, who gained some familiarity with the fauna at Puffin Island during August, is at present occupied, along with some other gentlemen, in the zoological laboratory of the college, in examining the various store bottles from Puffin Island and elsewhere, recording their contents, and sorting out the various groups of animals to be sent to specialists for further examination. When these

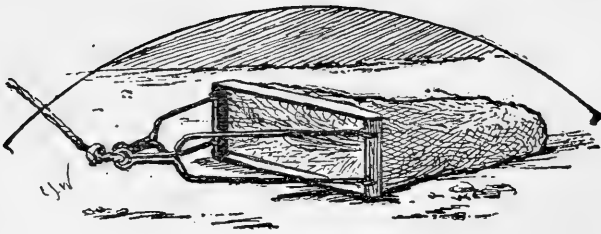
specimens have been investigated the final reports for the proposed volume will be collected and published.

This second volume of the "Fauna" will contain supplementary reports by Mr. Thompson, Mr. Walker, Mr. Lomas, and others upon the groups they discussed in the former volume, and also a report upon the Fishes of the district by Mr. Moore, on the Diatomaceæ by Dr. Stolterfoth, on the other Algæ by Mr. Harvey Gibson and by Prof. Phillips, on the Ostracoda by Mr. W. S. McMillan, on the Echinodermata by Mr. Chadwick, on the Sponges by Dr. Hanitsch, and on various smaller groups by other authors.

The appended list of subscriptions and donations for the year, and the treasurer's balance sheet, show that although the Puffin Island institution is managed in a very economical manner, increased support will be necessary in order to keep the station in an efficient condition even on the present modest scale. In last year's report it was stated that a fixed income of £100 would be required to meet the necessary expenses. Our subscription list for the year falls short of that amount, and even with the strictest economy the expenditure has exceeded the income. The biological station is so useful, has shown such good results during its short existence and is so modest in its demands upon the general public, that the committee believe that they need only point out this unsatisfactory state of the finances in order to elicit a somewhat increased measure of support from those who are interested in the biological investigation of Liverpool Bay.

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, University College, Liverpool.

Subscriptions and Donations should be sent to Mr. I. C. Thompson, F.L.S., 19, Waverley Road, Liverpool.



SUBSCRIPTIONS AND DONATIONS.

	Subscriptions.			Donations.		
	£	s.	d.	£	s.	d.
Bangor University College Students	—			0	5	0
Banks, Prof. W. Mitchell, 28, Rodney-st.	2	2	0	—		
Bickersteth, Dr., 2, Rodney-street	2	2	0	—		
Brown, Prof. J. Campbell, University College, Liverpool	1	1	0	—		
Burton, James H., Fryars, Beaumaris ...	2	2	0	—		
Caine, Nath., 10, Orange-court, Castle-st.	1	1	0	—		
Caton, Dr., 31, Rodney-street	1	1	0	—		
Davidson, Dr., 2, Gambier-terrace	1	1	0	—		
Denny, Prof., Firth College, Sheffield	1	0	0	—		
Derby, Earl of, Knowsley	—			5	0	0
Drysdale, Dr., 36A, Rodney-street	1	1	0	—		
Dutton, F. Victor, 9, Eaton-road, Chester	—			0	10	0
Earle, Rev. W., Bilton Grange, Rugby ...	1	1	0	—		
Glynn, Dr., 62, Rodney-street	1	1	0	—		
Gair, H. W., Smithdown-road, Wavertree	1	1	0	1	1	0
Gamble, Col. David, Windlehurst, St. Helens	2	0	0	—		
Gaskell, Holbrook, J.P., Woolton Wood, Much Woolton	1	1	0	—		
Gifford, J., Whitehouse-terrace, Edinburgh	—			1	0	0
Gutridge, H., 102, Hartington-road.....	1	0	0	—		
Henderson, W. G., Liverpool Union Bank	1	1	0	—		
Herdman, Prof., Univ. College, Liverpool	2	2	0	—		
Higgin, Thos., Ethersall, Roby	1	1	0	—		
Higgins, Rev. H. H., 29, Falkner-square	1	0	0	—		
Holder, Thos., 1, Clarendon Buildings, Tithebarn-street	2	2	0	—		
Hornby, T. D., Olive Mount, Wavertree...	1	1	0	—		
Hurst, C. H., Owens College, Manchester	—			3	3	0
Jones, Chas. W., Field House, Wavertree	5	0	0	—		
Leicester, Alfred, 24, Aughton-rd., Birkdale	1	1	0	—		
McMillan, W. S., 17, Temple-street.....	2	2	0	—		
McMillan, R., 20, Aubrey-street	—			0	12	0

	Subscriptions.			Donations.		
	£	s.	d.	£	s.	d.
Meade-King, R. R., 4, Oldhall-street	0	10	0	—		
Meade-King, H. W., Sandfield Park, West Derby	1	0	0	—		
Melly, George, 90, Chatham-street	1	0	0	3	0	0
Melly, W. R., 90, Chatham-street	1	0	0	—		
Miall, Prof., Yorkshire College, Leeds.....	1	1	0	—		
Nicol, W., St. Michael's Mount, St. Michael's	1	1	0	—		
Oakshott, T. W., Mayor of Liverpool	1	1	0	—		
Phillips, Prof. R. W., Univ. College, Bangor	1	1	0	—		
Poole, Sir James, Tower Buildings	2	2	0	—		
Rathbone, R. R., Beechwood House, Grassendale	1	1	0	—		
Rathbone, Theo., Backwood, Neston	2	2	0	—		
Rathbone, W., M.P., Greenbank, Allerton	2	2	0	—		
Roberts, Isaac, Kenessee, Maghull	1	0	0	—		
Scott, W. G., 26, Dingle-lane	1	1	0	—		
Shepherd, T., Kingsley Lodge, Chester...	1	1	0	—		
Swainson, Geo., North Drive, St. Anne's- on-the-Sea	1	1	0	—		
Tate, A. Norman, 9, Hackins-hey	2	2	0	—		
Thompson, Rev. J. C., Brondesbury Park, London	—			0	10	0
Thompson, Isaac C., Woodstock, Waverley- road.....	2	2	0	—		
Thornely, James, Baycliff, Woolton-hill ...	1	1		—		
Thornely, The Misses, Baycliff, Woolton.	—			1	0	0
Toll, J. M., 340, Walton Breck-road	1	0	0	—		
Walker, Alfred O., J.P., Chester	5	0	0	—		
Walker, A. O., Anon. per, Chester	—			0	12	6
Walker, Horace, South Lodge, Princes Pk.	1	1	0	—		
Watson, A. T., Tapton-crescent, Sheffield	1	1	0	—		
Westminster, Duke of, Eaton Hall	5	0	0	—		
Weekes, Mrs., 18, The Avenue, Brondes- bury, London	—			0	10	0
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	£73	17	0	£17	3	6
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LIVERPOOL MARINE BIOLOGY COMMITTEE,

Dr.

IN ACCOUNT WITH ISAAC C. THOMPSON, HON. TREASURER.

Cr.

1888.		1888.	
	£ s. d.		£ s. d.
To Salaries of Curator and Boy.....	57 5 0	By Balance, 31st Dec., 1887	8 14 0
„ Repairs, paint, sail, oars, &c. of Launch and Boat	11 11 3	„ Subscriptions, as per list	73 17 0
„ New Boat.....	8 0 0	„ Donations	17 3 6
„ Coal	6 13 4	„ Balance due Treasurer	2 1 1
„ Oil.....	2 0 3		
„ Repairs to Dredge and Tow-nets	0 8 4		
„ Carriage of Specimens, &c.	3 0 2		
„ Printing and Stationery.....	8 10 0		
„ Postages	3 10 3		
„ Sundries	0 17 0		
	<u>£101 15 7</u>		<u>£101 15 7</u>
By Balance due Treasurer	£2 1 1		

ISAAC C. THOMPSON,

HON. TREASURER.

Audited and found correct,

ALFRED LEICESTER.

LIVERPOOL, 31st December, 1888.

REPORT on the MARINE DIATOMACEÆ of the
L.M.B.C. DISTRICT.

BY DR. H. STOLTERFOTH, M.A.

[Read 8th February, 1889.]

IN the present condition of our knowledge of the Diatomaceæ, it is impossible to give a scientific arrangement of the genera and species. All the attempts that have hitherto been made are based on artificial systems, that must some day be superseded, and so I have thought it best in this catalogue, which I have prepared for the Liverpool Marine Biology Committee, to do what most of the recent writers on the subject have done, viz. place the genera and species in alphabetical order. This makes the list easy to consult, and in no way precludes its being used by those who adopt an artificial system of reference. One of the best of the artificial systems is that proposed by Professor H. L. Smith, and which will be found in Dr. Van Heurck's "Synopsis of the Diatomaceæ," p. 37 of the text.

The great difficulty that surrounds the study of the Diatomaceæ, is that so many writers seem to look upon it as necessary to give new names to even the commonest species, and the transference of well known forms from one genus to another, adds not a little to the complication. Different localities and conditions give rise to variations, which in many cases have been made to constitute new species. I have endeavoured to avoid this, and I hope that the following list will be of some use to those who are working at this subject. Very few lists of the Diatomaceæ of particular districts in this country have been published. They are as follows—

1. "New Forms of Marine Diatomaceæ of the Firth of

Clyde and Loch Fyne," by William Gregory, M.D. Transactions of Royal Society, Edinburgh, 1857.

2. Mr. Comber's "List of Diatomaceæ Found in the Neighbourhood of Liverpool." Transactions of Historic Society of Lancashire and Cheshire, vol. xi., 1859.

3. "The Diatomaceæ of Hull," by Mr. George Norman. Published by himself, 1865. This is a most admirable list, and little has been added to it up to the present day.

4. "List of Diatomaceæ Found in the Neighbourhood of Chester," by Dr. H. Stolterfoth, M.A. Published in the Proceedings of the Chester Society of Natural Science, 1874.

In the following list I shall confine myself to those forms of Diatomaceæ that are found in salt and brackish water affected by the tide. Mr. Comber's list, referred to above, contains 137 salt and brackish water species; to these I have been able to add 47, making 184 species in all. A large portion of my gatherings have been made in the estuary of the Dee, but they also extend along the coast of North Wales, and I have made a few gatherings in the Isle of Man. I have no surface gatherings of more than a few miles from the shore, and it is here that my list will, perhaps, be most deficient. I have examined many gatherings from the Bristol Channel, estuary of the Thames, the coast of Devonshire, and Northumberland, Tay in Scotland, &c. The general character of the forms found on the east and west side of England are much the same, but the frequency with which they recur varies considerably, and certain forms may be said to mark particular localities. This is what would be expected in an examination of this lowly order of the Flora.

For the growth of the Diatomaceæ heat and sunlight are essential, and on these factors depends the development of the siliceous skeleton, which is the characteristic of this order. As might have been expected in most specimens

found in this neighbourhood the siliceous skeleton is but poorly developed.

No department of Botany has been more fully illustrated than the Diatoms. A very good Bibliography is found in Dr. Van Heurck's "Synopsis," ch. iii., p. 43, and it is hardly necessary in the list that follows to give more than the authority upon which the names of genera and species rest. I have not considered it necessary to give the authorities in full, as the abbreviations are well known to those who study the subject.

The localities mentioned in the list are those in which the form was first observed.

Very rare means that only a very few forms have been seen.

Rare, that the form has only been seen in a very few gatherings, but may have been abundant in them.

Common, that the form has appeared in many gatherings.

Very common, that the form is present in most of the gatherings and is abundant.

LIST.

Achnanthes (Bory, 1822) *brevipes*, Ag. Surface of Dee, common.

A. longipes, Ag. Hoylake, common.

A. subsessilis, Ehr. Ince Marsh, rare.

Actinocyclus (Ehr.) *crassus*, W. Sm. Surface of Dee, rare.

A. ralfsii, W. Sm. Parkgate, rare.

Actinoptychus (Ehr.) *splendens* (Shad), Ralfs. Surface of Dee, rare.

A. undulatus, Ehr. Queen's Ferry, very common.

Amphiprora (Kutz.) *alata*, Kutz. Mostyn, very common.

A. paludosa, Greg. Mostyn, common.

- A. plicata*, Greg. Rhyl, rare.
A. pusilla, Greg. Bangor, rare.
A. vitrea, Greg. Hoylake, rare.

Amphora (Ehr.) *affinis*, Kutz. Queen's Ferry, common.

- A. binodis*, Greg. Ince Marsh, rare.
A. hyalina, Kutz. Mostyn, very common.
A. commutata, Grun. Burton Marsh, rare.
A. complexa, Greg. Mostyn, rare.
A. lævis, Greg. Ince Marsh, rare.
A. litoralis, Dn. Rhyl, rare.
A. membranacea, W. Sm. Holywell, rare.
A. minutissima, Gray. Helsby Marsh, rare.
A. salina, W. Sm. Connah's Quay, common.
A. spectabilis, Greg. Mostyn, rare.
A. ventricosa, Greg. Ince Marsh, rare.

Asterionella (Hassal) *bleakleyii*, W. Sm. Surface of the Dee, common.

A. ralfsii, W. Sm. Surface of the Dee, rare.

These forms are often very abundant in the summer.

A. bleakleyii grows in long continuous filaments like a corkscrew.*

Atheya (West) *decora*, West. Surface of the Dee, very rare. This form was described by Mr. West in the Trans. Micro. Soc., vol. viii., 1860, and I do not know of its having been seen by any one since. I found it on the Dee in 1874 for the first time, and have seen it two or three times since in surface gatherings.

Bacteriastrum (Lauder) *varians*, Lauder. Surface of Dee, common.

Berkleya (Grev.) *obtusa*, Grev. Puddington Marsh, rare.

* *Vide* Trans. of Micro. Soc., vol. viii., 1860, Mr. West's paper

- Biddulphia* (Gray) *aurita*, Breb. Connah's Quay, common.
B. baileyi, W. Sm. Surface of Dee, very common.
B. granulata, Roper. Surface of Dee, rare.
B. obtusa, Kutz. Connah's Quay, rare.
B. radiatus, Greg. Parkgate, rare.
B. rhombus, W. Sm. Parkgate, common.
B. suborbicularis, Grun. Surface of Dee, rare.
B. turgida, W. Sm. Parkgate, rare.

The form *B. aurita* is not so common on this coast as about the Thames and south coast, where it is found abundantly associated with *Actinoptychus splendens* and *Eupodiscus argus*.

- Campylodiscus* (Ehr.) *bicostatus*, W. Sm. Mostyn, rare.
C. cribrus, W. Sm. Mostyn, rare.

Cestodiscus (Grev.) *johnsonianum*, Greg. Mostyn, rare.

- Chætoceros* (Ehr.) *armatum*, West. Surface of Dee, rare.
C. boreale, Bail. Connah's Quay, rare.
C. paradoxum, Cleve. Surface of Dee.
C. wighamii, Brightw. Surface of Dee, rare.

- Cocconeis* (Ehr.) *scutellum*, Ehr. Hilbre Island, common.
C. britannica, Nægeli. Isle of Man, common.
C. eccentrica, Dn. New Brighton sands, Comber.

Coscinodiscus (Ehr.) *asteromphalus*, Grun. Surface of Dee, common.

- C. concinnus*, W. Sm. Parkgate, common.
C. eccentricus, Ehr. Parkgate, common.
C. fimbriatus, Ehr. Surface of Dee, rare.
C. obscurus, Schmidt. Surface of Dee, rare.
C. radiatus, Ehr. Connah's Quay, rare.

Cymbella (Ag.) *scotica*, W. Sm. Mostyn, rare.

Dickeia (Berk.) *ulvoides*, Berk. Colwyn Bay, rare.

Dimeregramma (Ralfs) *nanum*, Greg. Surface of Dee, rare.

Epithemia (Kutz) *constricta*, Greg. Mostyn, common.

E. gibba, Kutz. Helsby Marsh, common.

E. turgida, W. Sm. Frodsham Marsh, very common.

This genus seems to flourish equally well in fresh and brackish water, but is not found in the open tidal water of the Dee.

Eucampia (Ehr.) *zodiacus*, Ehr. Surface of Dee and Mersey, common.

E. striata, Stolt. Surface of Dee, rare.

This last form was described in the Journal of the Royal Microscopical Society by me in 1879. It has been placed by Mons. H. Peragello in his "Diatomies de la Baie de Villefranche," 1888, in the genus *Rhizosolenia*, because it has a terminal spine, which I have figured in my paper. I am doubtful if Mons. Peragello has ever seen my figure. This is the first notice I have seen of the form described in Europe. In Castracane's "Challenger Diatoms" a single valve is figured, but not named. I still think that from the mode of growth this form is allied to *Eucampia*, or perhaps to *Hemiaulus*.

Eupodiscus (Ehr.) *argus*, Ehr. Connah's Quay, doubtful. This form is abundant in the estuary of the Thames, Kiel harbour, &c., but on the west side of England it is hardly known.

Gomphonema (Ag.) *marinum*, W. Sm. Wepre Brook, rare.

Grammatophora (Ehr.) *marina*, Kutz. Colwyn Bay, rare.

G. serpentaria, Kutz. New Brighton, in Comber's list.

Hantzschia (Grun.) *virgata*, Grun. Colwyn Bay, very rare.

Hyalodiscus (Ehr.) *stelligis*, Bail. Surface of Dee, rare.
H. scoticus, Grun. Mostyn, common.

Licmophora (Ag.) *gracilis*, Grun. Mostyn, rare.
L. anglica, Grun. Rhyl, rare.
L. dalmatica, Kutz. Dingle Bay, Comber's list.

Lauderia (Cleve.) *delicatula*, Peragello. Surface of Dee, rare. This form I found with *Eucampia striata*, in 1879, and thought it a stage of growth of that form, but I think Peragello is right in placing it in the genus *Lauderia*.

Mastogloia (Theo.) *lanceolata*, Th. Puddington Marsh, rare.

M. smithii, Th. Mostyn, common.

Melosira (Ag.) *borreri*, Grev. Rhyl, rare.
M. nummuloides, Bory. Helsby Marsh, common.
M. sulcata, Ehr. Surface of Dee, rare.
M. westii, W. Sm. Connah's Quay, rare.

Navicula (Dn.) *abrupta*, Greg. Surface of Dee, very rare.

N. æstiva, Dn. Colwyn Bay, rare.
N. affinis, Ehr. Helsby Marsh, rare.
N. aspera, Ehr. Colwyn Bay, common.
N. boeckii, Herberg, Burton Marsh, rare.
N. bombus, Ehr. Mostyn, common.
N. carassius, Ehr. Mostyn, rare.
N. clepsydra, Ehr. Colwyn Bay, rare.
N. crabro, Ehr. Connah's Quay, common.
N. cyprinus, Ehr. Mostyn, rare.
N. didyma, Ehr. Bagilt, rare.
N. distans, W. Sm. Helsby Marsh, rare.
N. fortis, Greg. Mostyn, rare.
N. fusca, Greg. Mostyn, rare.
N. fusiformis, Grun. Mostyn, very rare.
N. granulata, Breb. Rhyl, rare.

- N. interrupta*, Kutz. Mostyn, common.
N. johnsonii, Greg. Colwyn Bay, rare.
N. litoralis, Dn. Colwyn Bay, rare.
N. lyra, Ehr. Surface of Dee, very rare.
N. marina, Greg. Colwyn Bay, common.
N. northumbrica, Dn. Colwyn Bay, rare.
N. numerosa, Dn. Hoylake, rare.
N. palpebralis, Breb. Connah's Quay, common.
N. peregrina, Dn. Mostyn, common.
N. pusilla, W. Sm. Connah's Quay, common.
N. pygmæa, Kutz. Mostyn, common.
N. rectangulata, Greg. Colwyn Bay, very rare.
N. rostrata, Ehr. Mostyn, very rare.
N. semiplena, Greg. Connah's Quay, rare.
N. suborbicularis, Greg. Mostyn, very rare.
N. subsalina, Dn. Helsby Marsh, common.
N. venata, Kutz. Chester cop, common.
N. westii, Greg. Queen's Ferry, common.
Nitzschia (Hassal) *bilobata*, W. Sm. Queen's Ferry, rare.
N. birostrata, W. Sm. Mostyn, rare.
N. closterium, W. Sm. Ince Marsh, very rare.
N. distans, Greg. Colwyn Bay, rare.
N. granulata, W. Sm. Mostyn, rare.
N. lanceolata, W. Sm. Mostyn, rare.
N. notabilis, Grun. Surface of Dee, rare.
N. obtusa, W. Sm. Helsby Marsh, rare.
N. panduriformis, Greg. Surface of Dee, rare.
N. paradoxa (*Bacillaria paradoxa*), Gmel. Surface
of Dee, common.
N. plana, W. Sm. Ince Marsh, very rare.
N. punctata, Grun. Mostyn, rare.
N. reversa, W. Sm. Helsby Marsh, rare.
N. sigma, W. Sm. Mostyn, very common.
N. scalaris, W. Sm. Holywell, rare.

N. tænia, W. Sm. Connah's Quay, very common.

N. tryblionella, Hantz. Helsby Marsh, common.

Plagiogramma (Grev.) *gregorianum*, Grev. Surface of Dee, rare.

P. van-heurckii, Grun. Surface of Dee, rare.

Pleurosigma (W. Sm.) *æstuarii*, W. Sm. Surface of Dee, common.

P. angulatum, W. Sm. Mostyn, very common.

P. balticum, W. Sm. Connah's Quay, very common.

P. delicatulum, W. Sm. Mostyn, common.

P. distortum, W. Sm. Connah's Quay, common.

P. elongatum, W. Sm. Mostyn, common.

P. fusciola, W. Sm. Mostyn, very common.

P. formosum, W. Sm. Bangor, rare.

P. hippocampus, W. Sm. Connah's Quay, very common.

P. litorale, W. Sm. Mostyn, rare.

P. marinum, W. Sm. Rhyl, rare.

P. prolongatum, W. Sm. Mostyn, common.

P. obscurum, W. Sm. Connah's Quay, rare.

P. scalprum, W. Sm. Queen's Ferry, rare.

P. strigilis, W. Sm. Bangor, rare.

P. strigosum, W. Sm. Mostyn, rare.

P. tenuissimum, Greg. Colwyn Bay, rare.

P. transversale, Roper. Surface of Dee, rare.

Most of the British forms of *Pleurosigma* have been found in this district. Mostyn and Connah's Quay may be noted as particularly rich in this genus.

Rhabdonema (Kutz.) *arcuatum*, Kutz. Holywell, rare.

R. minutum, Kutz. Hilbre Island, rare.

Rhaphoneis (Ehr.) *amphiceros*, Ehr. Connah's Quay, common. Many varieties of this form are found in the district.

Rhizosolenia (Ehr.) *imbricata*, Brightw. Surface of Dee, rare.

R. setigera, Brightw. Connah's Quay, rare.

R. styliformis, Brightw. Connah's Quay, rare.

R. wighamii, Brightw. Surface of Dee, rare.

Schizonema (Agardh.) *crucigera*, W. Sm. Helsby Marsh, common.

S. eximium, Th. Mostyn, rare.

S. helmentosum, Greg. Helsby Marsh, rare.

S. vulgare, Th. Helsby Marsh, common.

Scoliopleura (Grun.) *latistriata*, Breb. Mostyn, common.

S. tumida, Breb. Mostyn, common.

Skeletonema (Grev.) *costatum*, Grun. Surface of Dee, rare.

Stauroneis (Ehr.) *acuta*, W. Sm. Queen's Ferry, very rare.

S. salina, W. Sm. Connah's Quay, rare.

S. linearis, W. Sm. Helsby Marsh, common.

Stephanopyxis (Ehr.) *turris*, Grev. Surface of Dee, rare.

Striatella (Kutz.) *unipunctata*, Ag. Helsby Marsh, very rare. It was a long time before I found this form, which is so common on the south coast.

Surirella (Turp.) *constricta*, W. Sm. Burton Marsh, rare.

S. crumena, Breb. Helsby Marsh, rare.

S. gemma, Ehr. Mostyn, very common.

S. fastuosa, Ehr. Mostyn, rare.

S. salina, W. Sm. Railway bridge, very common.

S. splendida, Kutz. Helsby Marsh, rare.

S. striatula, Turp. Mostyn, very common.

Synedra (Ehr.) *affinis*, Kutz. Hilbre Island, very common.

S. affinis, var. *arcus*, Kutz. Helsby Marsh, very common.

S. fulgens, W. Sm. Isle of Man, common.

S. gallionii, Ehr. Isle of Man, rare.

S. obtusa, W. Sm. Helsby Marsh, common.

S. pulchella, var. *acicularis*, Kutz. Mostyn, common.

Toxonidia (Dn.) *gregoriana*, Dn. Connah's Quay, rare.

T. insignis, Dn. Surface of Dee, rare.

Triceratium, (Ehr.) *brightwellii*, West. Surface of Dee, rare.

T. favus, Ehr. Connah's Quay, very rare.

T. striolatus, Ehr. Surface of Dee, rare.

T. favus, which is so common in the estuary of the Thames, is a very rare form in this district, and not common on the west side of England.

REPORT on the MARINE ALGÆ of the L.M.B.C.
DISTRICT.

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[Read 8th March, 1889.]

IN the First Report of the Liverpool Marine Biological Committee* a brief catalogue is given by Mr. A. Leicester of species of marine Algæ collected during the various expeditions undertaken by the committee. As stated by Mr. Leicester, "no particular search was made for Algæ, the primary object of the expeditions being to collect animals." Mr. Leicester notes the occurrence of twelve species of Phæophyceæ, fifteen species of Rhodophyceæ, and one species of Chlorophyceæ.

It has been thought desirable by the committee that the Second Report should include a more detailed and complete list of the marine Algæ of the district mapped out as the field of the committee's work. Although I have not as yet had many opportunities of investigating the Algæ of that district with anything approaching thoroughness, I feel that the occasion of the publication of the Second Report should not be allowed to slip past without incorporating in that volume a synopsis of the work already done in this department of Botany, together with a record of the additions to the list of the marine Flora which have been made during the past year. From the little I have been able to accomplish in that line, I feel convinced that the marine Algæ form a field for investigation scarcely the borders of which have as yet been explored. I think this

* *The First Report upon the Fauna of Liverpool Bay and the Neighbouring Seas.* Liverpool, 1886, p. 312.

is especially true of the minute parasitic forms among the Rhodophyceæ. I trust that ere the time arrives for the publication of the Third L.M.B.C. Report I may be able to justify that remark, and to largely increase the list which at present represents our knowledge on the subject.

Since the establishment of the Biological Station on Puffin Island, Anglesey, the opportunities of satisfactorily dealing with the many and interesting problems connected with the structure, distribution, and life-history of marine Algæ, have been enormously increased. The zone between high and low water marks abounds in forms belonging to all the main divisions of the group, and I feel sure that a thorough exploration of that zone (which I purpose making during the ensuing summer) will result in the discovery of many species new to the district, if indeed we are not fortunate enough to meet with species new to British seas.

So far as I can discover, the literature on the Algæ of the district includes only several short papers published by Mr. F. P. Marrat, of the Liverpool Free Public Museum, in the *Liverpool Naturalist's Scrap Book* (1863-1864); a list quoted by the Rev. H. H. Higgins in the First Report of the L. M. B. Committee,* indicating those species which were found on the shores of Puffin Island by Mr. Marrat during an expedition of the Liverpool Naturalists' Field Club, in June, 1865; a list of Algæ from Puffin Island, published by Mr. C. S. Gregson in the *Naturalist*, vol. ii.; and the list by Mr. Leicester, already referred to. I have incorporated these lists in the present report, not only because I am anxious to present as complete a catalogue as possible, but also because Mr. Marrat's lists are hidden in the pages of a long extinct periodical, very scarce and not easy of access. The copy I have consulted is in the Free Library of Liverpool.

* *Pioneers in Local Biology*, loc. cit. p. 24.

Mr. Marrat has been for many years engaged in the investigation of the Algæ of the district, both fresh water and marine, and with great generosity he has allowed me to make use of his extensive unpublished list. I desire also to acknowledge his kindness in placing his notes at my disposal, extracts from which I have freely incorporated in the following pages.

Among the more recent treatises on the subject, that of Dr. Ferdinand Hauck of Trieste,* in Rabenhorst's *Kryptogamenflora*, is one of the most complete and exhaustive. I have followed Hauck's nomenclature, both specific and classificatory, save that I have altered the family terminations. I have, however, noted the synonyms employed by Harvey in his *Phycologia Britannica*, a valuable work, which, though considerably behind date in microscopic matters, may still be looked upon as the standard work on the subject for British seas. Where a species has not been observed by Hauck I have adopted Harvey's specific nomenclature.

Mr. Marrat draws attention to the fact that "the Mersey district is much less productive now than it was in former years. In 1860 the seaweeds on our coast were cleaner, finer in colour, and more healthy in their general appearance than they are now." This degeneration is, I think, without doubt to be accounted for by the increasing amount of impurities in the rivers Mersey and Dee, derived from the chemical and other works whose refuse finds its way into them. "The Algæ of the Cheshire coast," as Marrat remarks, "are peculiar and marked in their character. In place of the beautiful well-grown plants found on Puffin Island, the coast of Wales, Anglesey, and the Isle of Man, we have many dwarfed and stunted specimens. Parasites coat and envelope some species of

* *Die Meeresalgen Deutschlands und Oesterreichs*, Leipzig, 1885.

Ceramium and *Cladophora* almost from the time of their commencing to grow." Species belonging to "the genera *Ceramium* and *Callithamnion* are only about one-half the size of well-grown plants belonging to the same species found in the above named localities." I quite agree with Marrat in thinking that "the matted bases of close-growing and intertwined slender species would form a very prolific source of novelties." Marrat also calls attention to the "large mud-covered banks of Bromborough and Wallasey pools, upon the sides of which many beautiful but minute microscopic forms are exclusively found. Caves near the sea, only occasionally supplied with salt water, are fertile sources for the obtaining of the rarer species."

Whilst recently investigating the shores of Puffin Island, I was particularly struck by the fact, long ago pointed out by Forbes, namely, that the shore between high and low water mark could be divided into zones characterised by the luxuriant development of one or more especially prominent genus, as, for example, the *Laminaria* zone at extreme low water mark, the *Fucus* zone above, followed by other zones characterised by the presence of Rhodophyceæ and Chlorophyceæ. The association of various forms, such as, for example, certain species of *Polysiphonia* with certain species of *Fucus*, is also a point of some interest. I hope ere long to lay before the Biological Society some notes on the distribution of Algæ on the shores of Puffin Island, where these zones may be very readily studied.

Altogether 230 species of marine Algæ have been noted as occurring in the L. M. B. C. district, of which 59 belong to the Phæophyceæ, 115 to the Rhodophyceæ, 42 to the Chlorophyceæ, and 14 to the Cyanophyceæ. Of these 219 are recorded by Marrat in his published papers or are included in his private list. Of the 28 species noted by

Leicester, 24 are mentioned by Marrat. In the present report seven species are recorded as occurring in the district, though not included, so far as I am aware, in previous catalogues, published or unpublished.

Species recorded by Marrat, or mentioned in his lists as having been found by others, are distinguished by having (M) appended to them after the locality; those found by Leicester and by myself by (L) and (G) respectively.

Series A. RHODOPHYCEÆ.

Order I. FLORIDEÆ.

Family. PORPHYRIDÆ.

Bangia fusco-purpurea, Lyngb.

At the roots of *Polysiphonia* and *Ceramium* (M).

Not uncommon at the north end of Puffin Island (G).

Porphyra laciniata, Ag.

P. vulgaris, Harvey.

Plentifully distributed (M). *P. laciniata* has been considered as a variety of *P. vulgaris*. Marrat, who records both *P. vulgaris* and *P. laciniata*, mentions having found the latter occasionally as much as half an inch wide. Puffin I., 1865 (M), 1889 (G).

Family. SQUAMARIDÆ.

Peyssonnelia dubyi, Crouan.

Locality not recorded (L).

Petrocelis pellita, J. Ag.

Cruoria pellita, Harvey.

South shore, Hilbre I. and New Brighton (M).

Family. WRANGELIDÆ.

Chantransia virgulata, Thur.

Callithamnion virgulatum, Harvey.

On *Ceramium rubrum*, Eastham (M). Puffin I. (G).

Monospora pedicellata, Sol.

Callithamnion pedicellatum, Harvey.

Locality not recorded (M), (L). Puffin I. (G).

Spermothamnion turneri, Aresch.

Callithamnion turneri, Harvey.

Locality not recorded (M).

Niccaria wigghi, Endl.

Isle of Man (M).

Family. HELMINTHOCLADIIDÆ.

Nemalion multifidum, J. Ag.

The coast generally (M).

Family. CERAMIIDÆ.

Rhodochorton rothii, Näg.

Callithamnion rothii, Harvey.

Common on the rocks and pier walls (M).

R. floridulum, Näg.

Callithamnion floridulum, Harvey.

Locality not recorded (M). Puffin I. (G).

Anthithamnion cruciatum, Näg.

Callithamnion cruciatum, Harvey.

In rock pools at Hilbre I., parasitic on *Cladostephus spongiosus* (M).

A. plumula, Thur., var. *genuinum*.

Callithamnion plumula, Harvey.

Isle of Man (M).

Callithamnion pluma, Ag.

Parasitic on stems of *Laminaria digitata* and other species, Puffin I. (G).

C. thuyoides, Ag.

Isle of Man (M).

C. polyspermum, Ag.

Many localities (M).

C. tetragonum, Ag., var. *genuinum*.

Coast generally (M). Puffin I. (G).

C. tetragonum, Ag., var. *brachiatum*.

Callithamnion brachiatum, Harvey.

Coast generally (M). Puffin I. (G).

C. corymbosum, Ag.

Locality not recorded (M). Rather plentiful at Puffin I. (G).

C. byssoideum, Arn.

Hilbre I. (M).

C. seirospermum, Griff.

Seiropora griffithsiana, Harvey.

Hilbre I., parasitic on *Sphacelaria scoparia* (M).

C. granulatum, Ag.

C. spongiosum, Harvey.

Coast generally (M).

C. brodiaei, Harv.

Isle of Man and coast generally (M).

C. roseum, Lyngb.

Not rare, but locally not recorded (M).

C. hookeri, Ag.

Not uncommon in pools at New Brighton (M).

C. davesii, Lyngb.

On *Ceramium rubrum* at Rock Ferry, and on *Cladostephus spongiosus* on North shore (M).

Pleonosporium borneri, Näg.

Callithamnion borneri, Harvey.

Common on the South shore, and at Hilbre I. and New Brighton (M). Puffin I. (G).

Griffithsia barbata, Ag.

New Brighton (M).

G. setacea, Ag.

Isle of Man and Puffin and Hilbre Is., at low water (M and G).

G. corallina, Ag.

Isle of Man (M) ; locality not recorded (L).

G. equisetifolia, Ag.

In drift on Lancashire and Cheshire coasts (M).

Ptilota elegans, Bonnem.

P. sericea, Harvey.

Common (M) ; abundant at Puffin I. (G).

P. plumosa, Ag.

Locality not recorded (M and L) ; Puffin I. (G).

Ceramium tenuissimum, J. Ag.

C. nodosum, Harvey.

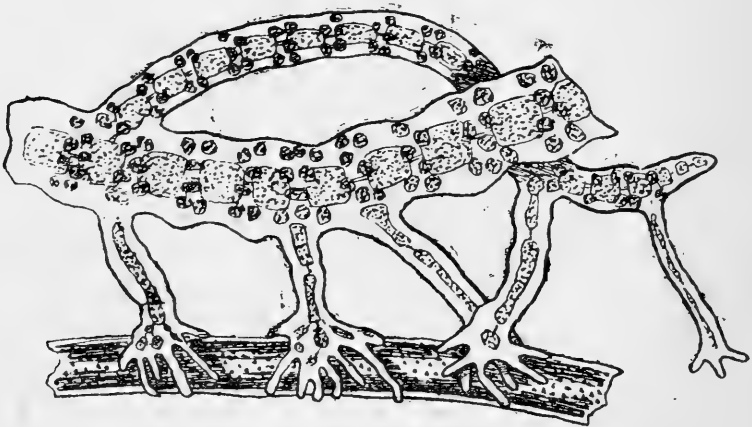
Hilbre I. (M) ; Puffin I. (G).

C. fastigiatum, Harv.

Hilbre I. (M).

C. deslongchampii, Chauv.

Hilbre I., New Brighton (M). Very abundant on Puffin I., parasitic on many species of Algæ (M and G). The figure shows a branch of *C. deslongchampii*



with twigs transformed into clasping organs. In this case the supporting plant was a stout filament of *Porphyra laciniata*, but I have found it with similar attachments to *Chylocladia articulata*, *Ceramium rubrum*, and other species. In some specimens

I fancied I detected an intercommunication of protoplasm between cells of the "host" and those of the "parasite," but I have not as yet succeeded in obtaining a specimen which shows this in such a manner as to leave no doubt as to the actual union of protoplasmic elements.

C. strictum, Grev. et Harv.

Common at Puffin I. (G).

C. diaphanum, Roth.

New Brighton and Hilbre I., parasitic or on rocks (M).

C. rubrum, Ag.

Very common at Hilbre I. and very variable, often parasitic (M). Extremely abundant at Puffin I. (M and G); locality not recorded (L).

C. rubrum, Ag., var. *decurrens*.

C. decurrens, Harvey.

Not uncommon at New Brighton and Hilbre I. (M).

C. ciliatum, Ducl.

Parasitic on *Chylocladia articulata*, at Puffin I. (M and G).

C. ciliatum, Ducl., var. *echinatum*.

New Brighton (M).

C. echionotum, J. Ag.

Puffin I. (M. and G.)

C. flabelligerum, J. Ag.

Locality not recorded (M); Puffin I. (G).

C. acanthonotum, Carm.

Purple forms at Hilbre I., white at Puffin I. (M). I found two specimens at Puffin I. which had the usual dark red colour.

C. botryocarpum, Griff.

Isle of Man (M).

Gloiosiphonia capillaris, Carm.

Isle of Man (M).

Family. SPYRIDIIDÆ.

Spyridia filamentosa, Harv.

Holyhead (M).

Family. CRYPTONEMIIDÆ.

Sarcophyllis edulis, J. Ag.*Iridæa edulis*, Harvey.

Isle of Man and Puffin I. (M).

Fastigiaria furcellata, Stackh.*Furcellaria fastigiata*, Harvey.

Hilbre I., Eastham, New Brighton, Rock Ferry (M).

Dumontia filiformis, Grev.

Shore near Little Hilbre I. (M); Puffin I. and Anglesey (M and G).

Family. GIGARTINIDÆ.

Chondrus crispus, Stackh.

Hilbre I., South shore, Eastham (M); locality not recorded (L); Puffin I. (M and G). Marrat notes the existence of an almost white variety near high water mark.

C. norvegicus, Lamour.

Rarely at Hilbre I. and Isle of Man (M).

Gigartina mammillosa, J. Ag.

Hilbre and Puffin Is., Anglesey, and I. of Man (M).

Gymnogongrus plicatus, Kütz.

Hilbre I. and I. of Man (M); Puffin I. (M and G).

G. griffithsiæ, Mart.

Isle of Man and rarely at New Brighton (M).

Phyllophora rubens, Grev.

Hilbre I., Isle of Man (M); Puffin I. (M and G).

P. membranifolia, J. Ag.

Hilbre I., Isle of Man, and Puffin I. (M).

Cystoclonium purpurascens, Kütz.

Hypnœa purpurascens, Harvey.

Hilbre and Puffin Is., New Brighton, and Isle of Man (M).

Family. RHODYMENIIDÆ.

Chylocladia articulata, Grev.

Hilbre I., Eastham, New Brighton, and I. of Man (M). Puffin I., very abundant (M and G).

C. claviformis (?).

Marrat also records a species under this name, without giving the authority, but I have not been able to find any mention of this species in the works I have had access to.

Rhodymenia palmetta, Grev.

Locality not recorded (L); Puffin I. (G).

R. palmata, Grev.

Plentiful at Hilbre I. (M); abundant at Puffin I. (G).

R. laciniata, Grev.

Not rare, but locality not stated (M).

R. bifida, Grev.

Rarely at Puffin I. (M).

R. ciliata, Kütz.

Isle of Man, Anglesey, and Puffin I. (M).

Plocamium coccineum, Lyngb.

Not uncommon at Isle of Man, Hilbre and Puffin Is. (M). I have found this species in abundance at Puffin I. Leicester records it, but does not state the locality. Also rarely at New Brighton, and cast ashore at Bootle and Southport (M).

Hydrolapathum sanguineum, Stackh.

Delesseria sanguinea, Harvey.

Isle of Man (M); Puffin I. (M and G).

Family. DELESSERIIDÆ.

Nitophyllum punctatum, Harv.

Rarely at New Brighton (M).

N. laceratum, Grev.

Generally (M).

Delesseria hypoglossum, Lamour.

Hilbre and Puffin Is., Isle of Man, Welsh coast (M).

D. ruscifolia, Lamour.

Isle of Man (M).

D. alata, Lamour.

Hilbre I., Hoylake, Isle of Man, and Anglesey (M). Very plentiful at Puffin I. (M and G). Marrat notes the finding of a green variety; but I have found many specimens with some fronds green and others intermediate between that and the natural colour on the same plant, the variation in the colouring being obviously due to decay, disease or bleaching.

D. sinuosa, Lamour.

Hilbre I. (M): Puffin I. (G).

Family. SPHÆROCOCCIDÆ.

Gracelaria confervoides, Grev.

Hilbre I., Welsh coast, Isle of Man (M). Puffin I. (M and G).

Sphærococcus coronopifolius, Stackh.

Isle of Man (M).

Family. SOLIERIIDÆ.

Catenella opuntia, Grev.

Hilbre I., Eastham, New Brighton, Puffin I., on the rocks very common (M). This species is also recorded by Leicester, although the locality is not stated. I searched for it at Puffin I., but was unable to find

any specimens. I fear that it is often confounded with *Chylocladia articulata*, which at first sight it closely resembles.

Family. GELIDIIDÆ.

Gelidium crinale, J. Ag.

G. corneum, var. *crinale*, Harvey.

Eastham (M).

G. corneum, Auct.

Marrat records the variety *latifolium* of this species from Hilbre I., and also a variety (unnamed) from the Isle of Man and from Hilbre I.

Family. SPONGIOCARPIDÆ.

Polyides lumbricalis, Grev.

P. rotundus, Harvey.

South shore, Hibre I. (M). Marrat marks this species with a query.

Lomentaria kaliformis, Gaill.

Chylocladia kaliformis, Gaill.

Isle of Man (M).

Family. RHODOMELIDÆ.

Odonthalia dentata, Lyngb.

Isle of Man, Hilbre and Puffin Is., and among drift Zoophytes at New Brighton (M).

Laurencia pinnatifida, Lamour.

Hilbre I. rarely (M). In abundance at Puffin I. (G).

L. cæspitosa, Lamour.

Locality not stated (M).

Rhodomela subfusca, Ag.

Hilbre and Puffin Is., occasionally (M); tolerably abundant at the latter (G).

R. lycopodioides, Ag.

Sparingly at Eastham and Hilbre I. (M).

Rytiphleæ thuyoides, Harv.

Occasionally at Puffin and Hilbre Is. (M). Marrat records this and the two succeeding species as members of the genus *Rhodomela*.

R. fructiculosa, Harv.

Occasionally at Puffin and Hilbre Is. (M).

R. pinnastroides, Ag.

Locality not stated (M).

Bonnemaisonia asparagoides, Ag.

Isle of Man (M).

Polysiphonia urceolata, Grev.

On rocks, at the roots of other Algæ (M and G).

P. pulvinata, Kütz.

Rarely at Eastham, New Brighton, and Hilbre I. (M); also occasionally at Puffin I. (M and G).

P. violacea, Grev.

Locality not recorded (M).

P. elongata, Harv.

Locality not recorded (M).

P. elongella, Harv.

Locality not recorded (M). In drift on Penmon Point, Anglesey (G).

P. variegata, Zanard.

Puffin I. (G).

P. brodiaei, Grev.

Locality not recorded (M); Puffin I. (G).

P. byssoides, Grev.

Locality not recorded (M); Puffin I. (G).

P. nigrescens, Grev.

Variable in colour, at New Brighton, Eastham, and Hilbre I.; common (M). Puffin I. (G).

P. fastigiata, Grev.

Common on species of *Fucus* (M). Extremely abundant at Puffin I., parasitic on *Ascophyllum nodosum* (G). Locality not recorded (L).

P. formosa, Suhr.

Locality not recorded (M and L) ; Puffin I. (G).

P. fibrata, Harv.

Hilbre and Puffin Is. (M and G).

P. fibrillosa, Grev.

Locality not recorded (L).

Dasya coccinea, Ag.

Marrat records two varieties, one a bright rose red, the other a dull purple, from the I. of Man, Hilbre and Puffin Is., and elsewhere. I found the rose red variety to be one of the commonest of the Rhodophyceæ on Puffin I. Marrat remarks that "the Hilbre Island plants are not like either the Manx or Devonshire forms." Locality not recorded (L).

Family. CORALLINIDÆ.

Melobesia farinosa, Lamour.

General on the coast (M).

M. membranacea, Lamour.

General on the coast (M). Puffin I. (G).

M. pustulata, Lamour.

Parasitic on *Phyllophora rubens*, at Puffin' I. (M) ; also on various other Rhodophyceæ at the same locality (G). I confess to having some doubts as to the advisability of separating these two forms, *M. pustulata* and *M. membranacea*. Croall and Johnstone (*Nature Printed British Seaweeds*) consider the latter as an "imperfectly developed state" of the former.

M. verrucata, Lamour.

Locality not recorded (M); parasitic on various Rhodophyceæ at Puffin I. (G).

M. rubra, Meneg.

General (M). This species is not recorded in the works of Harvey or any other writer on British seaweeds. I have not had access to Meneghini's works, and so am unable to say whether it is represented by a synonym in other lists.

Lithothamnion calcareum, J. Ag.*Melobesia calcarea*, Harvey.

A deep water species, dredged in large quantities in the "Hyæna" expedition of 1888. Prof. Herdman informs me that the bottom of the Irish Sea, round the eastern shores of the Isle of Man, seems in many places to be covered with this species.

L. polymorphum, Aresch.*Melobesia polymorpha*, Harvey.

Isle of Man (M).

L. fasciculatum, Aresch.*Melobesia fasciculata*, Harvey.

Puffin I. (M).

Lithophyllum lichenoides, Rosan.*Melobesia lichenoides*, Harvey.

Puffin I. (M and G).

Corallina rubens, Linn.*Jania rubens*, Harvey.

Puffin I. (M and G).

C. officinalis, Linn.

Very abundant in rock pools on the coast generally (M and G). Locality not recorded (L).

Series B. **PHÆOPHYCEÆ.**Order II. **FUCOIDEÆ.**Family. **FUCIDÆ.**

Sargassum linifolium, Ag.

Sargassum vulgare, Harvey.

Not unfrequently cast ashore (M).

Himanthalia lorea, Lyngb.

Abundant at the Isle of Man (M).

Ascophyllum nodosum, Le Jol.

Fucus nodosus, Harvey.

Very abundant at Puffin and Hilbre Is., and elsewhere (M and G). Locality not recorded (L).

A. nodosum, Le Jol., var. *scorpioides*.

Occasionally on the coast of Anglesey (G).

Fucus vesiculosus, Linn.

Abundant on the coast generally (M and G).
Locality not recorded (L).

F. platycarpus, Thur.

Two or three patches on the rocks at the north end of Puffin I. (G).

F. serratus, Linn.

Extremely abundant on the coast generally (M and G). Locality not recorded (L).

F. canaliculatus, Linn.

Abundant at Hilbre I. (M). Also at Puffin I. (G).

Halidrys siliquosa, Lyngb.

Frequently cast up in drift (M and G). Locality not recorded (L).

Cystosira granulata, Ag.

Rarely at Hilbre I. (M).

Order III. DICTYOTEÆ.

Family. DICTYOTIDÆ.

Dictyota dichotoma, Lamour.

I. of Man, Puffin I. (M). Locality not recorded (L).

Order IV. PHÆOZOOSPOREÆ.

Family. ECTOCARPIDÆ.

Myrionema vulgare, Thur.

M. strangulans, Harvey.

Locality not recorded (M).

M. lechlancherii, Grev.

Hilbre I., on *Rhodymenia palmata* (M).

M. punctiforme, Harv.

On *Ceramium rubrum* and *C. deslongchampi* at Hilbre I. (M).

Ectocarpus velutinus, Kütz.

Elachista velutina, Harvey.

Parasitic on *Himantalia lorea*, Isle of Man (M).

E. tomentosus, Lyngb.

Common on species of *Fucus* at Hilbre I. and New Brighton (M).

E. crinitus, Carn.

Marrat states that some plants of this species were found growing in the Aquarium in the Liverpool Museum, but does not state whence they were obtained.

E. confervoides, Le Jol.

E. siliculosus, Harvey.

The landing stage of New Brighton, and Eastham; also at Hilbre I. and elsewhere (M).

E. fasciculatus, Harv.

Occasionally at Hilbre I. (M).

E. granulosa, Ag.

New Brighton and Hilbre I. (M); Puffin I. (M and G).

E. littoralis, Lyngb.

On species of *Fucus* (M). One of the commonest species of *Ectocarpus* at Puffin I. (G).

E. hinksiae, Harv.

The coast generally (M and G).

Myriotrichia clavæformis, Harv.

Generally on the coast (M).

M. filiformis, Harv.

Locality not recorded (M).

Sphacelaria radicans, Ag.

Not uncommon on the South shore and at New Brighton (M).

S. cirrhosa, Ag.

Common at Hilbre I., Eastham, and I. of Man (M); also at Puffin I. (G).

S. fusca, Ag.

Not rare at Puffin and Hilbre Is. (M).

S. scoparia, Lyngb.

Common at Hilbre (M), and at Puffin Is. (G).

Chætopteris plumosa, Kütz.*Sphacelaria plumosa*, Harvey.

Hilbre and Puffin Is., rare (M); rather plentiful on the north-east end of Puffin I. (G). Locality not recorded (L).

Cladostephus verticillatus, Ag.

Puffin I. (M).

C. spongiosus, Ag.

Puffin and Hilbre Is., not rare (M). Plentiful at the former and tolerably abundant at low water at the latter locality (G). Locality not recorded (L).

Family. MESOGLÆIDÆ.

Elachista scutellata, Duby.

On the stems of *Himanthalia lorea*, near Port St. Mary, I. of Man (M).

E. flaccida, Aresch.

On *Cystosira fibrosa* (M).

E. fucicola, Fries.

Very common on species of *Fucus* (M and G).

Leathesia umbellata, Menegh.

L. tuberiformis, Harvey.

Hilbre I. (M).

Castagnea virescens, Thur.

Mesoglæa virescens, Harvey.

Locality not recorded (M).

Mesoglæa vermiculata, Le Jol.

M. vermicularis, Harvey.

Puffin and Hilbre Is., and shore generally (M and G).

M. verticillata, Ag.

Puffin I. (M).

Chordaria flagelliformis, Ag.

Hilbre I., Eastham, South shore, &c. (M). Puffin

I. (G).

Family. PUNCTARIIDÆ.

Punctaria plantaginea, Grev.

Coast generally (M and G).

P. latifolia, Grev.

Locality not recorded (L).

Dictyosiphon fœniculaceus, Grev.

Hilbre I., Eastham (M). In drift at Penmon Pt. (G).

Striaria attenuata, Grev.

Coast generally (M).

Desmarestia viridis, Lamour.

Isle of Man (M). Puffin I. (M and G). Locality not recorded (L).

D. aculeata, Lamour.

Cast ashore frequently; abundant at the I. of Man (M), and at Puffin I. (M and G). Locality not recorded (L).

Litosiphon pusillus, Harv.

On *Chorda filum*, at Bangor and Hilbre I. (M).

L. laminariæ, Harv.

On *Chorda filum*, at Bangor and Hilbre I. (M).

Family. SPOROCHNIDÆ.

Asperococcus echinatus, Grev.

I. of Man and Hilbre I. (M); Puffin I. (M and G).

A. turneri, Hook.

Locality not recorded (M).

Family. SCYTOSIPHONIDÆ.

Phyllitis fascia, Kütz.

Laminaria fascia, Harvey.

Hilbre I., at extreme low water (M).

Scytosiphon lomentarius, J. Ag.

Chorda lomentaria, Harvey.

Hilbre and Puffin Is. and Isle of Man (M).

Family. LAMINARIIDÆ.

Chorda filum, Stackh.

Hilbre I., between the Great and the Little Eye (M).

Puffin I., at extreme low water (G).

Laminaria digitata, Lamour.

Welsh coast and Isle of Man (M). Very abundant at extreme low water at Puffin I. (G). Locality not recorded (L).

L. saccharina, Lamour.

Port St. Mary, I. of Man (M). Puffin I. and Penmon Point (G). Locality not recorded (L).

L. saccharina, Lamour, var. *phyllitis*.

Laminaria phyllitis, Harvey.

On the life-boat, New Brighton (M).

Alaria esculenta, Grev.

I. of Man, Anglesey, and Hilbre I., at low water (M).

Ralfsia verrucosa, J. Ag.

Puffin I. (M and G).

Family. CUTLERIIDÆ.

Cutleria multifida, Grev.

Hilbre and Puffin Is., and Isle of Man (M).

Aglaozonia reptans, Kütz.

Zonaria parvula, Harvey.

Coast generally (M).

Series C. **CHLOROPHYCEÆ.**

Order V. OOSPOREÆ.

Family. VAUCHERIIDÆ.

Vaucheria marina, Ag.

New Brighton (M).

V. thuretii, Woron.

V. velutina, Harvey.

Forming velvety cushions on the mud near high water mark at Eastham (M).

Order VI. CHLOROZOOSPOREÆ.

Family. ULVIDÆ.

Monostroma grevillei, Wittr.

Ulva lactuca, Harvey.

Locality not recorded (M). Puffin I. (G).

Enteromorpha intestinalis, Link.

Not uncommon (M). Exceedingly abundant in pools near high water mark and beneath that point, at Puffin I. (G).

E. linza, J. Ag.

Ulva linza, Harvey.

Common (M and G).

E. compressa, Grev.

Not uncommon (M and G).

E. clathrata, T. Ag.

Eastham (M).

E. erecta, J. Ag.

Occasionally at New Brighton (M).

E. ramulosa, Hook.

Plentiful (M and G).

E. percursa, J. Ag.

Occasionally on mud at New Brighton (M).

E. ralfsii, Harv.

General on the coast (M and G).

E. granulosa, (—?).

Marrat records this species, without giving the authority, from New Brighton.

Ulva lactuca, Le Jol., var. *genuina*.

Ulva latissima, Harvey.

Common at Hilbre I. and New Brighton (M). Very abundant in pools at or near high water at Puffin I. (G). Locality not recorded (L).

Family. CONFERVIDÆ.

Chætomorpha melagonium, Kütz.

Conferva melagonium, Harvey.

The coast generally (M). Puffin I. (G).

C. crassa, Kütz.

Conferva linum, Harvey.

Locality not recorded (M). Puffin I. (G).

C. ærea, Kütz.

Conferva ærea, Harvey.

South shore and Eastham (M).

C. tortuosa, Kütz.

Conferva tortuosa, Harvey.

On the North slip, Prince's Pier (M).

Ulothrix flacca, Thur.

Lyngbya flacca, Harvey.

Isle of Man (M).

U. isogona, Thur.

Lyngbya speciosa, Harvey.

Common at Puffin I. (G), and generally (M).

Rhizoclonium tortuosum, Kütz.

Conferva implexa, Harvey,

Locality not recorded (M). Puffin I. (G).

R. riparium, Harv.

Bromborough and Wallasey Pools, Eastham, and
Hilbre I. (M).

R. gasparyi, Harv.

Eastham (M).

Cladophora arcta, Kütz.

Bromborough and Wallasey Pools, Eastham, and
Hilbre I. (M). Puffin I. (G).

C. lanosa, Kütz.

Isle of Man and Anglesey (M). Puffin I. (M and G).
Parasitic on *Fastigiaria furcellata*.

C. pellucida, Kütz.

In a cave at Hilbre I. (M).

C. rupestris, Kütz.

Very common (M and G).

C. hutchinsiae, Kütz.

Isle of Man, New Brighton, and Hilbre I. (M).

C. diffusa, Harv., recorded as from New Brighton by Marrat, is synonymous with *C. hutchinsiae*.

C. utriculosa, Kütz., var. *latevirens*.

C. latevirens, Harvey.

Not uncommon at New Brighton (M). Puffin I. (G).

C. flexuosa, Harv.

New Brighton, Hilbre I., Eastham (M). Puffin I. (G).

C. rudolphiana, Harv.

Not uncommon at Hilbre I. (M).

C. gracilis, Kütz.

Occasionally at Hilbre I. (M).

C. albida, Kütz.

Eastham and Puffin I. (M).

C. glaucescens, Harv.

Puffin and Hilbre Is. (M and G).

C. fracta, Kütz.

C. flavescens, Harvey.

Bromborough Pool (M).

C. refracta, Kütz.

Puffin I. (M).

C. uncialis, Harv.

Puffin I. (M).

Family. BRYOPSIDÆ.

Bryopsis plumosa, Ag.

Isle of Man, Anglesey, Hilbre and Puffin Is., New Brighton (M).

B. hypnoides, Lamour.

Hilbre I. (M).

Conferva arenosa, Carm.

South shore (M).

C. litorea, Harv.

South shore and Eastham (M).

C. sutoria, Berk.

Hilbre I. (M).

C. youngana, Dilln.

Bromborough and Wallasey Pools, and the life-boat,
New Brighton (M).

[The genus *Conferva* is one into which many dubious forms have been placed from time immemorial. I insert the above mentioned species here because they have been recorded by Marrat; and while they may be good species, there is the possibility that some of them may be merely varieties of one species under different conditions.]

Series D. **CYANOPHYCEÆ.**

Order VI. **SCHIZOPHYCEÆ.**

Family. **NOSTOCIDÆ.**

Calothrix confervicola, Ag.

Common on species of *Ceramium* (M).

C. scopulorum, Ag.

Generally distributed (M).

Rivularia plicata, Carm.

Generally distributed (M).

R. atra, Roth.

Generally distributed at Hilbre I. and South shore
(M).

R. biasoletiana, Menegh.

Schizosiphon warreniæ, Harvey.

On mud-covered rocks (M).

Sphærozyga carmichaelii, Harv.

Eastham (M).

Lyngbya maguscula, Harv.

Not uncommon at Hilbre I., Eastham, and Wal-
lasey (M).

L. semiplena, Ag.

Calothrix semiplena, Harvey.

Generally distributed (M).

L. æstuarii, Liebm.

L. ferruginea, Harvey.

Bromborough Pool and Hilbre I. (M).

Microcoleus chthonoplastes, Thur.

M. anguiformis, Harvey.

Generally distributed (M).

Oscillatoria littoralis, Carm.

North and South shores (M).

O. spiralis, Carm.

Eastham (M).

O. nigroviridis, Thwaites.

Eastham (M).

Family. CHROOCOCCIDÆ.

Gleocapsa crepidium, Thur.

On stones near high water mark, at Puffin I. (G).

SECOND REPORT on the *PORIFERA* of the L.M.B.C.
DISTRICT.

BY RICHARD HANITSCH, Ph.D.,

DEMONSTRATOR OF ZOOLOGY IN UNIVERSITY COLLEGE, LIVERPOOL.

With Plates V., VI. and VII.

[Read 8th February, 1889.]

SINCE the publication in 1886 of the "First Report upon the Porifera," by Mr. Thomas Higgin, F.L.S., in the first volume of "The Fauna of Liverpool Bay," several very important works upon the Sponges have appeared which have changed to a considerable extent the accepted views as to the classification of the group, and render a re-arrangement of the species dealt with in the former report absolutely necessary. I have found it convenient to arrange the Sponges in the following groups:—Myxospongiæ, Ceratosa, Monaxonida, Tetractinellidæ, Hexactinellidæ, and Calcarea. I regard these groups as orders, although I do not wish to state that they are all equivalent to each other. Every one of these orders, except the Myxospongiæ, has been treated of in a separate "Challenger" Report, and this fact justifies my classification sufficiently. In the further division of the orders I shall accept Ridley and Dendy's system for the Monaxonida, and Sollas's system for the Tetractinellidæ. In regard to the Calcarea, I shall follow Mr. Higgin's example and use Haeckel's classification, instead of that of Polejaeff. The Sponges in our district belonging to the remaining orders are so few in number that any further classification of them is unnecessary.

I will add an explanation, why I did not follow the latest classification of the sponges given by R. v. Lendenfeld,

in his "Catalogue of the Sponges in the Australian Museum, Sydney." This is the only work on sponges from that author which I have been able to see, and it would have been very difficult to identify even the genera by that catalogue, as figures of spicules and similar details necessary for identification are not given. Nor, perhaps, as v. Lendenfeld's work is a museum catalogue, should we expect to find illustrations of that kind in it. Finally, it did not seem advisable to me to re-arrange the species which I had identified chiefly by Bowerbank's "British Spongiadæ" and the "Challenger" Reports, according to the system of another author, especially as it has not yet been shown that v. Lendenfeld's classification is superior to that of the "Challenger" Reports.

The following list includes the Sponges recorded by Mr. Higgin in his "Report on the Porifera of the L.M.B.C. District." Those Sponges are marked in column "I." whilst the additions made in the present report are given in column "II." The nomenclature of this report differs in some cases from that of the first report, and I shall give the latter nomenclature in brackets. For the names of authors I use the following abbreviations:—

B. Bowerbank.	H. Haeckel.
C. Carter.	J. Johnston.
F. Fleming.	M. Montagu.
G. Gibson.	S. O. Schmidt.

I am able to add seven to the list of sponges recorded from this neighbourhood, of these is one (*Reniera semitubulosa*, S.) new to British seas, and one (*Seiriola compacta*) is new to science.

LIST of PORIFERA recorded from the L.M.B.C. DISTRICT.

Order I. MYXOSPONGIÆ.

Family.		I.	II.
HALISARCIDÆ <i>Halisarca dujardini</i> , J.	×	×

Order II. CERATOSA.

SPONGELIDÆ <i>Dysidea fragilis</i> , J.	×	×
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Order III. MONAXONIDA.

Subord. HALICHONDRINA.

HOMORRHAPHIDÆ.	<i>Halichondria panicea</i> , J.	×	×
	(<i>Amorphina panicea</i> .)		
	<i>Halichondria coccinea</i> , B.....	×	
	(<i>Amorphina coccinea</i> .)		
	<i>Halichondria albescens</i> , J.....	×	
	(<i>Amorphina albescens</i> .)		
	<i>Halichondria caruncula</i> , B.	×	
	(<i>Amorphina caruncula</i> .)		
	<i>Reniera varians</i> , B.	×	×
	(<i>Isodictya varians</i> .)		
	<i>Reniera elegans</i> , B.	×	
	(<i>Isodictya elegans</i> .)		
	<i>Reniera simulans</i> , J.	×	
	(<i>Isodictya simulans</i> .)		
	<i>Reniera fistulosa</i> , B.	×	×
	(<i>Isodictya fistulosa</i> .)		
	<i>Reniera clava</i> , B.	×	
	(<i>Isodictya clava</i> .)		
	<i>Reniera semitubulosa</i> , S.		×
	<i>Chalina oculata</i> , J.	×	×
	<i>Chalina limbata</i> , M.	×	×
	<i>Chalinula pallida</i> , B.	×	
	(<i>Isodictya pallida</i> .)		
	<i>Chalinula densa</i> , B.	×	
	(<i>Isodictya densa</i> .)		

Family.	I.	II.
HETERORRHAPHIDÆ. None.		
DESMACIDONIDÆ.. <i>Desmacidon incrustans</i> , J.....	×	
(<i>Halichondria incrustans</i> .)		
<i>Desmacidon fucorum</i> , J.....	×	×
(<i>Isodictya fucorum</i> .)		
<i>Esperia ægagropila</i> , C.....	×	
<i>Clathria seriata</i> , J.	×	
(<i>Ophlitaspongia seriata</i> .)		
<i>Plumohalichondria plumosa</i> , C...	×	
AXINELLIDÆ..... <i>Hymeniacidon sanguinea</i> , J.....	×	
<i>Raspailia viminalis</i> , S.		×
<i>Raspailia stelligera</i> , S.	×	×
(<i>Dictyocylindrus stuposus</i> , B.)		
Subord. CLAVULINA.		
SUBERITIDÆ. <i>Suberites carnosa</i> , J.	×	
<i>Suberites suberea</i> , M.....	×	×
<i>Cliona celata</i> , J.	×	×
<i>Papillina suberea</i> , S.	×	
(<i>Raphyrus griffithsia</i> , B.)		
<i>Polymastia mammillaris</i> , J.....		×
<i>Polymastia robusta</i> , B.		×

Order IV. **TETRACTINELLIDÆ.**

Subord. CHORISTIDA.

TETILLIDÆ..... <i>Tethya lyncurium</i> , J.....		×
PACHASTRELLIDÆ.. <i>Dercitus niger</i> , C.	×	
SEIRIOLIDÆ. <i>Seiriola compacta</i> , n. sp.		×
STELLETTIDÆ. <i>Stelletta grubii</i> , S.	×	
<i>Ecionema ponderosa</i> , B.....	×	×
GEODIIDÆ <i>Pachymatisma johnstonia</i> , B. ...	×	×

Subord. LITHISTIDÆ.

None.

Order V. **HEXACTINELLIDÆ.**

None.

Order VI. **CALCAREA.**

Family.		I.	II.
ASCONES	<i>Ascetta primordialis</i> , H.....		×
	<i>Ascetta coriacea</i> , F.	×	
	<i>Ascaltis botryoides</i> , F.	×	
LEUCONES	<i>Leucandra fistulosa</i> , J.....	×	
	<i>Leucandra gossei</i> , B.	×	
	<i>Leucandra nivea</i> , F.	×	
	<i>Leucandra johnstonii</i> , C.	×	
SYCONES	<i>Sycandra ciliata</i> , F.	×	×
	<i>Sycandra compressa</i> , F.....	×	×
	<i>Aphroceras ramosa</i> , C.	×	
	<i>Sycortis aspera</i> , G.....	×	

Order I. **MYXOSPONGIÆ.***Halisarca dujardini*, J.

Frequently met with by dredging and shore collecting at Puffin Island and other places. There seem to be two colours, grey and brownish.

Order II. **CERATOSA.***Dysidea fragilis*, J.

Dredged in Church Bay, near Holyhead, "Hyæna" Expedition, 1886. Collected on the Beacon Rocks, Puffin Island, 1st February, 1888.

Order III. **MONAXONIDA.***Halichondria panicea*, J.

Collected at Puffin Island, Hilbre Island, &c. on various occasions.

Reniera varians, B.

Collected at Hilbre Island, 20th March, 1886.

Reniera fistulosa, B.

Collected on "Hyæna" Expedition, 1888, off the south end of the Isle of Man, 20 fathoms.

Reniera semitubulosa, O. Schmidt.

Pellina semitubulosa, O. Schmidt.

Halichondria semitubulosa, Lieberkühn.

This Sponge was first described by Oscar Schmidt, in his "Spongien des Adriatischen Meeres." It had been found commonly near Venice, and formed an irregular base with numerous ascending branches, which were here and there fused together. The colour was greenish or whitish. One of the chief characteristics was that the dermal membrane could easily be separated from the underlying tissue. The oscula were found mostly on the extremities of the branches, but also on the other parts of the surface. The spicules were oxea. A few years afterwards O. Schmidt formed the new genus *Pellina*,* and gave the species which he formerly called *Reniera semitubulosa* as the type for it. In the same work he describes two other species of this genus: *Pellina bibula*, found in the Kattegat, and *Pellina profunditatis*, found near Florida.

Ridley and Dendy† do not agree with O. Schmidt's proposal to form a new genus for this sponge, not regarding the character of the separable dermal membrane as being of generic importance. They further remark, "The so-called dermal membrane is also a very distinct feature of *Halichondria panicea*, yet Schmidt keeps this species out of his genus *Pellina*, into which it ought certainly to fall

* Oscar Schmidt, "Spongienfauna d. Atl. Gebietes."

† Ridley and Dendy, "Report on the Monaxonida collected by H.M.S. *Challenger*," p. 15.



according to his definition, if such it can be called." For this reason I am also inclined to retain the generic name *Reniera* for this sponge.

A small specimen of it was found on the North Spit at Puffin Island, at low water, in September, 1887. The base of the specimen is about 2·5 cm. in height and 1 cm. in thickness. There are five branches arising from the base, three of which are broken off close to their origin, the two others are about 8 mm. in length by 3 mm. in diameter. The spicules are oxea, and measure about 0·3 mm. They are arranged in multispiculous triangular or quadrangular meshes.

Chalina oculata, J.

Dredged in Church Bay, near Holyhead, on the "Hyæna" Expedition, 1886.

Chalina limbata, M.

Two splendid specimens were obtained on the Beacon Rocks at Puffin Island, at low spring tide, 1st February, 1888.

Desmacidon fucorum, J.

Dredged in Church Bay, near Holyhead, on the "Hyæna" Expedition, 1886; also off the North side of Puffin Island 12—15 fathoms, in February, 1888; and on 24th March, 1888; also off Calf of Man, 20 fathoms, "Hyæna" Expedition, 20th May, 1888.

Genus *Raspailia*, Nardo.

The genus *Raspailia* was founded first by Nardo, in the year 1833. The exact words of his definition are not known to me, but as Oscar Schmidt* states that he accepts Nardo's definition of the genus, giving it however in his own words, we may take it for granted that

* Oscar Schmidt, "Spongien des Adriatischen Meeres," p. 59.

Schmidt's definition agrees in general with that of Nardo. The characters are: from the narrow base of the sponges of the genus *Raspailia* branches are given off which may be simple or dichotomous. The spicules are arranged in two different ways—some lie in bundles in the vertical axis, the others are placed horizontally and project through the ectoderm. The bases of the spicules are imbedded in ceratose. The colour of the sponges is a dark yellow. Schmidt describes three species of this genus, two of which are of special interest to us: *Raspailia viminalis*, S. (with large and small styli and spined styli), and *Raspailia stelligera*, S. (with large and small styli and spherasters).

Bowerbank, when he published the first two volumes of his "British Spongiadæ," took no notice of Schmidt's researches, and so it came to pass that many species which had been already described by Schmidt, were re-described by Bowerbank as new species, and were christened once more. To those privileged sponges belonged the genus *Raspailia*, Nardo. Bowerbank's error was first pointed out by O. Schmidt, in his second supplement to the above mentioned work, and he stated that the sponges of the genus *Dictyocylindrus*, B., belong either to *Raspailia*, Nardo, or to *Axinella*, S., and that *Dictyocylindrus stuposus*, B., is identical with *Raspailia stelligera*, S. Consequently we find in Ridley and Dendy's classification the genera *Raspailia*, Nardo, and *Axinella*, S., instead of *Dictyocylindrus*, B. But their definition of *Raspailia* does not quite agree with that of Nardo and Schmidt, as they have added the negative character "no microsclera." Now *Raspailia stelligera*, S., could not come under the genus *Raspailia* as defined by Ridley and Dendy, for this species has microsclera. And it becomes still more difficult to find a place for *Raspailia stelligera*, S., in Ridley and Dendy's system, when we read on page xxi. of their "Introduction"

to the Report on the Monaxonida, that the only stellate forms of microsclera "which are certainly known to occur in the Monaxonida" are "spirulæ, discastra and amphiastra." According to this, *Raspailia stelligera*, S., as having spherastrous microscleres would not even belong to the Monaxonida. But there can be no doubt that *Raspailia stelligera* is a true monaxonid sponge, and I think even the presence of microsclera not important enough to remove it from the genus in which it had been placed by Schmidt. Therefore I would amend two points in Ridley and Dendy's Report. Firstly, spherasters should be mentioned as being a fourth form of stellate microsclera in the Monaxonida; and secondly, the limits of the genus *Raspailia* should be enlarged by leaving out the negative character "no microsclera," so as to reconstitute the older and wider genus defined by Nardo and Schmidt.

Raspailia viminalis, Schmidt (Pl. V., figs. 2—4).

Dictyocylindrus ventilabrum, Bowerbank.

Both the figures and the description of *Dictyocylindrus ventilabrum*, B., as given by Bowerbank, agree so fully with all the characters of *Raspailia viminalis*, S., as given by Schmidt, that I do not hesitate to consider those species as identical.

One specimen of this species was dredged on the "Hyæna" Expedition, 1886, in Church Bay, near Holyhead. Bowerbank records it from the British Channel and Brighton, and O. Schmidt from the Adriatic Sea. The colour of the living sponge is orange yellow.

Our specimen was apparently quite a young one, as it measured only 3·5 cm. in height. The stem is cylindrical, has a well pronounced expanded base, and bears distally two branches. The beginning of a third branch is just visible (see Pl. V., fig. 2). Bowerbank had much larger

specimens at his disposal. Of one of them he gives the following description:—"The pedicel is barely an inch in height; at an inch and a half from the base it has divided into four primary branches; within one inch from their origin these primary branches each divide dichotomously, and this mode of division continues, with a single exception of one branch dividing trichotomously, so that at four inches from the base there are as many as twenty-two, all nearly in the same plane, assuming a fan-shaped series of branches, eight inches in height by about the same extent in width. The branches are cylindrical," &c.

A transverse section through this sponge shows us that it consists of a solid mass without central cavity. The oscula are numerous, although visible only in those sections. Bowerbank has stated that the "oscula and pores are inconspicuous." The oscula open into irregular cavities, branching throughout the whole sponge. The spicules consist firstly of styli of two different sizes. The large styli measure from 1.2 mm. to 1.5 mm. by 0.013 mm.; the shorter ones from 0.42 mm. to 0.45 mm. by 0.004 mm. Besides that, we find spined styli, 0.124 mm. by 0.0055 mm. The ordinary styli are arranged either in bundles running parallel to the longitudinal axis of the sponge, or they form bundles standing at right angles to the longitudinal axis, and project for about two-thirds of their length through the ectoderm. This latter point had been noticed by Bowerbank,* who said that "in the dried condition of the sponge the fasciculi of radiating spicula project from the central cylinder of the skeleton to the extent of at least one-third of the whole diameter of the branch," but he adds, "it is probable that in a living state their apices would be barely visible beyond the dermal membrane." As I have stated already, sections through a well preserved

* Bowerbank, "British Spongiadæ," vol. ii., p. 101.

specimen of *Raspailia viminalis* do not leave any doubt that in a living state the spicules do project beyond the ectoderm. These projecting bundles of styli consist, in most cases, of one large stylus surrounded by a number of small ones. In some cases the bundles consist only of small styli, and lastly the large styli are also found singly. All those different arrangements are represented in the semi-diagrammatic figure (Pl. V., fig. 4). The spined styli are found scattered throughout the whole mass of the Choanosome.

Raspailia stelligera, Schmidt (Pl. V., fig. 1).

Dictyocylindrus stuposus, Bowerbank.

As Mr. Higgin states, this species has already been collected at Port Erin, Holyhead and Isle of Man. On the 16th and 17th of February last, Professor Herdman obtained a number of bright orange coloured sponges at extreme low tide, under one of the ledges of rock, on the north end of Puffin Island, near the Biological Station. The specimens showed a narrow base and an expanded distal portion with more or less numerous short branches. The whole mass was beset with rough ridges, and spicules were seen projecting through the ectoderm. The height of the sponge-masses varied between 2 cm. and 4 cm. Transverse and longitudinal sections through this sponge show that the arrangement of the megasclera is here the same as in *Raspailia viminalis*. The only remarkable point is the great masses of ceratose in which the bases of the spicules, especially of those in the interior, are imbedded. The bundles of the projecting spicules consist of styli, and the centre of these bundles is commonly formed by one or more shorter and stouter styli (0·92 mm. by 0·012 mm.), which are surrounded by long and thin styli (0·8—1·5 mm. by 0·0043 mm.). The spicules of the

interior are in most cases strongyla (0·54—0·85 mm. by 0·012 mm.), besides which there are found also styli of the above mentioned kind, and a very few oxea. The microsclera are spherasters, with about twelve rays, and measuring 0·02 mm. in diameter. Those spherasters are found only in the ectosome; they lie very close to the surface and are numerous, although they do not form a continuous layer.

Suberites suberea, M.

Collected at Puffin Island, on the North side, 14th January, 1888, and on the South Spit, March, 1888.

Cliona celata, J.

Raphyrus griffithsia, B.

Very common, boring in old shells and in the limestone rocks, at Puffin Island.

Polymastia mammillaris, Johnston (Pl. VI., figs. 1—3).

Spongia penicillus, Montagu.

Halichondria mammillaris, Johnston.

One small specimen of this Sponge was dredged in Church Bay, near Holyhead, on the "Hyæna" Expedition of 1886, and it is the first one which has been obtained in the L.M.B.C. district, although the species had previously been found at many points on the British coast. Johnston gives the following localities: coast of Devon, Scarborough and Strangford. Bowerbank mentions Larne Lough, Guernsey, Shetland, and the Orkney Islands. According to Vosmaer,* it is found in the Atlantic, Arctic, Mediterranean and Adriatic Seas generally. The specimen from Holyhead has a rounded basal mass of about 7 mm. in diameter, and had apparently been fixed to a small stone. Four papillæ are given off, the largest of which is 8 mm.

* Vosmaer, "Sponges of the Willem Barrents Expedition, 1880 and 1881," in "Bijdragen tot de Dierkunde."

in height. I do not think it necessary to figure this specimen, as figures of the entire *Polymastia mammillaris* have been given by Johnston, Bowerbank and Vosmaer. Vosmaer figures also a section through the basal mass and one of the papillæ. As the figure, however, is quite a low power view, it does not show some points of interest which I was able to make out in transverse and longitudinal sections through two of the papillæ. The papillæ have the form of tubes, in which the diameter of the central cavity is about as large as, or slightly larger than, the thickness of the wall. This central cavity gives off numerous recesses into the wall, which come so close to the surface that only a thin membrane, 0.02 mm. in thickness, is left separating the cavity from the outer world (see figs. 2 and 3, Pl. VI.). Seen from the surface those membranes are round or oval in outline, with a diameter of 0.08 to 0.14 mm. Oscula are not present either on the extremity of the papillæ or on their sides. The absence of oscula in the papillæ agrees with the generic characters of *Polymastia* given by Ridley and Dendy.*—"Genus *Polymastia*, Bowerbank. Suberitidæ of massive, sessile form, with more or less numerous mammiform processes on the upper surface, some of which may bear oscula at their summits, but usually without visible openings." Pores are most probably present in the above mentioned thin membranes (pore membranes), but I have not been able to see them satisfactorily.

The skeleton of *Polymastia mammillaris* has already been sufficiently described by the above mentioned authors. In the wall of the papillæ we find bundles of large and stout tylostyli (0.75—0.8 mm. by 0.01—0.012 mm.), running parallel to the long axis of the papillæ, and further bundles of short and thin tylostyli (0.15 mm. by

* Ridley and Dendy, "Report on the Monaxonida collected by H.M.S. *Challenger*," p. 210.

0·003 mm.) standing perpendicularly to the longitudinal axis and projecting for half their length through the ectoderm. One spicule of the former kind is given in fig. 1 *a*, Pl. VI.; one of the latter kind in fig. 1 *b*, Pl. VI. In regard to the arrangement of the spicules see figs. 2 and 3, Pl. VI.

Polymastia robusta, Bowerbank.

Dredged in Church Bay, near Holyhead, on the "Hyæna" Expedition of 1886. The largest of the three specimens has a flat basal mass, 5·5 cm. by 4 cm. in horizontal expansion and 1·5 cm. in thickness. On one side it bears between 30 and 40 papillæ, which in the natural condition probably are standing upright, but now have become pressed down upon the basal mass. These papillæ are laterally compressed and vary greatly in size. The largest measure 2 cm. in height and 7 mm. in breadth. They taper towards the extremities, but there are no oscula visible on their extremities. The dermal membrane can very readily be torn off from the basal mass. The colour of the specimens, which have been kept in spirit for nearly three years, is whitish. The skeleton consists of styli, which are of two different sizes: 0·6 mm. by 0·01 mm. and 0·17 mm. by 0·004 mm. The arrangement of the spicules is similar to that of *Polymastia mammillaris*.

According to Bowerbank, *Polymastia robusta* is found on the coast of Northumberland.

Order IV. **TETRACTINELLIDÆ.**

Tethya lyncurium, J.

Dredged in Church Bay, near Holyhead, on the "Hyæna" Expedition of 1886. This species had not previously been recorded in the L.M.B.C. district, although it is found, according to Bowerbank, at various localities on the British

coast: Plymouth, Torquay, Guernsey, Diamond Ground off Hastings. I may add the Chausey Islands, off the Normandy coast, from which locality there is one specimen, collected by Professor Herdman in 1882, in the Zoological Museum of University College, Liverpool. *Tethya lynceurium* has been found by Oscar Schmidt in the Adriatic Sea, and by Vosmaer in the Adriatic, Mediterranean, and Arctic Seas. A description of this well known sponge is not wanted.

SEIRIOLIDÆ, n. fam.

The tetractinellid sponge, described below under the name *Seiriola compacta*, appears so different from all described forms that I am obliged to found a new family for it, the "Seiriolidæ," called after St. Seiriol's Island, an older name for Puffin Island. This new family belongs clearly to the demus *Streptastrosa*, Sollas, since *Seiriola compacta* is an astrophorous sponge in which one of the microscleres is some form of spiraster. The three families of the demus *Streptastrosa*, Sollas, are now as follows:—

Fam. 1. THEBNEIDÆ: "The ectosome never forms a cortex; the mesoderm is a collenchyma; the flagellated chambers eurypylous" (Sollas).*

Fam. 2. PACHASTRELLIDÆ: "Streptastrosa, in which the chief megascleres are calthrops; triænes being absent. The microscleres may be spirasters, spherasters or microrabds. The choanosomal mesoderm is sarcenchymatous and the chamber system aphodal" (Sollas).

Fam. 3. SEIRIOLIDÆ: The ectosome forms a cortex. Chief megascleres triænes. The choanosomal mesoderm is cystenchymatous.

* Sollas, "Report on the Tetractinellidæ collected by H.M.S. *Challenger*," pp. 59 and 104.

Seiriola,* n. gen.

Characterized by the tylostyles of the ectosome. This genus is formed for the single new species

Seiriola, compacta, n. sp. (Pl. VII., figs. 1 to 3).

This sponge was found by Mr. Rutherford, Curator of the Biological Station, Puffin Island, in June, 1888, in one of the caves on the N.W. side of the island which are exposed only at low spring tides.

The specimen forms a knob-like mass, like that of so many tetractinellid sponges, and measures horizontally 4 cm. by 1·5 cm., and vertically 1·3 cm. It is dark grey in colour and has a somewhat rough surface. A vertical section through this sponge shows that the cortex (which in this species is quite identical with the ectosome) is extraordinarily well marked off from the choanosome, and further examination shows that the ectosome is both in regard to skeleton and to histological structure, very different from the choanosome. The spicules of the ectosome are tylostyles, and their shape and arrangement reminded me at once of *Polymastia mammillaris*, which sponge, of course, belongs to quite a different group. These tylostyles measure from 0·1 to 0·38 mm. by 0·003 to 0·006 mm. They are arranged in bundles, and project for about one-half of their length through the ectoderm (see fig. 1, Pl. VII.).

The skeleton of the choanosome consists of megasclera and microsclera. The former show the following forms: dichotriæna, orthotriæna, oxea, styli, strongyla, tylota. The dichotriæna are very numerous, and are arranged immediately beneath the ectosome, with their cladomes directed towards the ectosome. The rhabdome measures from 0·36 to 0·42 mm., the protocladus from 0·06 to 0·09

* From Seiriol, an early Welsh saint, who is said to have had his cell on Puffin Island.

mm., and the deuterocladus from 0·037 to 0·045 mm. The orthotriæna are far less numerous and slightly smaller than the dichotriæna. They are also placed close to the ectosome. The oxea are the most numerous spicules, and are arranged in bundles, which take their origin in or immediately beneath the region of the triæna, and stretch vertically down through the whole depth of the choanosome. Those oxea measure 0·34 to 1·5 mm. by 0·009 to 0·026 mm. Amongst them we find a few stylote, strongylote and tylote spicules.

The microsclera are spherasters, 0·025 mm. in diameter, and spirasters 0·012 to 0·016 mm. in length. Besides those, I have found in some sections a third kind of microsclera, which looked like the fragments of the narrow blades of fret-saws, straight on one side, toothed on the other, and a few which were toothed on both sides (see fig. 2c, Pl. VII.). These spicules measure 0·08 mm. by 0·0014 mm., but I do not think I have seen a complete spicule of this kind. They were found in the choanosome immediately beneath the ectosome.

A great part of the choanosome, especially the portion in the neighbourhood of the ectosome, consists of a cystenchymatous tissue, also called vesicular connective tissue or bladder cells ("blasiges Bindegewebe" of German authors). It has been already remarked by other authors in various groups of the sponges, as by Vosmaer,* in *Polymastia hemisphærica*, by Sollas† in *Pachymatisma*, &c., and also in some of the Lithistidæ. A similar tissue is known to occur in many Molluscs and in Tunicata.‡

* Vosmaer, "Sponges of the Willem Barrents Expedition," 1880 and 1881. "Bijdragen tot de Dierkunde."

† Sollas, "Report on the Tetractinellidæ, collected by H.M.S. *Challenger*," p. xxxix.

‡ W. A. Herdman, "Report on the Tunicata, collected by H.M.S. *Challenger*," part i., p. 28—29.

I could not get a correct idea of the canal system of *Seiriola compacta*. The figure on Pl. VII. shows everything I could make out in regard to this point.

Ecionema ponderosa, Bowerbank.

Found in the caves on the N.W. side of Puffin Island, June, 1888.

Pachymatisma johnstonia, Bowerbank.

Found in the caves on the N.W. side of Puffin Island, June, 1888.

Order VI. CALCAREA.

Ascetta primordialis, Haeckel.

Collected at low tide at the south end of Puffin Island, on 8th September, 1888, by Professor Herdman.

The species is new to the district, although it is cosmopolitan, and has been recorded by Haeckel from nearly every part of the world.

Sycandra ciliata, Haeckel.

Collected at Isle of Man, August, 1886; common at Puffin Island.

Sycandra compressa. Haeckel.

Common at Puffin Island. Some very fine specimens were found hanging from the ledges of rock at the north end, below the Biological Station.

EXPLANATION OF THE PLATES.

<i>bl.</i> Bladder cells.	<i>o.</i> Ova.
<i>ch.</i> Choanosome.	<i>os.</i> Osculum.
<i>c.c.</i> Ciliated chambers.	<i>p.</i> Pores.
<i>e.</i> Ectosome.	<i>p.m.</i> Pore membrane.
<i>l.s.</i> Longitudinal bundles of spicules in transv. section.	

PLATE V.

- Fig. 1. *Raspailia stelligera*, S., nat. size.
 Fig. 2. *Raspailia viminalis*, S., nat. size.
 Fig. 3. *a.*, *b.* and *c.* Stylole spicules of *Raspailia viminalis*, S. (x 55). *d.* Spined spicule of the same (x 235).
 Fig. 4. Portion of a transverse section through the middle of the stem of *Raspailia viminalis* (x 40).

PLATE VI.

- Fig. 1. Tylostylole spicules of *Polymastia mammillaris*.
a. (x 100); *b.* (x 235).
 Fig. 2. Transverse section through one of the papillæ of *Polymastia mammillaris* (x 100).
 Fig. 3. Longitudinal section through one of the papillæ of *Polymastia mammillaris* (x 60).

PLATE VII.

- Fig. 1. Vertical section through *Seiriola compacta*, n. sp. (x 100). [N.B. The third cladus of every triæna has been left out as standing nearly at right angles to the plane of the section.]
 Fig. 2. Microscleres of *Seiriola compacta*, n. sp. *a.* (x 1000); *b.* (x 1000); *c.* (500).
 Fig. 3. The cladome of a dichotriæna of *Seiriola compacta*, n. sp. (x 200). [N.B. The rhabdome must be imagined as standing vertically upon the centre of the cladome.]

Fig. 1.



Fig. 2.

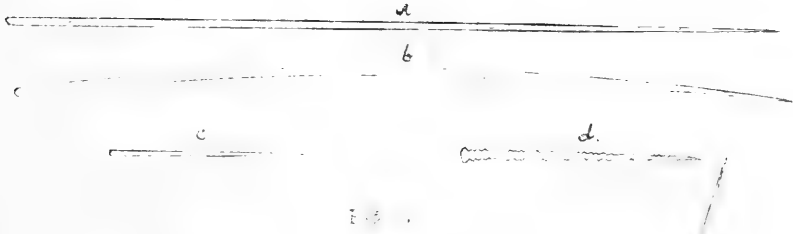
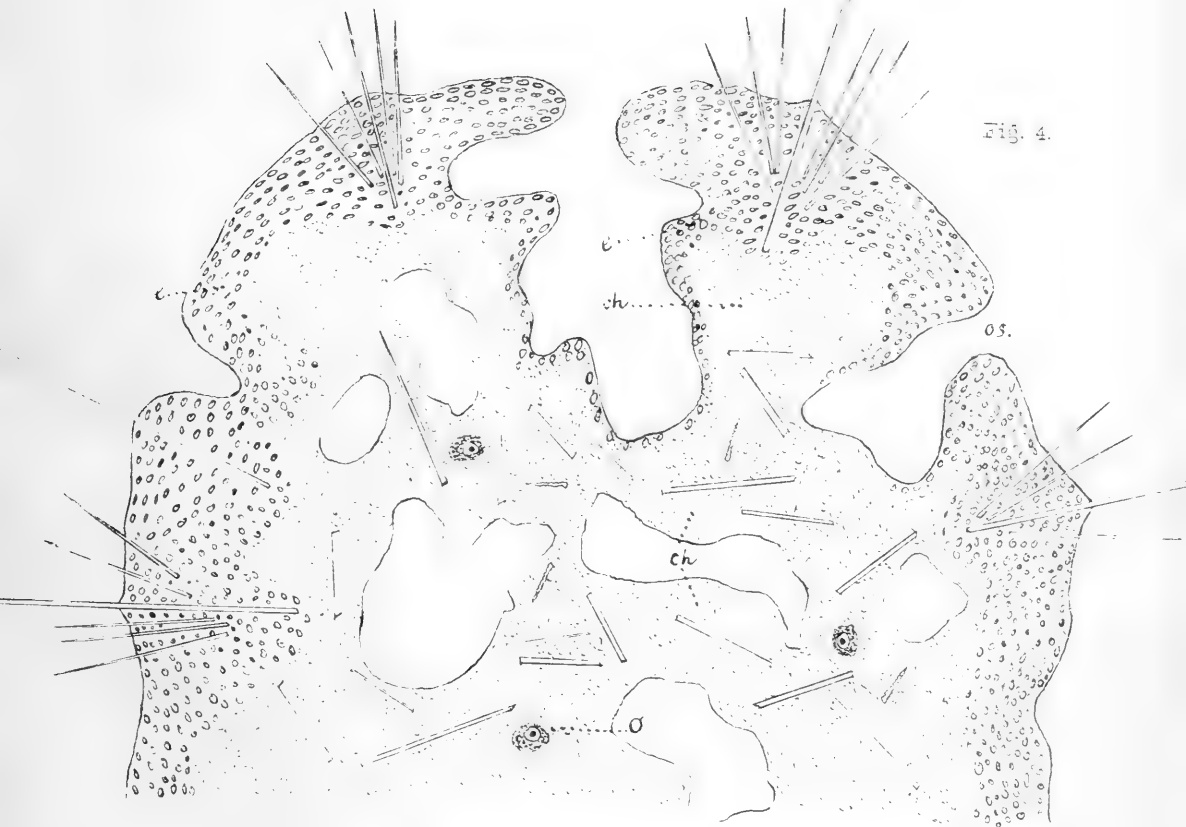


Fig. 3.

Fig. 4.



R. Hanitsch, del.

RASPAILIA STELLIGERA, Schmidt.

RASPAILIA VIMINALIS, Schmidt.

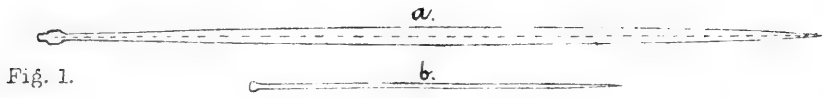


Fig. 1.

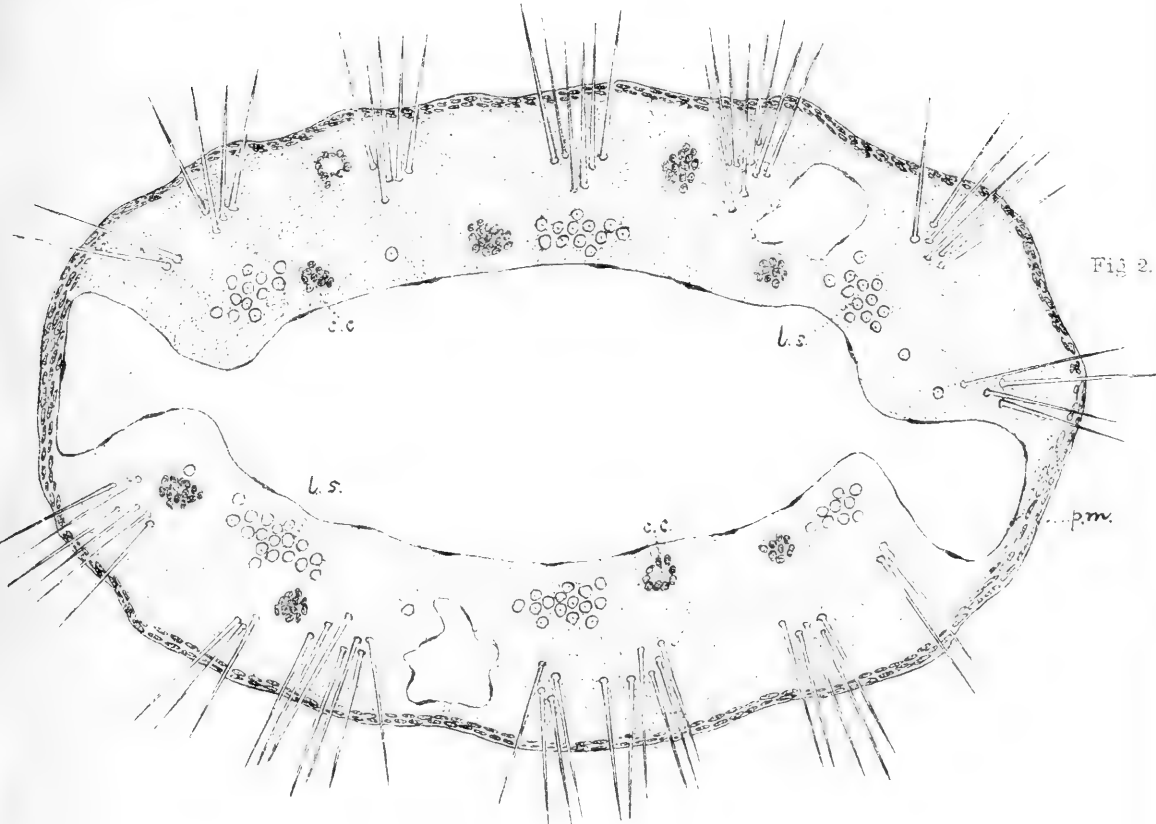


Fig. 2.

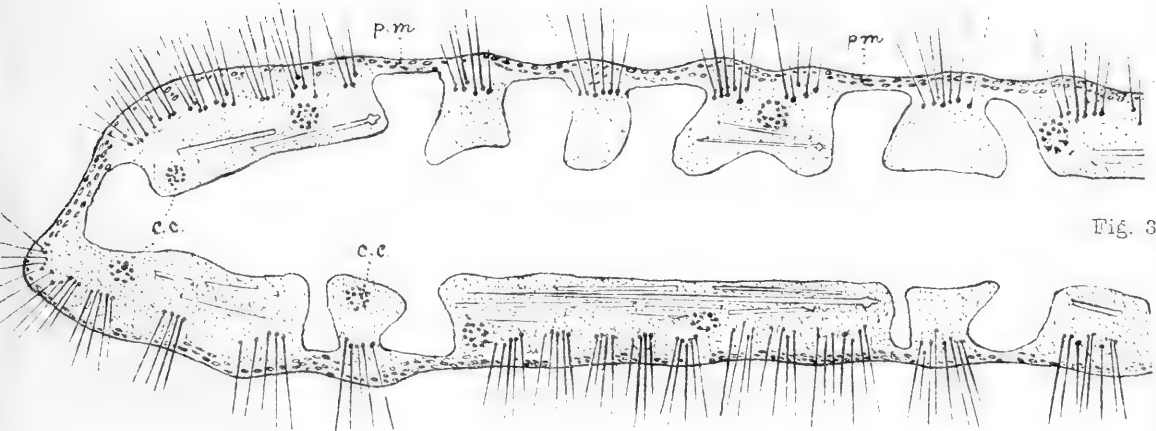


Fig. 3.

R. Hanitsch, del.

POLYMASTIA MAMMILLARIS, Johnston.

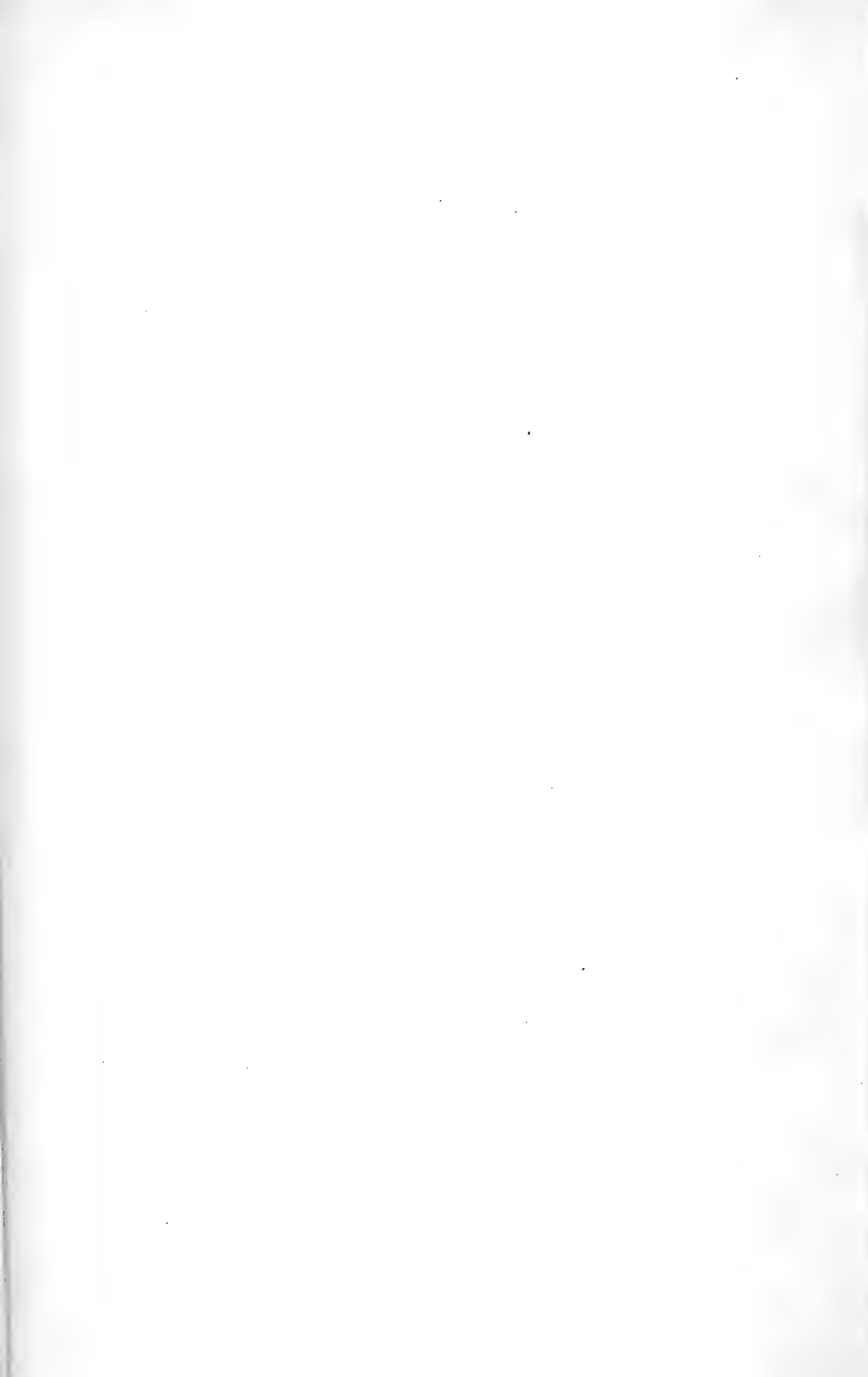


Fig. 1.

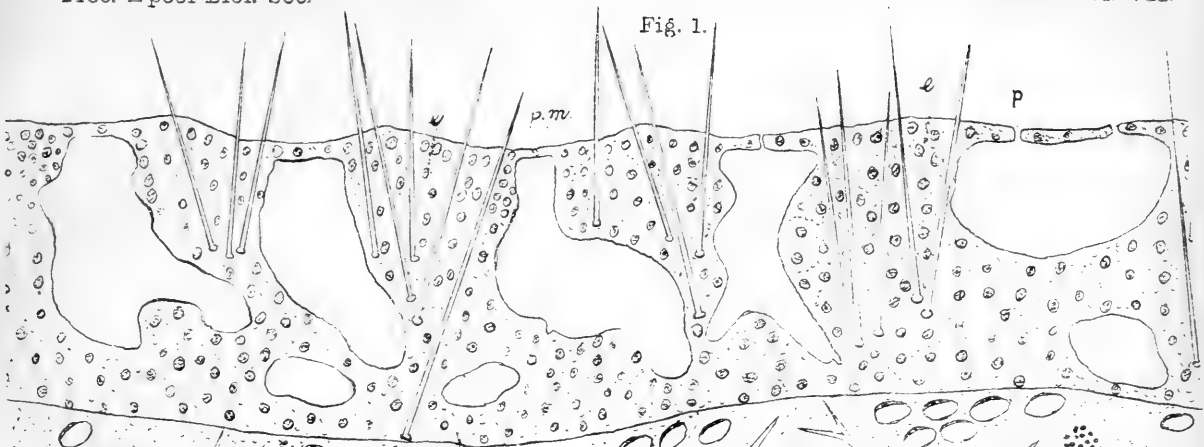


Fig 2. a



Fig 2. b

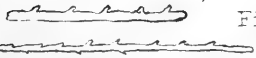


Fig 2. c

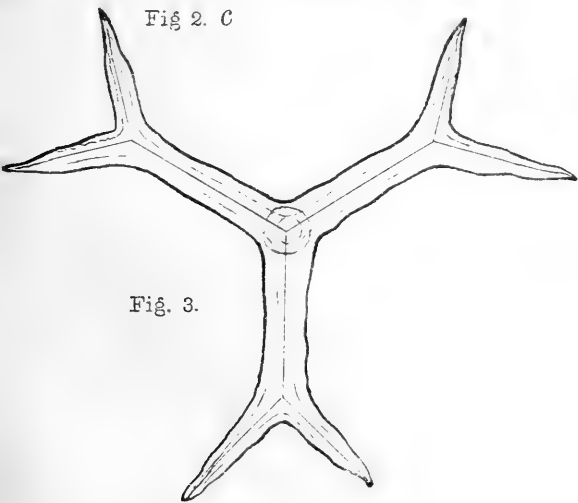


Fig. 3.

R. Hanitsch, del.

SEIRIOLA COMPACTA, n. sp.

SECOND REPORT on the ECHINODERMATA
of the L.M.B.C. DISTRICT.

BY HERBERT C. CHADWICK.

(Communicated by Professor Herdman.)

[Read 8th February, 1889.]

IN the following pages I have incorporated with the results of the work of the L.M.B.C., during the years 1886-7-8, my own observations on the Echinodermata of Beaumaris Bay and the Menai Straits.

The total number of species obtained by the Committee up to the present time is thirty-five, the additions to the previous lists* consisting of five Asterids, viz., *Stichaster roseus*, *Asterias glacialis*, *Solaster endeca*, *Porania pulvillus*, and *Luidia savignii*, and one Holothurian, *Cucumaria planci*. The Anglesey coast, from Bangor eastwards, round by Puffin Island to Holyhead, and the deep waters off the southern end of the Isle of Man, have again yielded most of the forms obtained. Though none of the species, nor yet of the groups to which they are assigned, can be said to be peculiar to any part of the L.M.B.C. district, the Asteroidea appear, both as regards species and individuals, in greatest force in the latter locality, while the Menai Straits are largely inhabited by four out of the six Ophiurids recorded in our previous list.

The Echinoidea are more generally distributed; all the recorded species being well represented in both the above-mentioned localities; and the same remark applies fairly well to the Holothuroidea.

* "Report upon the Crinoidea, Asteroidea, Echinoidea, and Holothuroidea," by Professor Herdman; and "Report upon the Ophiuroidea, by H. C. Chadwick, in "Fauna of Liverpool Bay," vol. i., 1886.

My thanks are due to W. Percy Sladen, Esq., the Rev. Canon A. M. Norman, and Professor Jeffrey Bell, for their courteous assistance during the preparation of this report.

CRINOIDEA.

Family. COMATULIDÆ.

Antedon rosaceus, Linck (sp.).

Comatula rosacea, Fleming, "Hist. British Animals," p. 490, 1828; Forbes, "British Starfishes," p. 5. 1841.

This species was found to occur in large numbers, at a depth of 10 fathoms, off Cemmaes Bay, North Anglesey, during the "Hyæna" Expedition of 1886. It was also taken in May, 1888, from a depth of 20 fathoms, off Port Erin. It occurs, too, off Bull Bay, on the north coast of Anglesey.

OPHIUROIDEA.

The successive dredging expeditions of the committee have not resulted in the discovery of any new Ophiurids, nor are there any new localities to record. I may, however, mention a specimen of *Ophiothrix pentaphyllum*, which I dredged from the Menai Straits, off Bangor, in August, 1887, and which agrees most remarkably with Forbes's description of his *Ophiocoma minuta*. The disk measures 3 mm. in diameter, and is decidedly pentagonal. Its centre is occupied by a white pentagon, which during life was bordered by deep red. The remainder of its surface is covered with short trifid spines, amongst which are a very few spines of considerable length and resembling those of the rays. The latter measured nearly 3·5 cm. in length. Their colour was grey, mottled and belted with a rosy hue, and the spines which fringe them partook of the same colours. With this specimen only before me, I should be inclined to support Forbes in regarding its characters as

distinctive, but having examined a number of examples of the undoubted young of *O. pentaphyllum* in which considerable variation was displayed, I have no hesitation in referring our specimen to that variable species.

ASTEROIDEA.

Family. ASTERIIDÆ.

Stichaster roseus, Müller (sp.).

Asterias rosea, Müller, "Zool. Dan. Prod.," p. 234, No. 2837. 1776.

Cribella rosea, Forbes, "British Starfishes," p. 106. 1841.

Asteracanthion roseus, Müller and Troschel, "Syst. der Asteriden," p. 17. 1842.

This is perhaps the rarest of the five additions to our list of Echinoderms in which the "Hyæna" expedition of 1888 resulted. It is a northern species, and an inhabitant of deep water. The specimens under notice were obtained off the south-eastern corner of the Isle of Man, from a depth of 20 fathoms.

Asterias rubens, Linn.

This species is very abundant at Beaumaris, and not uncommonly attains a very large size. I have seen at least a dozen specimens which measured from 12 to 15 inches in diameter. These approached *A. violacea* in the possession of numerous clavate spines, especially amongst those bordering the ambulacra. In the deeper parts of the Menai Straits, especially to the west of Garth Ferry, I have on two occasions dredged numbers of small Asterids, which, from the fact that they exhibit more or less markedly some of the characters of *A. hispida*, I have felt inclined to refer to that species; but, after carefully studying a number of examples from Puffin Island, in addition to those in my own collection, I have come to

the conclusion that I have before me simply a number of the young of the species under notice.

Asterias glacialis, Linn. (sp.).

Uraster glacialis, Forbes, "Brit. Starfishes," p.78. 1841.

In this species we have a second addition to our list of Echinoderms. Specimens were obtained from a depth of 20 fathoms, between the Calf of Man and Port Erin Bay, on 20th May, 1888, during the cruise of the "Hyæna."

Family. SOLASTERIDÆ.

Cribrella sanguinolenta, Müller (sp.).

Asterias sanguinolenta, Müller, "Zool., Dan. Prod.," p. 234, No. 2836. 1776.

Asterias oculata, Pennant, "Brit. Zool." vol. iv., p. 61, No. 46. Pl. xxx., figs. 5, 6. 1777.

Cribella oculata, Forbes, "Brit. Starfishes," p. 100. 1841.

Echinaster oculatus, Müller and Troschel, "Syst. der Asteriden," p. 24. 1842.

I have frequently taken three or four specimens of this species during an evening's ramble on the beach at Beaumaris. The roots of *Laminaria*, at extreme low water mark, seem to be its favourite haunt. I do not remember having taken it in the dredge. My largest specimen measures rather more than five inches in diameter, but specimens of this size are not common.

Solaster endeca, Linn. (sp.).

In this species we have another addition to our list of Echinoderms. It was taken on 20th May, 1888, from a depth of 20 fathoms, off the south-eastern corner of the Isle of Man, during the cruise of the "Hyæna."

Solaster papposa, Linn. (sp.).

This well known species occurs in considerable numbers at extreme low water mark, at Beaumaris, where I have

taken several specimens measuring eight inches in diameter. Almost every specimen forms a habitat for a great number of examples of the Caprellid *Podalirius typicus*, which cling tenaciously to the paxillæ by means of the fourth pair of thoracic limbs, the fifth pair being spread out behind, the sharp pointed terminal joints giving a very firm hold.

Porania pulvillus, Müller (sp.).

Asterias pulvillus, Müller, "Zool. Dan.," vol. i., p. 19, Pl. xix., figs. 1, 2. 1788.

Goniaster Templetoni, Forbes, "Mem. Wern. Soc.," vol. viii., p. 118, Pl. iv., fig. 2. 1839.

Asteropsis pulvillus, Müller and Troschel, "Syst. der Asteriden, p. 14. 1842.

In this species we have the fourth addition to our list made during the "Hyæna" expedition of 1888. It was taken, with the three previously mentioned, from a depth of 20 fathoms off the south-eastern corner of the Isle of Man, and with them and the subjoined *Luidia savignii* serves to show how rich and varied is the Echinoderm fauna of that district.

Family. ASTROPECTINIDÆ.

Astropecten irregularis, Pennant (sp.).

Asterias irregularis, Pennant, "Brit. Zool." vol. iv., p. 61, No. 47. 1777.

Asterias aurantiaca, Müller, "Zool. Dan. Prod.," p. 234, No. 2831 (but not of Linnæus). 1776; Forbes, "Brit. Starfishes," p. 130. 1841.

I have taken this species in the dredge from a depth of about ten fathoms in the Menai Straits, close to the training ship "Clio." I have also found it cast ashore at Southport.

It does not seem to be generally known that in the genera *Astropecten* and *Luidia*, a pair of "Tiedemann's bodies" are present at the point of junction of the stone canal with the circum-oral water vessel, where in *Asterias*, *Cribrella* and *Solaster* there is but one. In *Luidia* the members of each pair of these bodies are wider apart than in *Astropecten*.

Luidia savignii, Audouin (sp.).

Asterias savignii, Audouin; Savigny, "Histoire de l'Égypte," p. iii. (1809); description (1828), vol. xxiii., p. 9.

Luidia fragilissima, Forbes, "Brit. Starfishes," p. 135. 1841.

Luidia savignii, Müller and Troschel, "Syst. der Asteriden," p. 77. 1842.

Specimens of this fine Asterid were dredged from a depth of twenty fathoms between the Calf of Man and Port Erin Bay, on 20th May, 1888. The species had not previously been obtained by the committee.

The pedicellariæ of this species are well described by Rev. Canon A. M. Norman,* as "short, broad, and tumid—in fact, in the form of a nearly equilateral and equiangular triangle." Some few examples, however, nearly approach in form the same organs in *Luidia sarsii*, in which they are "much more elongated, narrow, and not tumid, and have the outline of a somewhat produced isosceles triangle." The pedicellariæ of *Luidia* differ from those of other Asterids in being composed of three valves or blades.

ECHINOIDEA.

The recent additions to our list of Echinoderms do not include any Echinoidea. Of the species recorded in Prof. Herdman's Report of 1886, I have twice taken *Echinus*

* "On the Genera and Species of British Echinodermata," *Ann. and Mag. Nat. Hist.*, 3rd series, vol. xv. 1865.

esculentus on the shore, within two hundred yards of Beaumaris pier, at times when the tide has been exceptionally low; and from the deeper parts of Beaumaris Bay I have frequently dredged specimens of *Echinus miliaris* of much larger size than those recorded by Prof. Herdman. A number of very fine specimens of *Spatangus purpureus*, some of them measuring 11 cm. across their longer diameter, were dredged from a depth of 25 fathoms, twenty miles S.E. of the Isle of Man, during the cruise of the "Weathercock," in the summer of 1886, while others were obtained off Red Wharf Bay, during the "Hyæna" expedition of the same year.

HOLOTHUROIDEA.

The Holothurians submitted to me are referable to three species. Of these *Thyonidium drummondii* and *Cucumaria hyndmanni* were recorded in Prof. Herdman's first Report, and are represented in the present collection, the former by one specimen from the neighbourhood of Puffin Island, and one from the "Hyæna" expedition of 1886; the latter by three specimens taken from a depth of 20 fathoms about twenty miles S.E. of the Isle of Man, during the cruise of the "Weathercock," in the summer of 1886.

The third species is well represented, and has, the Rev. Canon A. M. Norman informs me, been mistaken by several British authors, and was mistaken by myself, for *Cucumaria pentactes*, a form which it very closely resembles. Dr. Norman, however, identifies it as the *Cucumaria planci* of Marenzeller.* It is now, I believe, recorded for the first time under its correct name as a British species.† It occurs in considerable numbers in the deep waters surrounding Puffin Island to the north-east.

* *Abh. zool-bot. Ges. Wien*, xxiv. (1874), p. 300.

† Prof. Jeffrey Bell writes to Prof. Herdman that he has seen specimens from the south coast of England and the west of Scotland.

THIRD REPORT on the COPEPODA of LIVERPOOL
BAY (the L.M.B.C. DISTRICT).

BY ISAAC C. THOMPSON, F.L.S., F.R.M.S.

With Plate VIII.

[Read 8th March, 1889.]

IN the two previous Reports* on the marine Copepoda of the district *fifty* species were recorded. The second of these reports was drawn up at the close of 1887, and it is now most satisfactory to be able to record *thirty-three* additions since that time, of which five are new to British seas. As before, the majority have been taken by tow-net in the open sea, or by hand-net from the rocky shore pools seldom touched by ordinary tides.

A considerable number of the additional species we have lately obtained from sand and mud brought up by the dredge, and taken at low water in tidal pools, &c. Want of success in this direction has probably arisen previously from washing the material in sieves which allowed many of the very minute forms to escape with the water. The method latterly adopted has been to place the solid material direct into a very fine muslin bag, or into the finest meshed tow-net itself. Tied at the top, the bag is placed in a running stream of water, by which means all the soluble portion and the very finely suspended mud particles constituting the bulk of the mass are washed out. On examining the residue in a saucer of water, numbers of Copepoda are found floating upon the surface, which washed in the ordinary way would have been lost, and

* See "Fauna of Liverpool Bay," &c., vol. i., p. 201, 1886; and "Proc. L'pool Biol. Soc.," vol. ii., p. 63, 1888.

numbers of other species are found amongst the sand and debris, being easily picked out under the microscope.

Professor Herdman has again also added to the record several species taken from the branchial sacs of Ascidians, and it is probable that still further additions to the list of parasitic species will be made from the same source, this branch of the subject not having been specially dealt with hitherto.

The five species new to Britain are as follows:—

Pontella kröyeri, Brady.

Giardella callianassæ, Canu.

Lichomolgus albens, Thorell.

Cymbasoma rigidum, Thompson.

Lernæa branchialis, Linn.

Two night tow-nettings from Puffin Island contained single specimens of *Caligus rapax*, a parasitic species recorded by Dr. Byerley as occurring upon the Sapphirine Gurnard, but not since taken. Like the *Trebius caudatus*, alluded to in the last report, it seems probable that this species is a free swimmer at night only.

Mr. Rutherford, the curator of the Puffin Island Biological Station, has continued to send tow-nettings taken at various localities near the island whenever weather permitted, and the majority of the newly recorded species have been obtained from this source; this being one of the many ways in which the station has proved to be of the greatest benefit in the investigation of our marine fauna and flora.

Some of the species described for the first time in the last report have again been found. *Cyclops (Hersiliodes) puffini*, has occurred sparingly, and Professor Herdman has found *Lichomolgus sabellæ* again, attached to its host, the *Sabella*, this time in the sand near the landing place at Puffin Island.

By means of a continued series of observations throughout the seasons of the year, such as a biological station affords, we are enabled to study the distribution not only of the various groups but also of the different species. In the case of the Copepoda, the facts as regards the species are striking though difficult of explanation. A particular species may be comparatively abundant at one time and then appear to become extinct in the same locality. Instances of this occur in the case of *Pontella wollastoni* and of *Euterpe gracilis*, two rare forms alluded to in the last report as having been found off Puffin Island, and for a time both frequently met with. For many months past, however, neither species has occurred in the gatherings, though carefully looked for in the same localities as heretofore.

A very striking example of the seeming propensity of these minute Crustaceans to congregate in shoals was noticed during the "Hyæna" expedition of May, 1888. During the whole of the second day, whilst cruising near the east and south coasts of the Isle of Man, viz. from Douglas to Port Erin, the surface of the water literally swarmed with the large and beautiful Copepod, *Anomalocera patersonii*. Each cast of the tow-net brought up thousands of them; they were so numerous as to be distinctly visible to the eye on the smooth edge of the waves, and had the appearance of fine dust as seen from the side of the vessel. They were equally abundant during the day and after sundown, but, strange to say, none were to be found next morning, although we were traversing the same route as that on which they were in such profusion the previous day. Nor have we taken a single specimen of *Anomalocera* since that date, nor for three years previous to it, when a single pair was taken in the open sea, near the North-west Lightship.

It was natural to suppose that the animals might be found at a greater depth, after having left the surface, but such was apparently not the case, for while my tow-net swept the surface, Mr. McMillan used a deep sea tow-net of his own devising, allowing it to be drawn along while at the bottom, and occasionally to pass up through the intermediate depths. It is evident that we have yet much to learn as to the habits and distribution of these minute Crustaceans.

In this connexion it may be important to notice the extreme abundance of *Sagitta* in the tow-nets throughout the year.

Family. CALANIDÆ.

Pontella kröyeri, Brady.

One specimen, a fine male of this striking species, was taken off Puffin Island in August, 1888. With the exception of a few specimens which I found in the tow-nettings sent from Malta by Dr. Bruce (Proc. Biol. Soc., L'pool, vol. ii., p. 143), this species has been hitherto recorded only from Australasia and the Philippine Islands (Brady's "Challenger" Report on the Copepoda, p. 94).

Family. HERSILIIDÆ.

Giardella callianassæ, Canu.

This new species is fully described by M. E. Canu in "Bulletin Scientifique," series iii., September, 1888, p. 410. The only specimen I have of it was taken by tow-net in Liverpool Bay, during the "Despatch" expedition, 1886, and finding it to be something new, I waited for further specimens, in order to describe it fully. M. Canu has formed the new family *Hersiliidæ*, including therein three genera: *Hersilia*, Phillipi, *Giardella*, Canu, and *Hersiliodes*, Canu. The genus *Giardella* comprises our

present species only; the genus *Hersiliodes* includes two species, *Hersiliodes thompsonii* and *H. puffini*. The former species he most courteously connects with my name, the latter being the species hitherto known as *Cyclops puffini*, which he considers to be more correctly included in *Hersiliodes* than in the genus *Cyclops*. He thinks it possible that my specimens of *Hersiliodes puffini* are not fully developed forms, the adult being yet unknown. M. Canu figures three stages of *Giardella callianassæ*; the specimen found in our district corresponds with the second the "Cyclops" or less developed stage.

Family. NOTODELPHYIDÆ.

Notodelphys allmani, Thorell.

Notodelphys ascidicola, Allman, "Ann. and Mag. Nat. Hist.," vol. xx., pl. i., figs. 1—13 (1847).

Notodelphys ascidicola, Baird, "Brit. Entom.," p. 238, pl. xxx., figs. 7 and 8 (1850).

Notodelphys allmani, Thorell, "Bidrag till Kännedomen om Krustaceer som lefva i arter af Släktet Ascidia," p. 31, tab. i. and ii., fig. 1 (1859).

A few specimens, male and female, were found by Prof. Herdman in the branchial sacs of the Ascidian, *Ciona intestinalis*, dredged in the "Weathercock" expedition of 1886, and off the south end of the Isle of Man in the "Hyæna" cruise of 1888.

Doropygus pulex, Thorell.

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, May, 1888, in twenty fathoms.

Doropygus poricauda, Brady.

One specimen of this species was amongst several of the

last preceding taken from the branchial sac of *Ascidia plebeia*.

Botachus cylindratus, Thorell.

Found by Professor Herdman in the branchial sacs of *Ascidia mentula* and *Ascidia plebeia*, from the Isle of Man. About a dozen females were found, but only one male.

Family. HARPACTICIDÆ.

Ectinosoma spinipes, Brady.

Ectinosoma melaniceps, Brady and Robertson, "Ann. and Mag. Nat. Hist.," p. 130 (1873).

Taken by tow-net, between Liverpool and Isle of Man, from "Weathercock," August, 1886. Found in considerable numbers in mud dredged from Soderick Bay, Isle of Man, 1887; also from mud gathered at low water at Llanfairfechan, on the Welsh coast opposite Puffin Island.

Ectinosoma erythrope, Brady.

A single specimen of this species was taken by tow-net off Puffin Island, January, 1888.

Brady typica, Boeck.

Found by Mr. W. S. McMillan, F.L.S., in quantities in mud from the shore at Penmon Point, Anglesey; also in mud from Llanfairfechan shore. In material dredged at Port Soderick, Isle of Man.

Tachidius brevicornis, Müller.

In brackish water at the mouth of the Alt, near Formby, May, 1888; also in mud taken from the shore at Penmon Point.

Tachidius littoralis, Poppe.

Common in mud from Penmon Point, Anglesey, and from Llanfairfechan shore.

Stenhelia hispida, Brady.

Found sparingly in mud from Llanfairfechan shore, February, 1889; also in rock pools at Hilbre Island, March, 1889.

Stenhelia ima, Brady.

Canthocamptus rostratus, Claus, "Die frei-lebenden Copepoden," p. 122, t. xiii., figs. 5—8 (1863).

A single specimen was found in mud dredged by Mr. Clubb, in Soderick Bay, Isle of Man, 1887.

Mesochra lilljeborgii, Boeck.

Taken by tow-net off Puffin Island, June, 1886.

Laophonte thoracica, Boeck.

Taken sparingly by tow-net near Puffin Island lately.

Laophonte lamellifera, Claus.

Cleta lamellifera, Claus, "Die frei-lebenden Copepoden," p. 123, t. xv., figs. 21—25 (1863).

Like the last species this has been recently taken very sparingly by tow-net about Puffin Island.

Laophonte curticauda, Boeck.

I found one specimen of this species in a tidal pool at Hilbre, March, 1889.

Cletodes limicola, Brady.

Cletodes pectinata, Brady and Robertson, "Brit. Assoc. Report," p. 196 (1875).

Common in mud from shore at Penmon Point.

Cletodes longicaudata, Brady and Robertson.

? *Cletodes laticauda*, Boeck, "Nye Slægter og Arter af Saltvands-Copepoder," p. 20 (1872).

Occurs sparingly in mud taken from Llanfairfechan shore.

Cletodes propinqua, Brady and Robertson.

Occurs very sparingly with the last species in mud taken from Llanfairfechan shore.

Enhydrosoma curvatum, Brady and Robertson.

Rhyzothrix curvata, Brady and Robertson, "Brit. Assoc. Report, p. 19 (1875).

A number of this species were also found in mud from Llanfairfechan shore.

Nannopus palustris, Brady.

Another mud-frequenting species, although the first specimen taken was by surface tow-net near Puffin Island, in December, 1888. We have since found it sparingly in mud from Llanfairfechan shore, and also in mud dredged at Port Soderick, Isle of Man.

Platychelipus littoralis, Brady.

Numbers of this species, both sexes, were found by Mr. W. S. McMillan, in mud taken from Penmon Point.

Thalestris harpactoides, Claus.

A few specimens were taken by tow-net from "Hyæna," in May, 1888, both at Douglas Bay, Isle of Man, and at Port Erin. We have since found it off Puffin Island, and in tidal rock pools at Hilbre Island; also in mud taken from the shore at Penmon Point.

Thalestris serrulata, Brady.

One specimen only, a female, of this extremely rare species, I found in a tow-net gathering from Puffin Island, in January, 1889.

Scutellidium tisboides, Claus.

One specimen only of this rare species was dredged in Port Soderick, Isle of Man.

Scutellidium fasciatum, Boeck.

Porcellidium fasciatum, Boeck, "Oversigt Norges Copepoder," p. 56 (1864).

Aspidius fasciatus, Norman, "Brit. Assoc. Report," p. 298 (1868).

One specimen, found in a tidal pool at Hilbre Island, March, 1889, appears unmistakably to belong to this

species. It has, however, minute nodules in the middle of many of the setæ of the swimming feet.

Family. SAPPHIRINIDÆ.

Lichomolgus fucicolus, Brady.

Frequent amongst algæ on rocks around Puffin Island, and occasionally taken there in surface tow-net.

Lichomolgus albens, Thorell.

A few specimens of this species, new to Great Britain, have been taken by tow-net off Puffin Island.

Family. ARTOTROGIDÆ.

Cyclopicera lata, Brady.

One specimen was dredged at Port Soderick, Isle of Man, 1887.

Cyclopicera gracilicaudata, Brady.

One specimen was taken by tow-net at Puffin Island, April, 1888.

Dyspontius striatus, Thorell.

Mr. W. S. McMillan found one specimen in a tow-net gathering from Puffin Island, May, 1888.

Family. CYMBASOMATIDÆ.

Cymbasoma rigidum, Thompson.

It is interesting to be able to record amongst those new to Britain the capture of a single specimen of *Cymbasoma rigidum*, the original species for which the family Cymbasomatidæ was first established, having been taken by myself at the Canary Islands, in 1887. It occurred later very sparingly in the material sent by Dr. Bruce from Malta. Then a second species of the same genus, *Cymbasoma herdmani*, was found near Puffin Island, and it has also been found by Mr. W. S. McMillan at Torbay, and in

large numbers by Mr. Sinel at Jersey. Still later, isolated specimens of *C. herdmani* and *C. rigidum* have been found in tow-nettings taken both in the Firth of Clyde and the Firth of Forth. Both species appear to be widely distributed, but rarely plentiful.

Family. LERNÆIDÆ.

Lernæa branchialis, Linn. (Pl. VIII., figs. 1--6).

About a year ago 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 adult 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, Peniculus und Lernæa, 1868." The adult forms correspond 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 as will be seen (Pl. VIII., figs. 1, 5 and 6), 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 other 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 (fig. 6) is about 1-18th inch in length, the male rather smaller, and the larval form (fig. 1) about half the size of the female. I am indebted to our colleague Mr. Helenus Robertson for kindly producing enlarged micro-photographs of this

and other species from my mounted specimens, thus greatly facilitating the task of subsequently drawing them. Fig. 6 is taken from Mr. Robertson's photograph.

DESCRIPTION OF PLATE VIII.

Fig. 1. <i>Lernæa branchialis</i> , Linn., larval stage.	x 250
Fig. 2. Anterior antenna of the same	400
Fig. 3. Larval stage, swimming feet.....	400
Fig. 4. Do. footjaw	400
Fig. 5. Adult male	250
Fig. 6. Adult female	250

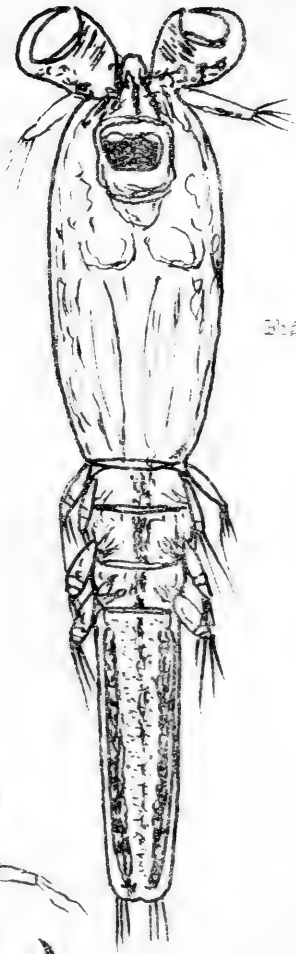


Fig. 6.

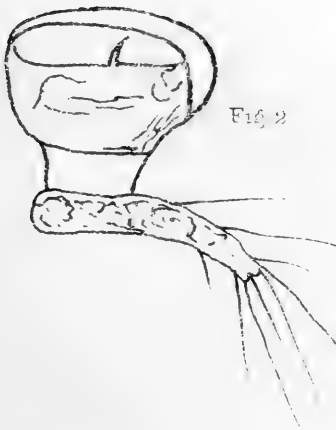


Fig. 2

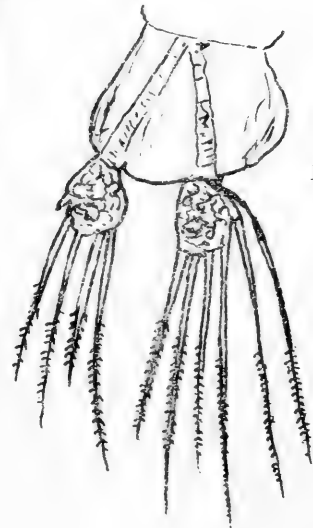


Fig. 3

[From Proc. Biol. Soc. L'pool. Vol. II. Read 12th November, 1887.]

SECOND REPORT on the COPEPODA of
LIVERPOOL BAY.

BY ISAAC C. THOMPSON, F.L.S., F.R.M.S.

With Plates I. and II.

SINCE the last Report on the Marine Copepoda of the district, thirty-one additional species have been recorded, making fifty species altogether known to the district. Four of them are new to Britain, three of them being altogether new to science. Two of the other species have not been before recorded in Britain for fifty and thirty years respectively.

Some of the species noticed in the first Report as having been found locally or sparingly have since proved to be very common throughout the district. Of these may be mentioned *Pseudocalanus elongatus*, *Dias longiremis* and *Oithona spinifrons*. *Calanus finmarchicus* then alluded to as not having been found nearer than the Isle of Man, was subsequently taken by tow-net, during the "Weathercock" excursion, far out at sea, at about the centre of the L. M. B. C. area, and has since been taken off Puffin Island.

The establishment of the Biological Station on Puffin Island has greatly aided tow-netting operations, and many of the rarer forms obtained have been found in material forwarded therefrom. Mr. Rutherford, the curator, collects whenever the weather renders tow-netting operations practicable and forwards the material at once by post. On a recent occasion, during the early morning hours of

a dark cold night, the tow-netting from Puffin Island consisted of quantities of *Tomopteris* and *Sagitta*, with only a few Copepoda. It is, however, noticeable that with the exception of *Trebius caudatus* (referred to later) the night collections have hitherto been little different from those of the day. During the early spring of the present year, I noticed on several occasions large quantities of diatomaceous matter floating near the surface of the sea, but it disappeared about May, and there has been no observation of the gelatinous Algæ referred to in last Report about our coasts.

The thirty-one species recorded since the last Report are as follows :—

FAMILY CALANIDÆ.

Paracalanus parvus, Claus.

This rare form, described by Claus in his work on the marine Copepoda of Trieste, was taken by tow-net near Puffin Island, in September, in the "Gamecock" expedition.

Dias discaudatus, Giesbrecht.

Taken off the Anglesey coast by tow-net on the "Hyæna" expedition.

Temora velox, Lilljeborg.

This brackish water species is probably somewhat common in the district about salt marshes. Mr. W. S. McMillan found it as far inland as Sefton, and we recently together found it plentiful in the long narrow pools immediately behind the Leasowe breakwater.

Eurytemora hirundo, Giesbrecht.

This rare form, hitherto unknown to Britain, was found in two early morning gatherings, tow-netted by Mr. Clubb, in the Crosby Channel, and was referred to at length in a paper read before the Biological Society last session.

Pontella wollastoni, Lubbock.

This species, with the last, was referred to specially in a recent paper (Proc. L'pool Biol. Soc., vol. I., Pl. VI.) as having been found during the "Weathercock" expedition, the only previous record of its occurrence near Britain being by Sir John Lubbock, who took it at Weymouth in 1857. It has since occurred during the past summer in several gatherings taken around Puffin Island.

Parapontella brevicornis, Lubbock.

Found sparingly in the open sea, and more recently around Puffin Island.

Isias clavipes, Boeck.

Taken on several occasions in the open sea some miles from land. Neither Boeck nor Brady notice a pair of remarkable trifid spines which occur one on each side of the first abdominal somite of the female.

FAMILY CYCLOPIDÆ.

Thorellia brunnea, Boeck.

Found very sparingly in the open sea.

Cyclopina littoralis, Brady.*C. gracilis*, Claus.

Both of these species of *Cyclopina* have been found in recent tow-net gatherings about Puffin Island.

Cyclops puffini, n. sp. (Pl. I., figs. 1 to 9).

Length 1-20th inch. Cephalothorax five jointed, the first about as long as the remaining four. Anterior antennæ (fig. 2) six jointed and clothed with fine setæ, the third joint longer than any of the others. In the male the second and third joints from the apex are very wide

at their terminations, strong spines proceeding therefrom. Posterior antennæ (fig. 3) terminated by several spines and plumose setæ. Mandible (fig. 4) divided at apex into long slender spinose teeth. Maxilla (fig. 5) furnished with several plumose spines; termination of palp has deeply serrated edge. Footjaws (figs. 6 and 7) slender, with spines at apex. First four pairs of swimming feet (fig. 8) two jointed, the basal joint serrated on outer edge, outer joint strongly spined. Fifth pair swimming feet (fig. 9) composed of one joint only, with one side serrated, the other having short setæ and terminated by one single spine and two serrated leaf-like spines. Abdomen three jointed in both sexes; the first joint is doubly toothed at posterior angles; second joint also toothed and shorter than the others. Caudal segment about twice as long as broad, with a seta about middle on each outer side, and terminated by several setæ, the largest on each side being widely barbed near the apex and plumose below.

First found among the tow-net gatherings from "Gamecock," taken off Puffin Island, and since found sparingly in same locality.

FAMILY HARPACTICIDÆ.

Longipedia coronata, Claus.

Common near coast line throughout the district.

Laophonte similis, Claus.

L. curticaudata, Boeck.

Found in the peaty pools of submarine forest at Leasowe.

L. serrata, Claus.

One specimen only of this rare species was taken recently, by tow-net, off Puffin Island.

Euterpe gracilis, Claus.

Several specimens of this rare form have been taken about Puffin Island during the past summer. Brady, in his "Monograph of British Copepoda" (Ray Society, 1876—1879), states there have been previously only two known habitats for this species, viz. Heligoland, and Kinsale harbour, Ireland. I recently found it about the Canary Islands.

Dactylopus tisboides, Claus.

D. stromii, Baird.

Diosaccus tenuicornis, Claus.

These three species have been sparingly found by Mr. W. S. McMillan and myself in the peaty pools about the submarine forest, Leasowe.

Thalestris clausii, Norman.

T. rufocincta, Norman.

T. hibernica, Brady and Robertson.

T. longimana, Claus.

These four species of *Thalestris* I have found at various times in the rock pools about Hilbre Island.

Westwoodia nobilis, Baird.

Rock pools at Hilbre Island.

Harpacticus fulvus, Fischer.

Rock pools at Puffin Island, also about Hilbre Island.

Peltidium interruptum, Goodsir.

Rock pools at Hilbre Island and by tow-net off Anglesey, and frequently around Puffin Island.

Idya furcata, Baird.

At Penmaenmaur, in open sea and in tidal pools.

FAMILY CORYCÆIDÆ, DANA.

Lichomolgus sabellæ, n. sp. (Pl. II., figs. 1 to 9).

Length, female 1-10th inch, male 1-15th inch. Body ovate, first segment nearly half the length of the cephalothorax. Rostrum short and beak-like. Anterior antennæ (fig. 2) alike in both sexes, composed of seven joints, the two basal joints large and strong and about equal in length to the other five; their edges are roundly serrated and curled over, with several setæ. The third joint has three long setæ on inner margin, and the terminal joint has several long setæ at apex. Posterior antenna (fig. 3) also alike in both sexes, four jointed; the second joint has four teeth placed longitudinally; the terminal joint has several hooked claws both at side and at apex, the latter having also several long setæ. The mandible is strongly toothed, the terminal portion having three spines. The maxilla (fig. 4) has a long process terminated by a blunt spine, and bearing on each side a row of sharp teeth similar to those of the mandible; the other extremity has five digital spines. Anterior footjaw (fig. 5) two jointed; the second joint terminated by four short spines. Posterior footjaw two jointed; that of the male (fig. 7) is terminated by a long falciform claw, similar to that of *L. fucicolus*, Brady, that of the female (fig. 6) is elongated and terminated by three claw-like spines. Swimming feet of the first four pairs are two branched (fig. 8), each branch three jointed and bearing several spines and plumose setæ. The fifth feet (fig. 9) in both sexes are composed of one short straight joint terminated by two spines. Abdomen is five jointed in each sex; the first joint nearly equal in length to the remaining four and much broader, especially in the male. The caudal segments are parallel and about three

times as long as broad, and each terminated by four setæ, in addition to a small seta about the middle of outer edge.

Several specimens of this strongly marked species were sent to me by Mr. Herbert Chadwick of Manchester, adherent upon a species of *Sabella* found on the Beaumaris beach, and of which he informs me all the specimens he found were similarly infested. Although preserved in alcohol the crustaceans tenaciously adhered by their hooked antennæ to the tentacles of the *Sabella*, from which it required some force to remove them. The females were the most plentiful, though several of both sexes were on a single worm. The species is easily distinguished by its long narrow ovisacs and remarkable antennæ; it is of a greyish brown colour.

FAMILY ARTOTROGIDÆ.

Acontiophorus scutatus, Brady and Robertson.

One specimen only found on Algæ in rock pools at Hilbre.

FAMILY CALIGIDÆ.

Trebius caudatus, Kroyer (Pl. II., fig. 10).

A few specimens of this parasitic species were found in recent night tow-nettings taken off Puffin Island. Baird gives a small figure of it in his "Natural History of the British Entomostaca" (Ray Society, 1849). He states that it was found on a skate in Belfast Lough, by Mr. Wm. Thompson, in 1837, since which time it does not appear to have been recorded. The few specimens I have found being all taken at night would seem to indicate that it is only then a free swimmer.

FAMILY CYMBASOMATIDÆ.

Cymbasoma herdmani, n. sp. (Pl. I., figs. 10 to 12).

Length 1-10th inch. Cephalothorax nearly the same width throughout, truncated at each end, five jointed, the first joint being nearly equal in length to the remaining four. Anterior antennæ of male (fig. 11) five jointed, strong and muscular—the fourth joint being nearly equal in length to the preceding three; there is a hinged joint between the fourth and terminal. There are several spines and setæ throughout the antennæ, the apex bearing a terminal claw. First four pairs of swimming feet alike in structure (fig. 12), the basal joint very large. Both branches three jointed, and clothed with strong spinose setæ. Abdomen of male five jointed, gradually getting smaller, the fifth being wedge-shaped laterally. Caudal segments divergent and stumpy, a little longer than broad, each terminated by six spinose setæ.

One specimen only, a male, was found in an autumn night's tow-netting, taken off Puffin Island; and I have since found another in a tow-net gathering sent from Malta by Dr. Bruce. The only hitherto known species of this genus, *C. rigidum*, Thompson,* was taken by tow-net off Teneriffe.

It is with peculiar pleasure that I name this species in honour of my friend Professor Herdman, the founder of Puffin Island Biological Station, to whom I am indebted for help on many occasions.

* Described in a paper read before Linnæan Soc., London, Nov. 17, 1887.

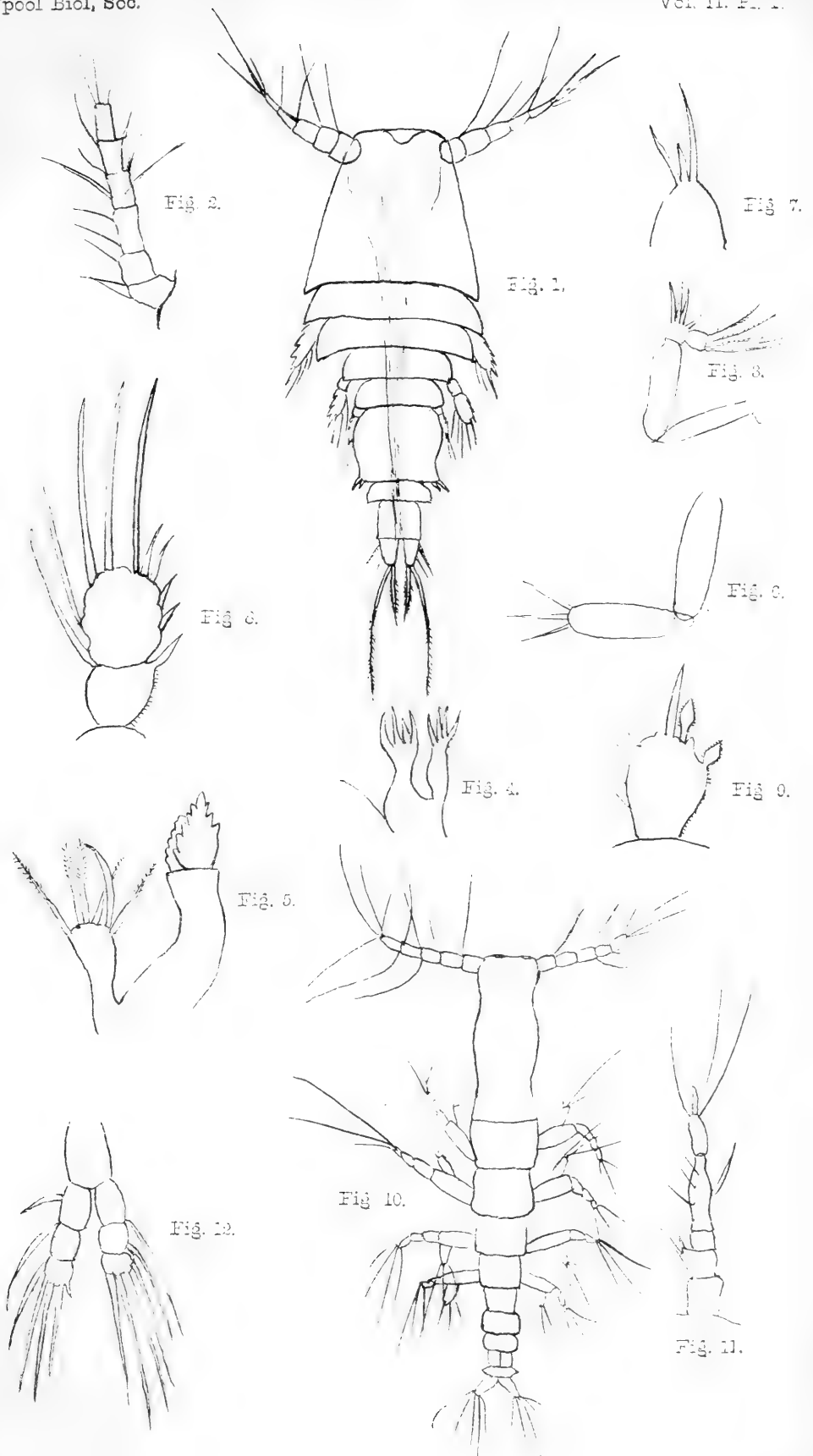
DESCRIPTION OF PLATES.

PLATE I.

Fig. 1.	<i>Cyclops puffini</i> , n. sp., female,	× 150 diams.
Fig. 2.	Anterior antenna of do.	250 ,,
Fig. 3.	Posterior antenna of do.	250 ,,
Fig. 4.	Mandible of do.	400 ,,
Fig. 5.	Maxilla of do.	400 ,,
Fig. 6.	Anterior footjaw of do.	400 ,,
Fig. 7.	Posterior footjaw of do.	400 ,,
Fig. 8.	One of third pair swimming feet of do.	400 ,,
Fig. 9.	One of fifth pair swimming feet of do.	400 ,,
Fig. 10.	<i>Cymbasoma herdmanni</i> , n. sp., male,	150 ,,
Fig. 11.	Anterior antenna of do.	250 ,,
Fig. 12.	One of swimming feet of do.	250 ,,

PLATE II.

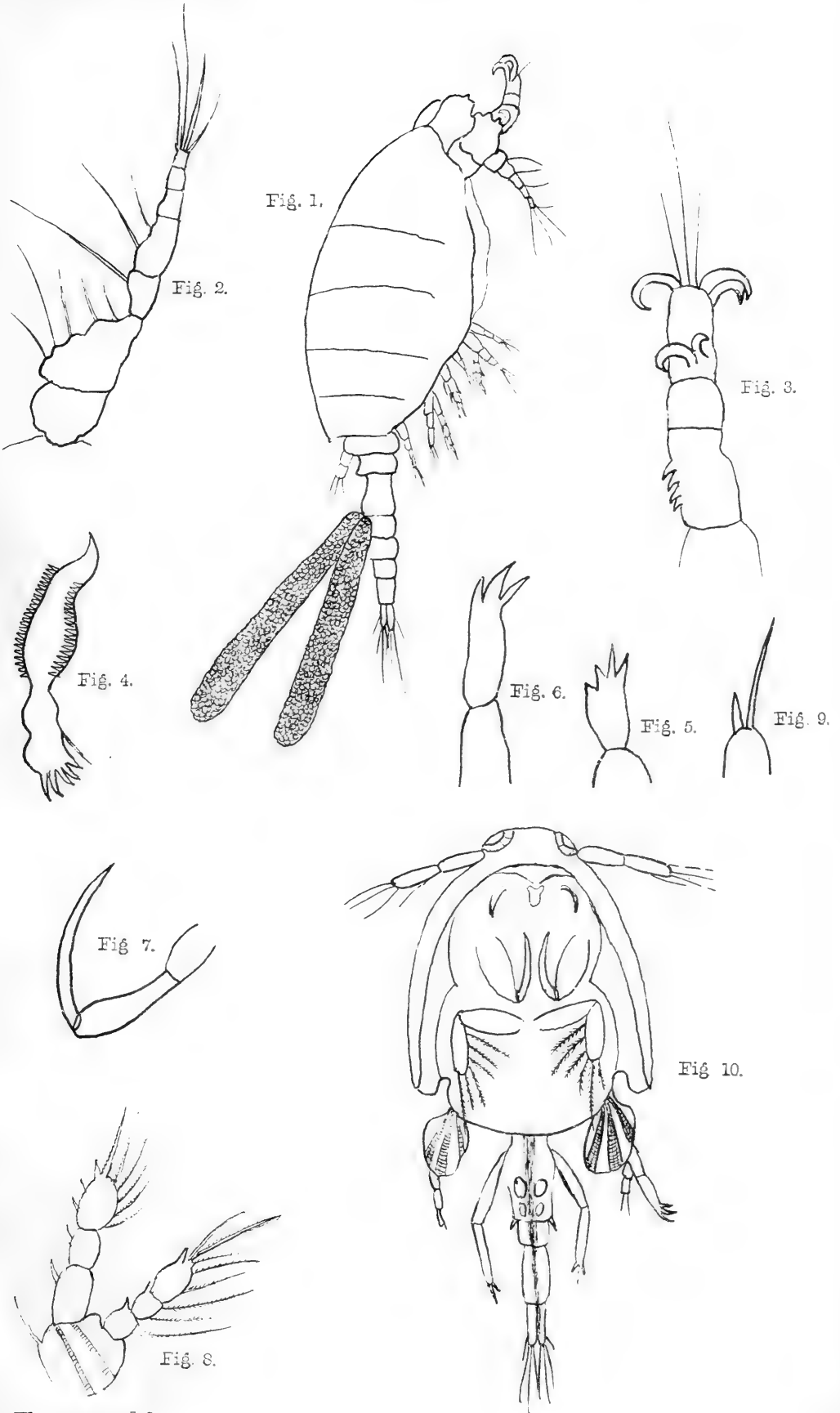
Fig. 1.	<i>Lichomolgus sabellæ</i> , n. sp., female,	× 150 diams.
Fig. 2.	Anterior antenna of do.	250 ,,
Fig. 3.	Posterior antenna of do.	250 ,,
Fig. 4.	Maxilla of do.	400 ,,
Fig. 5.	Anterior footjaw of do.	400 ,,
Fig. 6.	Posterior footjaw of do.	400 ,,
Fig. 7.	Posterior footjaw of male,	400 ,,
Fig. 8.	One of fourth pair of swimming feet,	400 ,,
Fig. 9.	One of fifth pair of do.	400 ,,
Fig. 10.	<i>Trebius caudatus</i> , Kroyer,	150 ,,



I. C. Thompson, del.

CYCLOPS PUFFINI, n. sp. Figs. 1--9.

CYMBASOMA HERDMANI, n. sp. Figs. 10--12.



I. C. Thompson, del.

LICHOMOLGUS SABELLÆ n. sp. Figs 1 -- 9.
TREBIUS CAUDATUS, Kroyer, Fig. 10.

[From Proc. Biol. Soc., L'pool. Vol. II. 1888.]

REPORT on the CRUSTACEA of LIVERPOOL BAY,
1886—1887.

BY ALFRED O. WALKER, J.P., F.L.S.

With Plate XIII.

[See "Report on Fauna of Liverpool Bay," pp. 212 to 221.]

THE species enumerated in the following list were taken by dredging in the following localities :—

I. In the Turbot Hole, about 17 fathoms deep, close to Puffin Island, from the "Hyæna," on 12th June, 1886.

II. At two points between Liverpool and the Isle of Man, 20 and 30 fathoms deep respectively, from the "Weathercock," on 28th August, 1886.

III. At a point between Liverpool and Puffin Island, off the west coast of the Constable Bank, from the "Gamecock," on the 3rd September, 1887. This was the British Association dredging excursion.

The species taken on these occasions are indicated by the above numbers affixed to them.

In addition to these, dredging was carried on occasionally in shallow water (3 to 5 fathoms) in Colwyn Bay; on one occasion with considerable success (24th May, 1887), using a small dredge having the lips masked with pieces of wood, so as to prevent it from digging up the sand, and the net lined with canvas.

Some species were also taken on the shore at low water of spring tides at Colwyn Bay.

Species not previously recorded are marked (*).

AMPHIPODA.

**Orchestia gammarellus*, Pallas, = *O. littorea*, Leach.
In immense numbers under stones on grass above high

water mark, in company with Coleoptera (*Bembidium*, &c.), near Tal-y-Cafn, on the Conway. A female was taken at low-water mark, Penmaen, Colwyn Bay, 13th April, 1888, having probably gone to sea to deposit her ova.

**Hysale Nilsoni*, Rathke, = *Allorchestes Nilssonii*, Bate. One specimen in a large gathering of *G. locusta* from Hilbre Island, made by Mr. I. C. Thompson, on 15th November, 1886.

**Lysianassa longicornis*, Lucas. Two females (I). Taken in the same locality last year, and wrongly referred to *L. costæ* (see Report I., p. 212).

**Tryphosa ciliata*, Sars ("Oversigt af Norges Crust.," p. 81, pl. iii., fig. 4). Two specimens were obtained by placing a quantity of fragments of shells brought up by the dredge in a glass jar filled with sea water, when they swam out. The colour, which is milk white, is very protective among broken shells. Sars says that this species may be distinguished from *T. nana*, Kr., by its more compact form, by the strongly projecting lateral lobes of the head, and by having the fourth segment of the pleon depressed (Pl. XIII., figs. 1—4).

**Harpinia plumosa*, Kröyer, = *Phoxus plumosus*. Three specimens (II and III).

**Pontocrates Norwegicus*, Boeck, = *Kroyera arenaria*, Bate. One specimen in a tidal pool at Penmaenrhos, Colwyn Bay. Flagellum of lower antennæ in this case longer than the animal. Colour hyaline. Eyes bright red under a network of pure white.

**Urothoe elegans*, Bate. A specimen taken by Mr. I. C. Thompson in the tow-net off Puffin Island, at night, October, 1887. The pink colour was well preserved in Dean's solution.

Pleustes bicuspis, Kröyer, and *Calliopius bidentotus*,

Norman. It appears to me that these are one species, agreeing as far as I can see in all respects both with Boeck's description and Kröyer's figure and description of *Amphithoe bicuspis* in his "Grönlands Amphipoder." On the other hand there can be little doubt that Mr. Spence Bate has erred in referring his *Pherusa bicuspis* to that species. The form of the wrist (carpus) and hand (propodos) of both gnathopods, as shown and described both in the British Museum Catalogue and the "British Sessile Eyed Crustacea," is alone sufficient to show that the species in question cannot belong to the genus *Pherusa*, as limited by this author. In *Pherusa* the wrist of the gnathopods is narrow and as long as the hand, while in *P. bicuspis* it is short and produced backward, as shown in the figure.[†] Moreover Canon A. M. Norman informs me that the name of *C. bidentatus* was originally given in MS. by Mr. Spence Bate himself, who must therefore have recognized it as distinct from his *Pherusa bicuspis*. Whether it should be referred to *Pleustes* or *Calliopius* is a more difficult question. It is one of the commonest species in Liverpool Bay, and is found at all depths down to 30 fathoms, becoming more abundant as the depth increases. It varies much in colour, being pure white, freckled with red, or olive green. The long upper antennæ are generally barred with red. (I, II and III).

Pleustes bicuspis, Kröyer, "Grönlands Amphipoder," Danske Vid.-Selsk. Afhandling viii., 1838.

Paramphithoe bicuspis, Bruzelius, Skand. Amphip. Gamm., 1859, p. 73.

Paramphithoe bicuspis, A. Boeck, Crust. Amph. Bor. und Arct., 1870.

[†] I have examined the type specimens in the British Museum and find that they agree with the figure in the Brit. Sess. Eyed Crust., but not with Kröyer's and Boeck's figure and descriptions of *Amphithoe bicuspis*.

Amphithopsis bicuspis, A. Boeck, Forhandl. ved de Skand. Naturf., 8 de Möde, 1860.

Calliopius bidentatus, Norman, Nat. Hist. Trans. Northumberland and Durham, 1867 [not described]. McIntosh, Ann. and Mag. Nat. Hist., 4th ser., vol. xiv., p. 268.

Non Pherusa bicuspis, Sp. Bate, Cat. Amph. Crust., Brit. Mus., 1862; and Sp. Bate and Westwood, Brit. Sess. Eyed Crust., 1863.

Head furnished with a very small beak. Body elongate; epimera much smaller than in *Pleustes pulchellus*, Kr.; back rounded. First and second segments of the pleon having each a spine in the middle of the hinder margin. Lower hind angle of the third segment of the pleon curved upwards and acute. Antennæ long. The hands of the first and second feet (gnathopods) large and oval, and armed along the edge with slender spines. The last pair of uropods having the inner branch more than twice as long as the peduncle. Telson elongate, oval. Length 6.5 mm.—Boeck, Skand. og Arkt. Amphipod., 1876, p. 308. The upper antennæ have the first joint of the peduncle as long as and much thicker than the two following. The flagellum is long and slender, and generally has the joints alternately red and white in lengths of five to nine joints. The first joint is as long as the three following. The peduncle of the lower antennæ is much longer than that of the upper, the first two joints together being about equal in length to the third, which is equal in length to but thicker than the fourth. The first and second gnathopods are almost exactly alike. In addition to the long spines (about five in number) with which the palms are armed, there are also some shorter spines and hairs; all these appear to be arranged along the two edges of the groove in which the finger folds. The last pereopods

have the lower hinder angle of the merus joint prolonged downwards nearly half the length of the carpus. The spine on the first segment of the pleon is much shorter than that on the second, and is sometimes almost obsolete (Pl. XIII., figs. 5—9).

Dexamine spinosa, Mont. A very large specimen, approaching in size examples from the Arctic Sea, was taken in a tidal pool at Rhos Bay, 18th June, 1886.

Atylus Schwammerdamii, M. Edwards. A specimen taken at (I) differed from the common shallow water form in being larger, freckled with brown, and having brilliantly white eyes.

Halirages (Atylus) bispinosus, Bate. A few imperfect specimens in a gathering dredged by Mr. R. D. Darbishire, off Fleetwood, in 7 fathoms, October, 1886. The bulk of the gathering consisted of *Gammarus locusta* and *Atylus Schwammerdamii*.

Calliope leviuscula, Kr. Specimens collected by Mr. I. C. Thompson at Penmaenmawr are darker in colour than those from Colwyn Bay.

Pherusa fucicola, Bate. I have some doubt whether the species recorded under this name in the first Report be not the young of *C. leviuscula*.

Gammarus marinus, Leach. A few female specimens at low water, Penmaenrhos, 23rd April.

**Mæra longimana*, Leach. One female (I).

**Cheirocratus Sundevalli* = *Lilljeborgia Shetlandica*, Bate. (I). Colour, when alive, white mottled with bright red, the spots densest on the top of the head. There is a double tooth at the lower distal angle of the second joint of the peduncle of the lower antennæ. Another, male specimen, taken in the "muzzled" dredge in 3 fathoms, Colwyn Bay, 24th May, 1887.

Amathilla Sabini, Leach. Two specimens of the large

form of this species (the largest about one inch long), taken on the shore, Colwyn Bay, April and May, 1887. The young differ materially from the adult form in wanting the dorsal carina, and in the form of the last uropods. Mr. Stebbing considers *Grayia imbricata*, Bate and Westwood, to be this young form.

Stenothoe (Montagua) marina, Bate. One specimen from Fleetwood, 7 fathoms (R. D. D.).

Metopa Alderi, Bate. Penmaenrhos, April, 1887. Penmaenmawr (I. C. T.).

**Ampelisca equicornis*, Bruzelius. Several specimens at (II). This species is nearly allied to *A. tenuicornis*, Lillje, of which, as Sars† has pointed out, *Tetrommatius typicus*, Sp. Bate, and *A. Gaimardi*, Sp. Bate, are the male. The female may be distinguished by the length of the upper antennæ, which are much longer than the peduncle of the lower, and both sexes by the absence of the tufts of hairs on the under side of the peduncle of the upper antennæ, and the upper side of that of the lower antennæ. Boeck says that the back is not carinate in this species; but in a large female specimen among the above a slight carina in the pleon can be seen. The length of this specimen is about 14 mm. Boeck gives 5 mm. as the length of a female with ova.

**Ampelisca lavigata*, Lillje, = *A. Belliana*, Bate and Westwood. One specimen at (II). Several in the "muzzled" dredge, Colwyn Bay, 3 fathoms, 24th May, 1887. It has the habit of floating on the surface of the water.

**Haploops tubicola*, Lillje. One specimen at (II), found in sand taken home for examination (for shells) by Mr. F. Archer.

Photis (Eiscladus) longicaudatus, Bate (?). One female

† "Oversigt af Norges Crustaceer."

with ova at (I), May, 1885. Boeck refers this to *P. Reinhardi*, Kröyer, while Mr. Norman considers it to be identical with *P. Lütkeni*, Boeck. Neither species has the last uropoda as long as shown in the Brit. Sess. Eyed Crustacea. This species was recorded in error from Colwyn Bay in the first Report. Mons. Chevreux (Assn. pour l'av. des Sci., Blois, p. 314) also notices the length of the last uropods in Bate and Westwood's figure as being much greater than in the specimens taken by him on the coast of Brittany, and suggests that *Eiscladus brevicaudatus*, Norman (Report on Deep Sea Dredgings on the Coasts of Northumberland and Durham, 1864), might be the species he has taken. Mr. Norman informs me that a specimen was so named by Mr. Spence Bate, but no description was ever published.

**Photis tenuicornis*, Sars, "Oversigt af Norges Crustaceer," Christiania Videnskab. Forhandl., 1882. One specimen (a male) of this species, not hitherto recorded in Great Britain, taken at low water mark, among Algæ, &c., at Penmaenrhos, Colwyn Bay, 8th April, 1887. It may be distinguished from the other species by the shape of the hand of the first gnathopods, which has a concave edge, while that of the others is convex; by the lower angle of the hand being nearer to the base than to the distal extremity; and by the antennæ being less thickly clothed with hairs.

Aora gracilis, Bate. (III); Black Point, Anglesey, at low water, October, 1887.

**Gammaropsis erythrophthalmus*, Lillje. *Eurystheus erythrophthalmus*. (I and II); also at Colwyn Bay. Rather common. Colour, pale green with scarlet eyes.

Podocerus falcatus, Mont. Puffin Island; abundant at low water of spring tides, September, 1887. Boeck refers *P. pulchellus* and *P. pelagicus* to this species.

Cerapus abditus, Templeton. Black Point, Anglesey, low water. One female.

ISOPODA.

**Jera Nordmanni*, Rothke. Under stones, Penmaenrhos, 27th June, 1887. Very variable in colour.

CUMACEA.

**Diastylis Bradyi*, Norman (Ann. and Mag. Nat. Hist., 5th series, vol. iii.). One specimen (a female), in 3 fathoms, Colwyn Bay, 24th May, 1887, in the "muzzled" dredge. In my specimen the sides, as well as the ventral surface, of the fourth, fifth and sixth segments are spinous, and the postero-lateral margin of the fifth is produced backwards about half way between the ventral and dorsal surface (i.e. on the side), and terminates in a strong spine with a smaller spine close below it (Pl. XIII., figs. 10 and 11). The only previously recorded locality for this species is Lough Swilly, Co. Donegal, where it was dredged in 15 fathoms, during the "Porcupine" expedition in 1869. Mr. Norman informs me that it has been also taken on the Northumberland and Durham coasts.

PODOPHTHALMATA.

SCHIZOPODA.

**Mysis vulgaris*, Thompson. Taken in considerable numbers by Mr. F. Archer, at the mouth of the river Alt, in brackish water. A large proportion of the specimens had the telson deformed, as described in a previous number of the Liverpool Biological Society's Proceedings.

**Mysis Lamornæ*, Couch. One specimen, in 3 fathoms, Colwyn Bay, 24th May, 1887, in the "muzzled" dredge. A pretty species, with bright red thorax, maxillæ and maxillipedes, and a red spot on the last abdominal segment before the telson.

MACROURA.

**Palæmon squilla*, Linn. One specimen (female with ova), taken in a tidal pool at Beaumaris, by Mr. H. C. Chadwick, July, 1878.

Pandalus brevirostris. (II).

Hippolyte pusiola, Kröyer. (II). Several specimens; carapace banded with red. The wrist of the second pair of legs has seven joints (and not four as described by that author), being one more than in the same limb in *H. Cranchii*, from which it is also distinguished by having a pointed rostrum. (See Kinahan, in Nat. Hist. Review, 1857, p. 159, pls. ix. and x.)

Hippolyte Cranchii, Leach. One specimen, 3 fathoms, Colwyn Bay, May, 1887.

**Crangon (Steiracrangon) Allmanni*, Kinahan. (II). Several specimens. Colour, greyish white, freckled with light red.

Crangon trispinosus, Hailstone. Colwyn Bay, April, 1887, at low water, spring tide.

Crangon fasciatus, Risso. Colwyn Bay, two specimens, dredged in 3 fathoms, 24th May, 1887.

**Palinurus vulgaris*, Latreille. A fine specimen in the Grosvenor Museum, Chester, is said to have been taken in the Isle of Man.

Homarus vulgaris, M. Edwards. A very large specimen, the hands measuring 9 inches in length; taken from under a rock in Rhos Bay, 1886.

Galathea intermedia, Lillje. (II). Rather common.

ANOMOURA.

Pagurus cuanensis, Thompson. (II). Several specimens. The shells inhabited were all covered with the sponge (*Suberites domuncula*, Schmidt), characteristic of this species.

**Pagurus lævis*, Thompson. One specimen, from Douglas, 1886.

Porcellana platycheles, Penn. Abundant in spring, 1886, at Penmaenrhos. Mr. H. C. Chadwick, in lit., says, "Up to the summer of 1877 this species was well represented at extreme low water mark at Beaumaris. Since that time, however, I have not seen one." (See Report I.)

BRACHYURA.

Ebalia tuberosa, Penn, = *E. Pennantii*, Leach. (II).
Two males.

Ebalia tumefacta, Mont., = *E. Bryerii*, Leach. (II).
Several specimens.

**Portunus holsatus*, Fabr. Two specimens, dredged by Mr. H. C. Chadwick, in 10 fathoms, near Garth Ferry, Menai Straits, 1887.

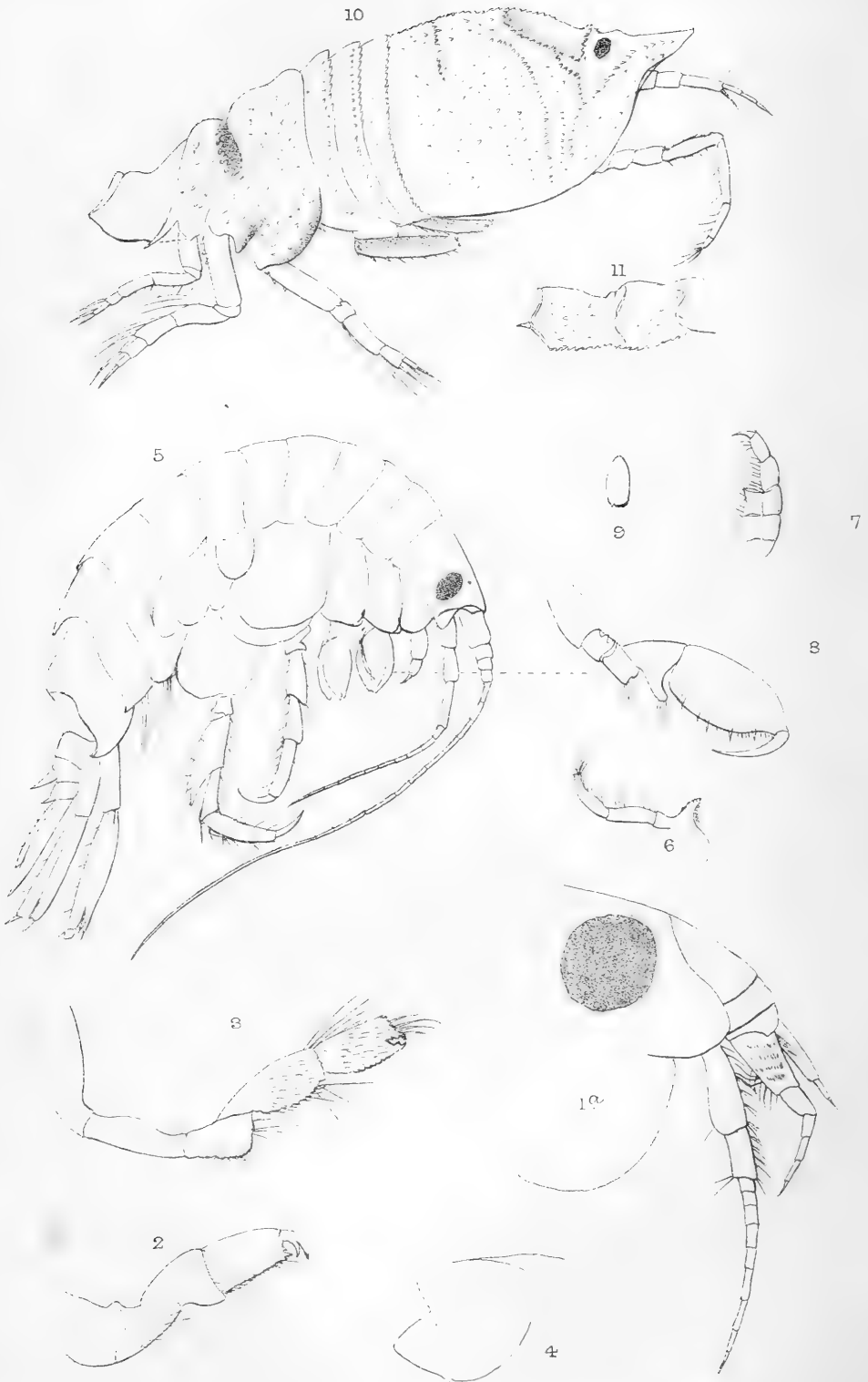
Portumnus latipes, Penn. Not uncommon on the shore at Colwyn Bay, in July, 1887. It makes a complicated track on the sand, at one end of which is a small depressed mound, under which the crab is found about 3 or 4 inches below the surface. The broad last joint in the hind legs of this species seem to be used for burrowing rather than swimming. One kept for some weeks in an aquarium never attempted to swim.

Pilumnus hirtellus, Leach. One specimen, dredged off Penmon, Anglesey (Chadwick).

**Xantho rivulosa*, M. Edwards. One specimen, taken at extreme low water mark at Beaumaris, July, 1878, by Mr. Chadwick, who writes, "It was almost buried in gravelly mud. I have since searched diligently for it many times without success."

Eurynome aspera, Penn. (II). Two specimens.

Inachus Dorsettensis, Leach. (II). Two specimens.



Alfred O. Walker del.
Parker & Coward lith.

West Newman & Co. imp.

TRYPHOSA CILIATA (Sars), Fig. 1-4 .
 PLEUSTES BICUSPIS (Kröyer) ... 5-9 .
 DIASTYLIS BRADYI (Norman) ... 10-11 .

DESCRIPTION OF PLATE XIII.

- Fig. 1. Head of *Tryphosa ciliata*.
Fig. 2. First gnathopod of do.
Fig. 3. Second do. do.
Fig. 4. Third segment of pleon.
Fig. 5. *Pleustes bicuspis*, Kr.
Fig. 6. Mandible of do.
Fig. 7. Maxillipede.
Fig. 8. First gnathopod.
Fig. 9. Telson.
Fig. 10. *Diastylis Bradyi*, Norman. Head and thoracic segments.
Fig. 11. Penultimate segments of abdomen.

APPENDIX to THIRD REPORT on the COPEPODA
of LIVERPOOL BAY (the L.M.B.C. DISTRICT).

BY ISAAC C. THOMPSON, F.L.S., F.R.M.S.

With Plate IX.

[Read 10th May, 1889.]

SINCE the Third Report on the Copepoda of Liverpool Bay was published, a new and interesting species of Copepod was taken by the dredge in Port Erin Bay, Isle of Man, during the fifth cruise of the "Hyæna," in April, 1889. Several specimens, all females, some having ovisacs, were found by both Mr. W. S. McMillan and myself in washings of muddy sand dredged from five fathoms. Besides a large number of Amphipoda, a few other species of Copepoda were found, amongst which were a number of specimens of *Ectinosoma spinipes*, Brady, which in general appearance the new species much resembles. It differs, however, from the characters of the genus *Ectinosoma* in several important particulars, especially in the anterior and posterior antennæ and in the form of the fifth foot. In these and other particulars it so nearly agrees with the general form and generic characters of *Jonesiella*, Brady, that I have placed it in this genus. After careful dissection, however, I am unable to make out any jointing whatever in the anterior antennæ, except one joint near the apex, and the animal is too minute and fragile to allow of the use of potash or any other clarifying medium which might disclose further structure. Another point of difference is in the inner branch of the first pair of swimming feet, which in *Jonesiella* has only two joints, while all the specimens of this species we have dissected have three joints. But I

think that these points should constitute specific rather than generic differences when the other more important characters agree, and I therefore prefer to slightly modify an existing genus rather than make a new one.

I have named this species after the steamer "Hyæna," belonging to the Liverpool Salvage Association, who have on many occasions most courteously placed that vessel at the disposal of Professor Herdman for the work of the L.M.B.C.

Family. HARPACTICIDÆ.

Jonesiella hyænae, n. sp. (Pl. IX., figs. 1 to 10).

Length 1-30th inch. Body ovate, of nearly equal thickness throughout; head and first thoracic segment coalescent. Rostrum (fig. 4) long and spatula like; rounded anteriorly. Anterior antennæ (fig. 2) broad at base with cleft on each side near the base, then widening and surmounted by a tree-like crown, having a second segment at apex and several spinose and plumose setæ. Posterior antennæ (fig. 3) two branched, the outer branch being two jointed. The lower joint has two short plumose spines; the apical joint is edged on outer side with short spines, and has several long spinose setæ at the apex. The inner branch is short (joints not made out), and is terminated by two long plumose setæ. Mandibles (fig. 5) broad and strongly toothed; palp of one short stout joint and bearing several long and short spines. First footjaw (fig. 6) much resembles that of *Jonesiella fusiformis*, Brady and Robertson. Second footjaw (fig. 7) two jointed, bearing a finely curved narrow clawed hand, the latter being jointed near the centre. The first joint has two or three short plumed spines at the apex; the second joint is finely ciliated on its inner margin. First pair of swimming feet (fig. 8) have three joints to each branch, the inner branch being rather

Fig. 1.

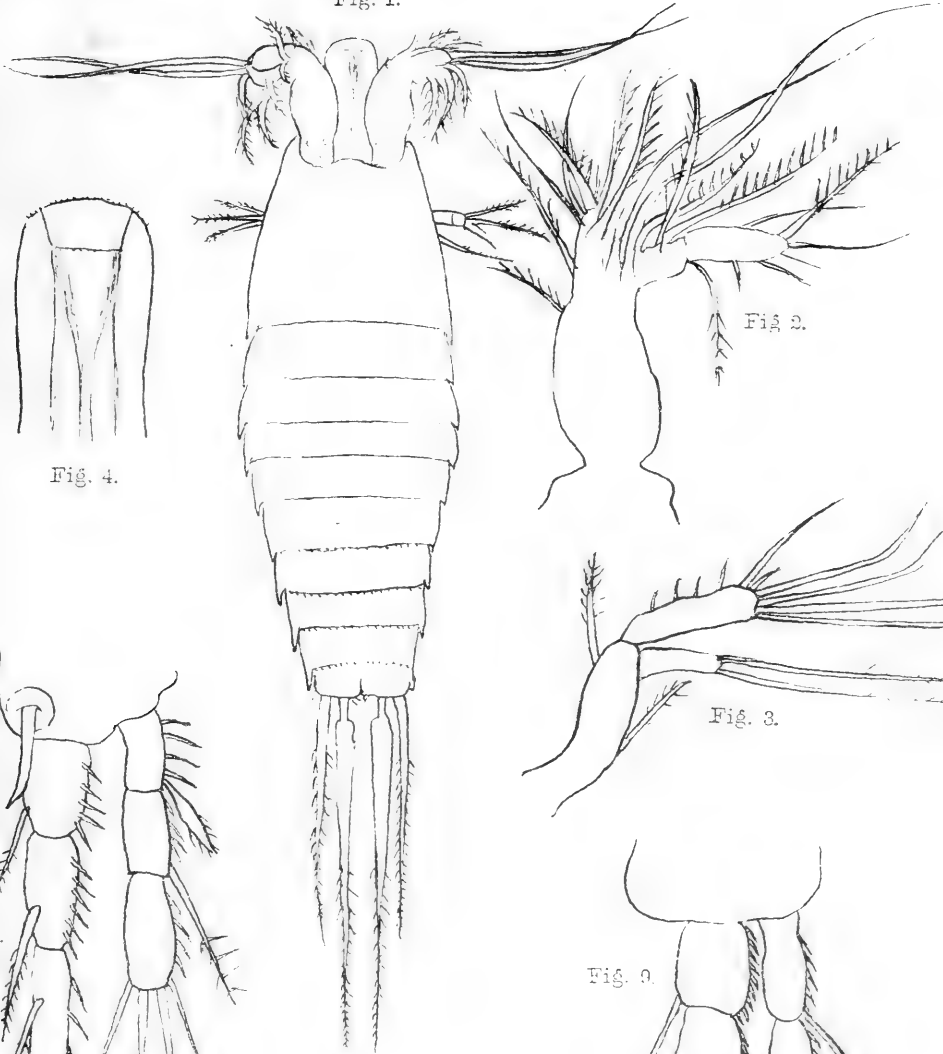


Fig. 2.

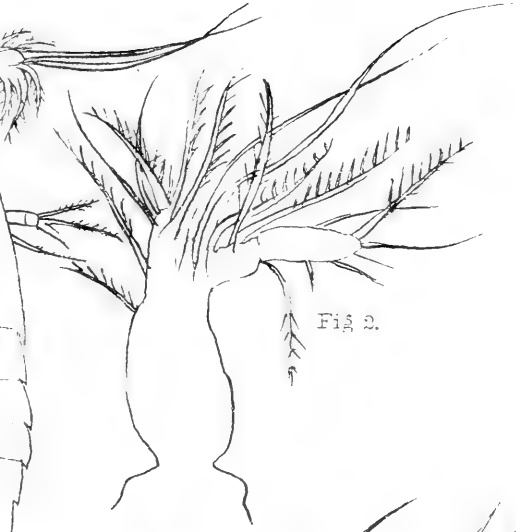


Fig. 4.

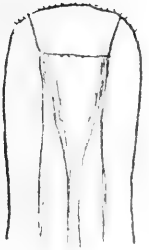


Fig. 3.

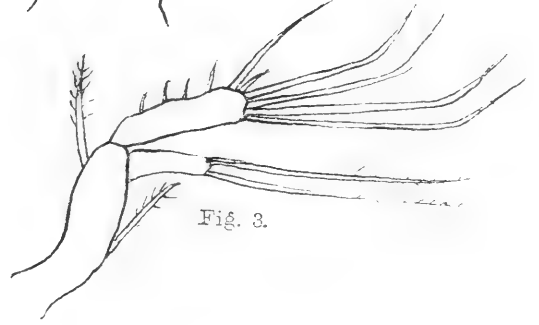


Fig. 8.

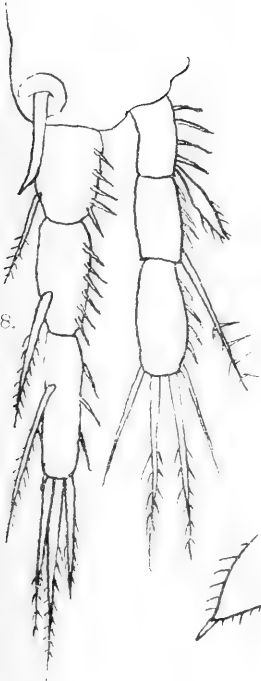


Fig. 9.

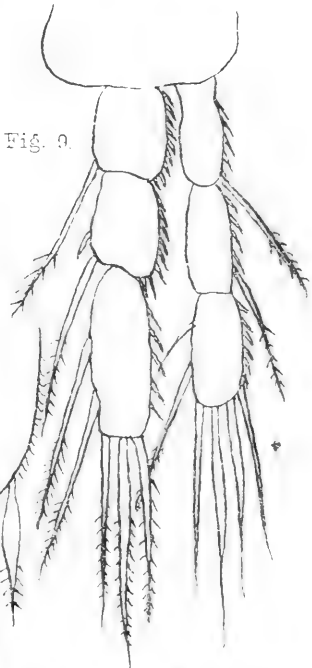


Fig. 10.



Fig. 6.



Fig. 7.



Fig. 5.



I. C. Thompson, del.

JONESIELLA HYÆNÆ, n. sp. Figs. 1 to 10.

longer than the outer; outer margins of all the joints fringed with spines, the lateral and terminal spines being plumose. The inner side of the base of each of the first pair bears a short stout spine curved at the end. The second, third and fourth swimming feet (fig. 9) have both branches three jointed and are spinose like the first. The fifth pair of swimming feet (fig. 10) have two large rounded foliaceous joints and a smaller one at outer side, each edged all round with fine cilia, the large joints bearing several long and short spear shaped spines, plumose near the apex. Caudal segments very short and broad and appear like a divided abdominal segment terminated on each side by two spear shaped spinose setæ, plumose near the apex, the inner ones considerably longer than the outer, and narrowed at the base.

EXPLANATION OF PLATE IX.

Jonesiella hyæncæ, n. sp.

Fig. 1.	Adult female	× 250	diams.
Fig. 2.	Anterior antenna	500	„
Fig. 3.	Posterior antenna	500	„
Fig. 4.	Rostrum	500	„
Fig. 5.	Mandible and palp.....	500	„
Fig. 6.	First footjaw	500	„
Fig. 7.	Second footjaw	500	„
Fig. 8.	First swimming foot.....	500	„
Fig. 9.	Third swimming foot	500	„
Fig. 10.	Fifth swimming foot.....	500	„

THIRD REPORT* on the HIGHER CRUSTACEA
of the L.M.B.C. DISTRICT.

BY ALFRED O. WALKER, F.L.S.

With Plates X. and XI.

[Read 8th March, 1889.]

THE collections made this year (1888) of the Podophthal-
mata, Cumacea, Isopoda, and Amphipoda, are undoubtedly
the most interesting since the foundation of the Liverpool
Marine Biology Committee. Five species of the first,
three of the second, four of the third, and fifteen of the
fourth of these orders are new to our fauna, while probably
one Isopod and four Amphipoda are new to the British
lists, two of these latter being new to science. The
collections that have been examined were:—

I. From Puffin Island, collected at the following dates.

a. March 24th, by Prof. Herdman and three others,
chiefly by dredging and with the weighted tow-net, in
the Turbot Hole.

b. July 24th, by Prof. Herdman, Mr. Hurst, and
Mr. Dutton of Chester.

c. August 15th, by Mr. Hurst and Mr. Clubb, off
the N.E. end of the island.

d. September 8th and 9th, by Professor Herdman,
Mr. Hurst, and the Reporter, at extreme low water,
chiefly on the Spit at the south end of the island.

II. May 19th to 21st, in the “Hyæna,” during a trip to
the Isle of Man, when the electric light (E.L.) was

* For First Report, see “Fauna of Liverpool Bay,” vol. i., pp. 212—226,
1886; for the Second Report, see “Proc. Biol. Soc., L’pool,” vol. ii., pp.
171—181, 1888.

used, as mentioned in Professor Herdman's Report for 1888 on the Puffin Island Biological Station, with excellent results.

- III. April to July, at Colwyn Bay, shore-hunting, dredging, &c. by the Reporter.
- IV. September 20th, at Bull Bay, Anglesey, by Mr. R. Newstead, Curator of the Grosvenor Museum, Chester.

The following species are either recorded for the first time in the fauna or in the locality indicated, or are mentioned on account of some point of interest in connexion with them.

BRACHYURA.

Xantho rivulosa, Risso.

X. tuberculata, Couch.

II. Three specimens, dredged between Calf of Man and Port Erin. They belonged to the *tuberculata* form, which was considered by Couch to be distinct, and is described and figured as such in Bell's "British Stalk-eyed Crustacea." It has since been shown to be a mere variety.

Portunus puber, Linn.

Bull Bay (IV.), in the lobster-pots, where it is said to be common. The specimens were of large size.

ANOMURA.

**Eupagurus pubescens*, Kröyer.

II. This was taken abundantly in the dredge west of the Calf of Man, but all young specimens.

**Anapagurus hyndmanni*, Thompson.

II. Scarce.

**Galathea dispersa*, Sp. Bate.

II. Thanks to the admirable monograph of the Galatheidæ by M. Jules Bonnier ("Bull. Scient. de la France

* Indicates a species not previously recorded in "Fauna of Liverpool Bay."

et de la Belgique," 1888), which the author has been kind enough to send me, I was able to identify all the specimens dredged off the Isle of Man as belonging to this species. It is best distinguished by the strong tooth on the inner side of the merus joint of the third maxillipedes being connected with the distal extremity of the joint by a ridge on which are two to four smaller teeth.

**Munida bamffia*, Pennant.

II. One specimen. Notwithstanding the high authority of Mr. G. O. Sars, who considers *M. rugosa*, Fabr., as distinct from *M. rondelii*, Bell,† I agree with M. Bonnier and others in holding them to be the same, and therefore referable to the older name of Pennant. Mr. R. Pocock, of the British Museum, and I examined a large number of individuals at that institution, and found them to vary so much in the characters relied on by Sars that it was impossible to separate the two forms.

MACRURA.

**Caridion gordonii*, Sp. Bate.

II. One female, with ova, between Calf of Man and Port Erin.

Pandalus brevirostris, Rathke.

II. Several between Calf of Man and Port Erin.

CUMACEA.

**Cuma scorpoides*, Montagu.

II., E.L. Two young males. Taken by electric light (E.L.) at Ramsey. Recognizable by the lateral carina extending longitudinally from the rostrum across the carapace and free thoracic segments (see Norman, "Brit. Assoc. Report," 1868, p. 273).

† "Oversigt af Norges Crust.," p. 6, pl. i., fig. 5.

**Iphinoe trispinosa*, Goodsir.

II., E.L. Three males. Port Erin. These were the variety without the serrated dorsal crest.

**Pseudocuma cercaria*, Van Beneden.

II., E.L. A very large number, all males, at Port Erin. This is certainly the species described under the above name by G. O. Sars,† but it is difficult to believe that Van Beneden's‡ figures and description (which Sars remarks are "faulty in the extreme") can refer to the same. Our experience in the "Hyæna" confirms Norman's statement, that this is "the most numerically abundant species of Cumacean in the British seas."§

ISOPODA.

**Anceus maxillaris*, Mont.

III. A specimen of the Praniza form of this (?) species, taken in a rock pool at Penmaenrhos, attached to a young *Cottus* behind the second dorsal fin. Colour, brilliant blue-green.

Janira maculosa, Mont.

II. A number of specimens on a mass of *Aleyonium digitatum*, dredged between the N.W. Lightship and Isle of Man, on the outward trip of the "Hyæna," 19th May, 1888.

**Munna fabricii*, Krøyer (Pl. XI., figs. 16 to 18).

I. A single specimen, without the long ambulatory legs and long outer antennæ. The telson agrees with Krøyer's

† Middelhavet's Cumaceer, Arch. fur Math. og Naturvidenskab, 1878, p. 114, pls. 40—42.

‡ "Recherches sur la Faune litoralè de la Belgique." Crust., p. 85, pl. xiv. *Leucon cercaria*.

§ "Ann. and Mag. Nat. Hist." 5th series, vol. xix., p. 102.

figure in general form, but wants the teeth at the edge both near the proximal and distal extremity (see G. O. Sars, "Oversigt af Norges Crust.," p. 65). The first pair of feet also agree with Kröyer's figure.

**Dynamene rubra*, Mont. (Female.)

D. viridis, Leach. (Female.)

Næsa bidentata, Leach. (Male.)

D. varians, Stebbing.

I. and IV. On Algæ. Stebbing† and Hesse‡ have pointed out that the above are all one species. The colour appears to depend upon that of the weed on which they feed. The specimens from Bull Bay were green when taken, but turned red in spirit.

**Dynamene montagui*, Leach.

IV. With the last species, of which it may possibly be the adult female.

Ligia oceanica, Linn.

I. A specimen was found by Dr. Herdman in a rock pool on the N.E. end of Puffin Island, on 14th February, 1889. As this species is not usually found in the water (its habits being much the same as those of the strictly terrestrial Oniscidæ, except that it lives near the sea), it is probable that the specimen in question was a female that had gone into the sea to deposit its ova, as appears to be the case with the otherwise practically terrestrial Amphipod *Orchestia gammarellus*. The space under the thoracic segments was quite empty, as if it had recently been filled with ova. It is an interesting fact as bearing upon the phylogeny of the terrestrial Isopoda, that the common *Porcellis scaber* if it falls into water sinks at once to the bottom, where it will crawl and live for a considerable

† "Proc. Linn. Soc.," vol. xii., 1876. Zool., p. 146, pl. vii.

‡ "Ann. des Sciences Nat." 5th series, vol. xvii., p. 1.

time. This, coupled with the amphibious habits of *Ligia*, seems to point to an aquatic origin.

AMPHIPODA.

Hyperia medusarum, Müller.

Two large females with ova from lobster-pots. IV. Mr. Newstead says the eyes were brilliantly luminous.

Hyale nilsonii, Rathke.

A single female. I.a.

Orchestia gammarellus, Pallas.

A male under a stone on grass close under Burton Rock, on the Dee, on 7th February. Another near Port Erin, "fully 500 yards from the shore" (T. L. Denson in lit.).

**Lysianax ceratinus*, † n. sp. (Pl. X., figs. 1 to 8).

Lateral lobes of the head prominent, subangular. First four epimera deeper than the corresponding dorsal segments, the first equal in width at the widest part to the two next together. *Third pleon segment having the hinder angle rounded, but approaching to subangular.*

EYES large, oval, dark, occupying the greater part of the head.

UPPER ANTENNÆ: First joint as long as the lateral lobe of head, upper and lower margins produced to a point, the lower rather the longer; second joint rather more than half as long as the first; third joint about half as long as the second. Flagellum eight-jointed, the last joint minute. Accessory appendage four-jointed, the first

* It is possible that this may be the female of *L. longicornis*, Lucas, though it differs from the male of this species as described and figured by this author in not having the telson terminated by a rounded point, in the form and armature of the last uropods, and in the shape of the lateral cephalic lobe. From the same (?) species as figured by Bate and Westwood it differs in having no spines on the telson and no hairs on the last uropods.

† κεράτινος, horny.

reaching to the middle of the second joint of the flagellum, the last joint minute.

LOWER ANTENNÆ: First joint shorter and thicker than the second, which is equal to the third. Flagellum ten to eleven-jointed, the first joint nearly equal to the three succeeding united.

FIRST GNATHOPODS: First joint as long as the three following, the second and third being very short, wrist and hand about equal. First joint with a few hairs on the front margin, the second densely hairy on the hind margin, the third with short fur on the hind margin and long hairs at the distal end. The hand tapers and forms with the immovable finger an elongated cone, furnished on the hinder (i.e. lower) margin *with a row of five or six short spines* and a few setæ. On account of the roundness of this joint the spines cannot always be seen. The finger has a hinged spine articulated to the upper side near the point beyond which it extends, giving it the appearance of being split.

SECOND GNATHOPOD: First joint the longest, second equal to the fourth (wrist), which is longer and deeper than the hand. This limb is of a type common in this family, and is well represented by that of *Orchomene serratus*, in Boeck's "Amphipoda," pl. v., fig. 2.k.

FIRST PERÆOPODS: Hinder margins of third and fourth joints equal, and furnished with long hairs. Front margin of third produced to one-third of the length of the fourth. Fifth joint half as long again as the fourth, with nine or ten strong spines on the hinder margin and three more slender on the front.

LAST PERÆOPODS: First joint dilated; a row of twelve or thirteen spines on the anterior margin gradually increasing in size downwards and terminating at the apex, which is produced downwards, in a group of one large and

two smaller spines. Second joint short and terminated anteriorly by a similar group of spines. Third joint produced downward for about one-third the length of the fourth, the lobe thus formed being crowned with a double spine and the hind margin having three strong spines. The remaining joints are somewhat variable in length and armature in different specimens.

All the peræopods have the third joint produced.

UROPODS: First pair projecting beyond the others; peduncle longer than rami, both spinous. Second pair projecting as far as the third, spinous as the first. Third pair with the peduncle longer than the rami, widening suddenly at the proximal and tapering slightly towards the distal end; it has three small spines on the upper margin. The rami are round, the outer slightly the longer, the inner with two minute spines. There are no hairs (setæ) of any kind on the uropods.

TELSON concave, entire, quadrate, with the side curved; hinder margin straight.

LENGTH 10 mm.

The integument is hard, and horny both in colour and texture—hence the specific name, from *κεράτινος*, horny.

I. b. A single female specimen of the same species as those recorded in Report I. as *L. costæ*, and corrected in Report II. to *L. longicornis*, Lucas. Neither of these appears to be correct, as far as it is possible to judge from females only, no male having yet been taken in our district. Stebbing ("Challenger" Report) shows that *Lysianassa* was already preoccupied in the Mollusca and substitutes *Lysianax*. I include the present species in the genus in spite of the uropoda not being ciliated, which I submit is scarcely a fit generic character. The squamiform entire telson, and the conical propodos of the first gnathopod with apparently immoveable dactylos, are such marked

characteristics as to be sufficient reason for referring it to *Lysianax*.

**Lysianax audouinianus*, Sp. Bate (Pl. X., figs. 9 and 10).

II. Two young specimens on *Halichondria*, dredged in thirty fathoms, twenty-two miles S.E. of Isle of Man. Length 3 mm. Heller† has described a form which he calls *Aristias tumidus*, (jun.), Kröyer, but which he says differs in some of the mouth organs from the adult. It also differs in having an entire telson. But Hansen‡ says that *A. tumidus* of all authors except Kröyer is not the same species as the latter's, and proposes the name of *A. neglectus* for *A. tumidus*, Auct. Boeck includes with this *Lysianassa audouiniana*, Bate, but, as Hansen points out, this species has an entire telson, while in the genus *Aristias*, Boeck, it is cleft to the base. I therefore refer both my specimens and those of Heller to *L. audouiniana*, although they should properly be placed in a new genus, as the strongly subchelate character of the first gnathopod does not agree with Boeck's definition of *Lysianassa*. In my specimens the inner rami of all the uropods are minutely toothed on *both* edges, as are also the outer rami on the inner edge. As however it requires a high power ($\frac{1}{4}$ -inch objective) to see this denticulation, it may have escaped observation.

**Hippomedon denticulatus*, Bate and Westwood.

One young specimen, Port Erin, five fathoms. II., E.L. Hansen§ points out differences between this species and *H. holbolli*, Kr., with which Boeck unites it. In the former the integument is smooth, while in the latter it is reticulate and granulate. The hinder angle of the third pleon

† "Crust. &c., Oster. Ungar. Nordpol. Expn.," p. 6, pl. iv., figs. 1—8.

‡ "Videnskabliger Meddelelser Nat. Forening i Kjobenhavn," 1887.

§ "Vidensk. Med. Nat. Forening i Kjob.," 1887. p. 63.

segment in the former is much more produced and curved than in the latter. Bate and Westwood's figure differs from both as figured by Hansen in the shape of the telson; also in the second uropods, which they figure as spinous, but describe as "simple." In my young specimen these have a single spine about one-third of the length of the ramus from the peduncle, and a similar spine on the inner (?) ramus of the third uropods about the middle.

**Orchomene goësi*, Boeck.

I. *d.* A single specimen. New to the British lists. Distinguishable by the short and wide hand and wrist of the first gnathopod, and by the very broad peduncle and short rami of the third uropods.

**Tryphosa hörungii*, Boeck.

I. *a.* Three specimens. New to British lists.

Tryphosa ciliata, Sars.

I. *a.* One specimen. I question whether this is distinct from *T. nana*, Kr.

**Euonyx chelatus*, Norman.

Euonyx chelatus, Norman, "Brit. Assoc. Rep.," 1866.

Opis leptochela, Bate and Westwood, "Brit. Sess. Crust.," vol. ii., p. 501.

One specimen off the Lighthouse. I. Norman, in his report on the Shetland dredging, *l.c.*, describes this species. As the first gnathopods have the hand long and slender instead of very large, according to the character of *Opis*, as defined by Kröyer, it should not in any case have been referred to that genus. Norman says it is parasitic on *Echinus esculentus*. In my specimen the second gnathopod is not so hairy as shown in Bate and Westwood's figure, and the tooth or hump on the dorsal surface of the fourth pleon segment is much more marked.

Bathyporeia pilosa, Lindström.

II., E.L. In immense numbers, of both sexes.

Urothoe marinus, Bate.

U. elegans, Bate.

One specimen. Male. I.

**Amphilochus manudens*, Bate.

One specimen. I. a.

Metopa alderi, Bate.

Several specimens, all very small. I. and II.

Iphimedia obesa, Rathke.

One specimen. Length 4 mm. I. a. This specimen was nearer *I. eblana*, Bate, which however Stebbing considers is only a (? young) form of *I. obesa*.†

**Monoculodes longimanus*, Bate and Westwood.

M. longimanus, Bate and Westwood.

M. grubei, Boeck, "Brit. Sess. Crust.," vol. ii., p. 507.

Several specimens. II., E.L.

**Megaluropus agilis*, Norman.

A few specimens. II., E.L. An undescribed species, having some remarkable characters, notably the very broad third uropods, and the position of the eye in the front portion of the lateral cephalic lobe. It has long been in the rich collection of Norman, who is about to publish a description in the "Ann. and Mag. Nat. Hist."‡ He informs me that he has specimens from the east, west, and south coasts of Great Britain. The third uropods are very fragile and often missing in dead specimens.

Dexamine spinosa, Mont.

Not common on Puffin Island. I. d.

**Atylus vedlomensis*, Bate and Westwood.

Dexamine vedlomensis, Bate and Westwood.

Not common. I. d. II., E.L.

† "Challenger" Report, p. 295.

‡ "Ann. and Mag. Nat. Hist.," 6th series, vol. iii., p. 445, pl. xviii., figs. 1 to 10.

**Tritæta gibbosa*, Bate.*Atylus gibbosus*, Bate and Westwood.

Not uncommon on Sponges, Ascidians, &c. I., II., III. Most easily obtained by placing freshly gathered pieces of *Halichondria panicea* in sea water, when it emerges from them.

Halirages bispinosus, Bate.

I. d., IV.

Calliopius leviusculus, Sp. Bate.

Very abundant. I. d. All the specimens taken were freckled with red. This species varies in colour remarkably in different localities. At Colwyn Bay it is generally greenish white, while those I have seen from Penmaen-mawr were olive coloured.

**Calliopius norvegicus*, Rathke (?).

Llandudno. I. b., III., IV. It is remarkable that this species, which has not been previously recorded as British, should this year have been taken at all the above localities, at Bull Bay (IV.) abundantly. Mr. Stebbing informs me, however, that it is not uncommon at Ilfracombe. Meinert† and Zaddach‡ do not consider it distinct from the preceding. I am surprised at this statement, for the longer and more slender antennæ, the teeth on the under side of the last joints of the peduncle of the upper antennæ in the male (in place of the strong tooth at the distal extremity of the last joint in *C. leviusculus*), the smaller and weaker gnathopods with the wrist not produced into a spur, and lastly the angulated hind margin of the third pleon segment above the lower angle, make the distinction unmistakable. At the same time, I doubt whether *C. norvegicus* of Boeck (which is certainly our species)

† "Crust. Isop. Amphip. und Decap. Daniæ." Natur. Tidsk. 1877-8.

‡ "Die Meeres-Fauna an die Preuss. Küste."

be identical with *Amphithoe norvegicus* of Rathke. The latter has the upper antennæ only half as long as the lower, whereas I have never seen a specimen in which they were not almost exactly equal as shown by Boeck. Rathke's other characters also are scarcely sufficient to connect them.

Gammarus marinus, Leach.

I. a.

Melita obtusata, Mont.

I. a., II. A number on *Asterias rubens*, dredged between the N.W. Lightship and the Isle of Man on the outward voyage of the "Hyæna," May 19th, 1888.

Amathilla sabini, Leach.

I. a.

**Ampelisca tenuicornis*, Lilljeborg.

A. typica, Boeck, non Bate.

(?) *A. carinatus*, Bruzelius.

I. a. II., E.L., and dredged. The confusion as regards the above species is great (see Stebbing, "Challenger" Report, p. 542). As this author remarks,† his *A. zamboangæ* from the Philippine Islands approaches closely to *A. carinatus*, Bruz. Two of the specimens from Port Erin agree so closely with the admirable drawings of *A. zamboangæ* that the two forms can hardly be regarded as other than local varieties.

Ampelisca lævigata, Lillj.

II., E.L. Many specimens, both at Ramsey and Port Erin. This appears to be the commonest species of the genus in Liverpool Bay.

Photis reinhardi, Kr.

One female, with ova. II., E.L.

† "Challenger" Report, p. 1687, note.

Nænia rimapalma, Bate.

· I. a.

Amphithoe podoceroides, Rathke.

I. a. Stebbing† considers this to be the same as *A. rubricata*, Mont., though the former is green and the latter red. Here again, as in *Dynamene rubra*, Mont., and *D. viridis*, Leach, the colouring probably depends on that of the weed in which the animals are found. Montagu's name being the older should have the precedence, as Stebbing points out.

**Podocerus capillatus*, Rathke (Pl. XI., figs. 14 and 15).

Janassa variegata, Boeck.

I. c. One small specimen, 2 mm. long, taken in the tow-net by Mr. I. C. Thompson. There is much confusion about this species, which appears to me to have arisen chiefly from the figure in Bate and Westwood,‡ and from their statement that it is possibly only a variety of *P. variegatus*, Leach. The figure of the entire animal as shown by these authors may or may not be the last named species, but the separate drawings of the lower antennæ and second gnathopod unquestionably indicate *P. capillatus* of Rathke. Leach's characters are so unsatisfactory that it seems hopeless to determine whether his *P. variegatus*, *Jassa pulchella*, and *J. pelagica*, are one and the same species (*P. falcatus*, Mont.) or not. But the upper antennæ without a secondary appendage, the thickness and dense hairiness of the lower antennæ, with the flagellum consisting of one long and two minute joints unprovided with the hooks which occur in the same member in *P. falcatus* (and *P. variegatus*, as figured by Bate and Westwood), together with the form of the second gnathopod, all mark *P. capillatus* as very distinct from

† "Challenger" Report, pp. 204 and 594.

‡ Brit. Sess. Crust., p. 442.

P. falcatus at any age. Indeed the absence of a secondary appendage would seem to justify Bruzelius in placing it in a separate genus, *Jassa* of Leach, though it is not easy from Leach's description (in the Trans. Linn. Soc., vol. xi., p. 361) to see in what material point this genus differs from his *Podocerus*.

**Podocerus isopus*, n. sp. (Pl. XI., figs. 11 to 13).

Lateral lobe of the head a sharp right angle. Eyes round, centre dark, surrounded by a ring of clear facets.

ANTENNÆ subequal, the upper rather the longer, sparsely hairy; the peduncle of the lower and the flagellum of the upper being the longer. The *upper antennæ* have the second and third joints equal, about five tufts of two hairs on the under side of each. The secondary appendage, which consists of one long and one minute joint terminated by setæ, is rather more than half as long as the first joint of the flagellum. This has five joints, the second and last being the shortest; the last is also much thinner than the penultimate. The *lower antennæ* have the second joint of the peduncle about three-fourths the length of the third; the flagellum is five-jointed, the first joint nearly as long as the second and third together; the fourth joint is terminated by two, and the fifth (which is small) by one curved spine.

FIRST GNATHOPODS: Wrist shorter than the hand, rounded posteriorly. Hand ovate, palm undefined, with many hairs, two strong spines in the middle and one nearer the wrist. Finger long, reaching the lower spine, and serrated on its distal half, but not as far as the point.

SECOND GNATHOPODS: Like the first gnathopods, except that the margin of the palm in the distal half is somewhat sinuate. In the male (?) the hand is about one-third larger than in the first pair; in the female the two limbs differ but little in size.

UROPODS: The three pair extend about equally backwards; in the first the peduncle is slightly longer, in the second shorter, and in the third much longer than the rami. The peduncle of the third has three short spines on its upper margin, and five or six at the distal end. The outer ramus is longer than the inner, straight, smooth and tapering, terminated by a minute nail; the inner is curved, minutely denticulate on the concave side, with a comb-like process of five or six somewhat larger teeth overlapping the nail.

TELSON convex, triangular, with curved sides and rounded apex; a pair of upright spines on each side of a median line, somewhat nearer the apex than the base.

The specific name is derived from ἴσος equal, πούς foot, referring to the equality between the first and second gnathopods, which is unusual in the genus *Podocerus*. The animal is variable in colour and prettily mottled.

I. a., III. It is with great hesitation that I describe as new a small species taken as above. One at least of the specimens was a female, with ova, which agrees with Boeck's description of the female of *P. anguipes*, Kr., except in size—Boeck giving 10 mm. as the length, while this specimen was not more than 3 mm. If I am right in believing some of my specimens to be males, then it is certainly not *P. anguipes*, for the second gnathopod (which is almost the same shape as, and but little larger than the first) in these differs from that in the female only in being slightly larger. It is possible that Boeck has been mistaken in referring the small males he mentions as resembling the females to *P. anguipes*. If this be so, the present species may be considered as new to science, and I propose to name it provisionally *Podocerus isopus*. Mr. Stebbing informs me he has received similar forms from Mr. D. Robertson, taken in the Clyde district, and con-

sidered them to be females of *P. anguipes*, Kr., in spite of their small size. No male of this species, which has a very characteristic second gnathopod, is known to have been taken on the British coasts, which furnishes another reason for believing our species to be distinct.

**Corophium crassicorne*, Bruzelius.

I. d. Two or three specimens of what I take to be the young form of the above. The upper antennæ have three spines on the first joint; the lower have one double spine on the first joint, two double and one single on the second, and one single on the third joint of the peduncle. Hoek,† who describes and figures this form, also considers it probably the young of the above species, though some females had eggs. In other respects my specimens agree closely with Hoek's figures of the adult *C. crassicorne*. Norman has taken this form at Roundstone, in Ireland.

CAPRELLIDÆ.

Proto ventricosa, Müller.

P. pedata, Mont.

P. goodsiri, Bate. (Old male.)

Three or four specimens. *I. d.* Stebbing‡ holds that *P. goodsiri* is merely a form of *P. ventricosa*, in which he has been confirmed by Mayer.§

Ægina phasma, Mont.

Protella phasma, Bate and Westwood.

Several fully developed specimens. *I. d.*

**Caprella acanthifera*, Leach.

Three or four specimens. *I. d.*, IV. None of the specimens had fully developed tubercles or spines, and they

† "Tijdschrift Nederland. Dierkund. Vereen.," Deel. iv., p. 118, pl. viii, figs. 9 and 10.

‡ "Ann. and Mag. Nat. Hist." Series 4, vol. xvii., p. 78.

§ "Fauna, &c. des Golfes v. Neapel.," part vi., 1882. Caprelliden.

were only recognizable by the peculiar skull-shaped head and the sparse hairiness of the lower antennæ. A female, with eggs, from Bull Bay, had a large tubercle on the first segment. Mayer (*l.c.*) shows that perfectly smooth forms are not uncommon, but that it is on this segment that a spine or tubercle is most often developed.

In conclusion, I have to tender my hearty thanks to the Rev. T. R. R. Stebbing and the Rev. Canon Norman, for their kind assistance, and especially to the former, for the gift of his magnificent work on the "Challenger" Amphipoda. The bibliography alone of this work is a perfect monument of patient work, and, consisting as it does of a resumé of all that has been written on the entire subject, accompanied by the author's comments, is a complete library in itself. It is no exaggeration to say that it will be indispensable to every student of the Amphipoda.

DESCRIPTION OF PLATES.

PLATE X.

Figs. 1 to 8, *Lysianax ceratinus*, n. sp.

Fig. 1. Antennæ.

Fig. 2. Mandible and palp.

Fig. 3. Maxillipede.

Fig. 4. First gnathopod.

Fig. 5. Third segment of pleon.

Fig. 6. First and second joints of last peræopod ;
6a, spines on the same.

Fig. 7. Telson.

Fig. 8. Third uropod.

Figs. 9 and 10. *Lysianax (?) audouinianus*, Sp. Bate.

Fig. 9. First gnathopod.

Fig. 10. Second gnathopod.

PLATE XI.

Figs. 11 to 13, *Podocerus isopus*, n. sp.

Fig. 11. Head and antennæ.

Fig. 12. First (a) and second (b) gnathopods of female.

Fig. 13. Third uropod.

Figs. 14 and 15, *Podocerus capillatus*, Rathke.

Fig. 14. Antennæ.

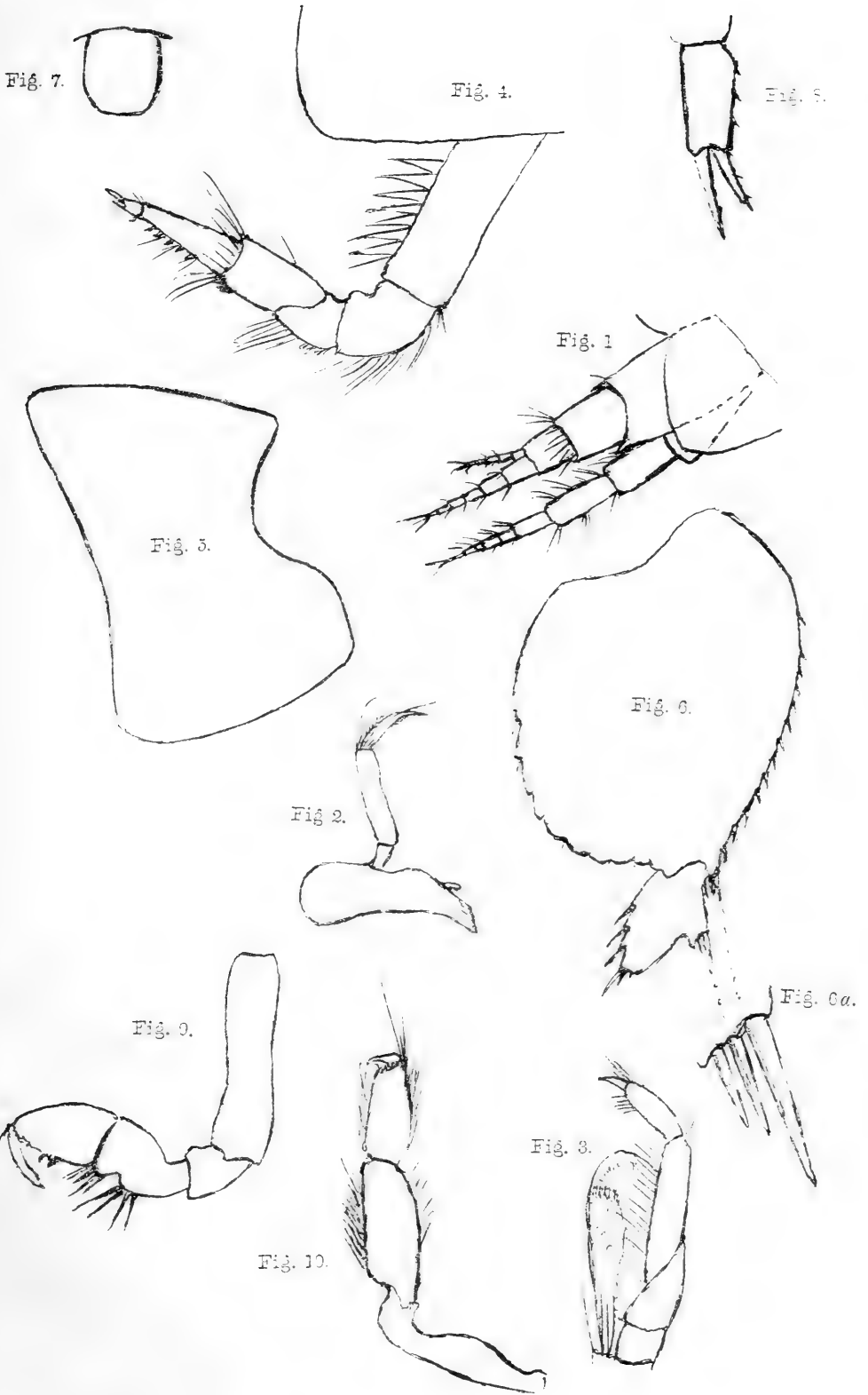
Fig. 15. Second gnathopod.

Figs. 16 to 18, *Munna fabricii*, Kröyer.

Fig. 16. First foot.

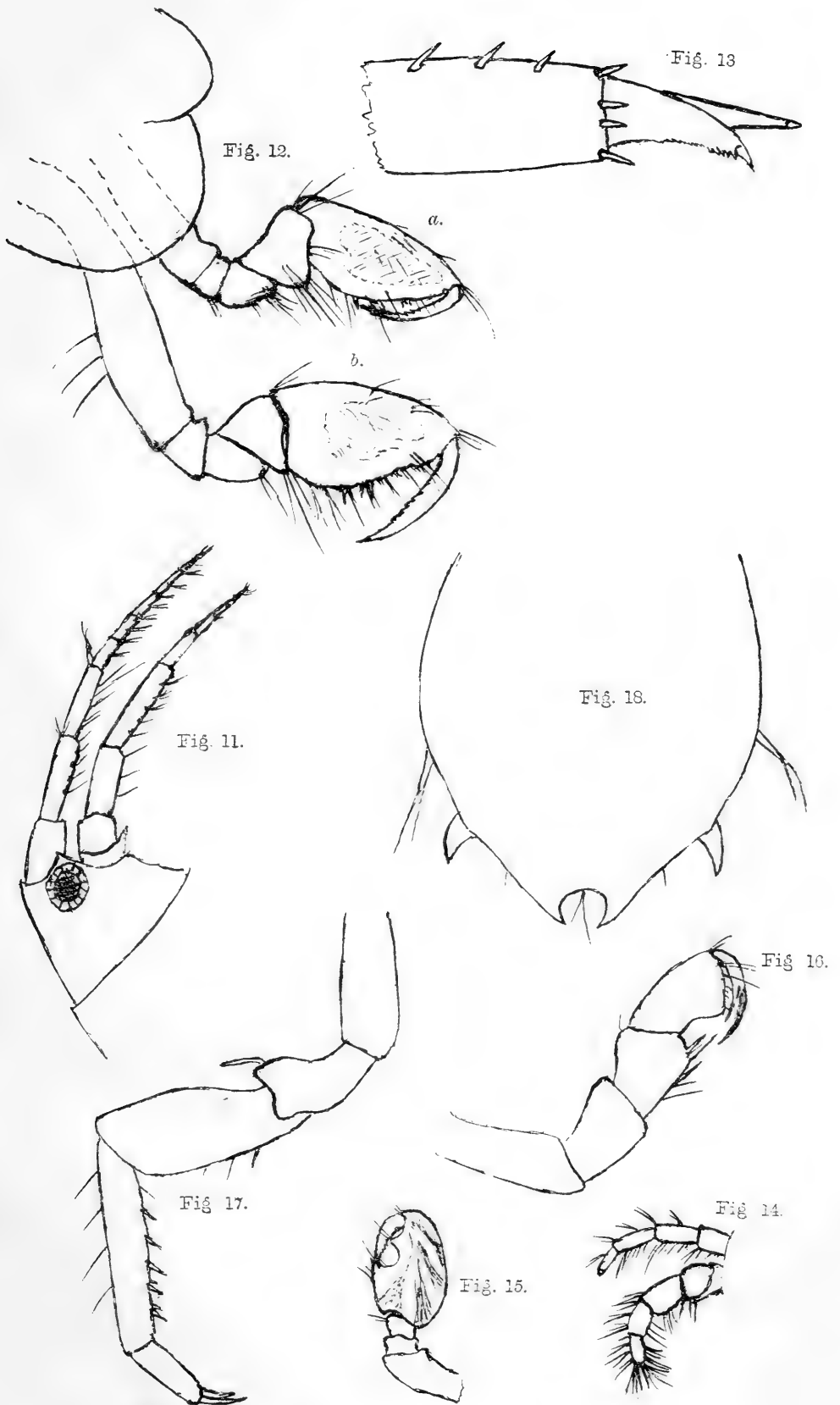
Fig. 17. Second foot.

Fig. 18. Telson.



A. O. Walker, del

LYSIANAX CERATINUS, n. sp. Figs. 1 to 8.
LYSIANAX (?) AUDOUINIANUS (Sp. Bate). Figs. 9 and 10.



A. O. Walker, del

PODOCERUS ISOPUS, n. sp. Figs. 11 to 13

PODOCERUS CAPILLATUS (Rathke) Figs. 14 and 15.

MUNNA FABRICII (Kroger) Figs. 16 to 18.

SECOND REPORT on the POLYZOA of the L.M.B.C. DISTRICT.

BY JOSEPH LOMAS, ASSOC. N.S.S.,
SPECIAL LECTURER ON GEOLOGY IN UNIVERSITY COLLEGE, LIVERPOOL.

[Read 12th April, 1889.]

IN the last report ninety-eight species of Polyzoa were recorded as occurring in the L.M.B.C. district. Since that time numerous dredging and shore expeditions have taken place, resulting in the addition of ten species new to the locality. These, along with a new species, described in the previous report as a new variety of *Pedicellina gracilis*, bring the total number up to 109.

Membranipora flemingii, Busk, mentioned in the first report without any definite localities, has been met with off Anglesey, Calf of Man, &c.

The "Weathercock" expedition of August, 1886, is notable among those held since the former report for the abundance of Celleporas brought up. *Cellepora pumicosa*, *C. costazii*, *C. armata*, *C. avicularia*, and *C. dichotoma* were dredged in a deep hole (thirty-five fathoms), about ten miles from the Isle of Man, the three last being new to the district. *Mucronella peachii*, *Scrupocellaria scruposa*, *Crisia cornuta*, *C. eburnea*, *Cellaria fistulosa*, and *Diastopora patina* also appeared in this prolific region.

The "Hyæna" expeditions of 1886, 1887 and 1888, and Easter, 1889, have also resulted in important additions to our fauna. While dredging near the Calf of Man, in May, 1888, a bank of dead shells, chiefly Pectunculi, was touched. The valves were thickly encrusted with Polyzoa, and twenty-three species were obtained, four of them

being new to the district. On a single Pecten valve thirteen species existed, among them being *Hippothoa distans*, *Stomatopora incrassata*, *Membranipora dumerilii*, *M. craticula*, and *Schizoporella unicornis*. A Buccinum shell also was found encrusted with ten species.

The Biological Station at Puffin Island has afforded a large amount of good material, and the results obtained after examining the same are embodied in a "Report on the Polyzoa of Puffin Island,"* read before the Biological Society in November, 1887. Altogether fifty-one species are recorded from the island, and five species and three varieties are given which have not been found in any other part of the L.M.B.C. district.

In addition to the above localities, shore collecting in all parts has been conducted, but little has resulted from this source. This leads one to the conclusion that future successes are to be looked for when examining the deeper parts of the area during our dredging expeditions.

SPECIES NEW TO THE LOCALITY.

Cellaria sinuosa, Hassall.

Farcimia sinuosa, Hassall.

Salicornaria sinuosa, Johnst., Busk, &c.

Fine specimens were dredged at a depth of twenty-seven fathoms, near Port Erin, in the "Hyæna" expedition of Easter, 1889.

Schizoporella unicornis, Johnston.

Lepralia unicornis, Johnst., Busk, Alder, Hincks.

Lepralia cusata, Johnst., Busk, Hincks, Reuss, &c.

Dredged in the "Hyæna" expedition of 1888, near the Calf of Man, from a depth of twenty fathoms.

* Proc. L'pool Biol. Soc., vol. ii., p. 74.

Mastigophora hyndmanni, Johnston.

Lepralia hyndmanni, Johnst., Busk.

This species is given on the authority of Mr. R. Kirkpatrick, of the British Museum, who found it among specimens collected by Mr. J. Gregory, F.G.S., at Puffin Island, in August, 1887. It has not since been met with.

Mucronella ventricosa, Hassall.

Lepralia ventricosa, Hass., Johnst., Busk, &c.

Puffin Island.

Cellepora armata, Hincks.

This rare species, which has only been found in a few localities, was dredged in the "Weathercock" expedition of 1886, between Liverpool and the Isle of Man, from a depth of twenty-five fathoms.

Cellepora avicularis, Hincks.

"Weathercock" expedition of 1886, from twenty-five fathoms.

Cellepora dichotoma, Hincks.

Cellepora avicularis, Smitt.

"Weathercock" expedition of 1886, from twenty-five fathoms. "Hyæna" expedition (Easter, 1889), south of Port Erin, from twenty-seven fathoms.

Stomatopora incrassata, Smitt.

Alecto retiformis, Hincks.

On Pecten shell, "Hyæna" expedition of 1888, near the Calf of Man, depth twenty fathoms.

Stomatopora granulata, M-Edwards.

Alecto granulata, M-Edwards, Johnst., Busk.

Dredged near Puffin Island.

Stomatopora johnstoni, Heller.

Alecto granulata, Johnst.

Dredged near the Calf of Man, during the "Hyæna" expeditions of 1888 and of Easter, 1889.

Ascopodaria nodosa, Lomas.

Pedicellina gracilis, var. *nodosa*, "Fauna of Liverpool Bay," vol. i.

Ascopodaria nodosa, Lomas, "Proc. L'pool Lit. and Phil. Soc.," 1886,
vol. xli., p. xlvi.

Zoarium consists of a slender chitinous stolon, from which branches, bearing polypides, are given off at intervals.

Peduncle chitinous, hollow, expanding below into a muscular swelling. A second muscular swelling is found in the middle, and a third at the top, just under the head.

This form was described in the "First Report upon the Fauna of Liverpool Bay" (p. 190, pl. iii., fig. 2), under the name of *Pedicellina gracilis*, var. *nodosa*. Further research, however, led me to believe that it should be placed in the new genus lately founded by Busk, *Ascopodaria* ("Challenger" Report, vol. xvii.); so in 1886 I described it as *Ascopodaria nodosa*, in a paper read before the Literary and Philosophical Society of Liverpool.

The characteristic features of the new genus mostly reside in the stem, which is chitinous, tubular, and rigid, and joins the stolon by a broad barrel-shaped dilatation. In *A. nodosa*, the "basal cylinder" is broad below, and tapers suddenly near the top, becoming continuous with the stem. It is not annulated like *A. discreta*.

Separating the basal cylinder from the stem is a septum, which stretches nearly across, leaving a perforation in the middle. The whole swelling is filled with muscular tissue, which is prolonged for a short distance on each side into the stolon; and a septum, similar to the one in the stem, separates the muscular portion from the tubular stolon on each side. The septum may serve to give attachment to the muscles which have to do with the movement of the peduncle.

The most striking feature, however, is the presence of a second swelling in the middle of the stem, muscular in

its nature; and there is a third and smaller one under the head.

The portion between the basal cylinder and the medial swelling is about the same length in all the specimens I have examined, but the part between the medial swelling and the head varies very greatly. In one colony there was, along with the ordinary type, a form without a medial swelling, but the length of the stem was equal to the first joint in the others. This may be an imperfectly developed specimen, and it would seem to indicate that, as the individual grows, the head swelling becomes the medial one by an elongation of the upper joint. The differences in length of the upper joint also favour this view.

The stem may be described as a rigid chitinous tube. Now chitin, being merely a product of the ectodermal cells, cannot be regarded as supplying any living connexion between the different parts of the zoarium. But under a high power a very delicate tissue of elongated nucleated cells is seen, inside the chitinous covering, connecting the different muscular parts in the stem and stolon.*

The specimens were collected by Professor Herdman, off Port Erin, in the summer of 1885, and were adherent to seaweeds (*Ptilota*, &c.). It has not since been observed in the L.M.B.C. district.

Besides the above additions to our fauna, the following observations have been made on species previously recorded.

Alcyonidium gelatinosum, Linn.

Some points in the anatomy† of this species have been worked out; and it has been found to contain certain

* Busk has observed the same "parenchymatous tissue" in other species of *Ascopodaria*.

† Lomas, "Proc. L'pool Biol. Soc.," vol. i., p. 29.

calcareous spicules* in the peripheral parts of the gelatinous ectocyst. Professor Herdman has described † some specimens obtained from the west coast of Scotland, and recently also from Puffin Island, ‡ in which the colony was conspicuously spotted. These white spots were found on sectioning to be very much enlarged "cells," containing polypides, and greatly distended with mature spermatozoa. These colonies were virtually males, as none of the polypides were found to contain mature ova. A spotted colony collected lately at Puffin Island was found, however, to contain large numbers of ripe ova and embryos, but no spermatozoa. Professor Herdman has suggested that this unisexual condition may be the result of proterandry—the male reproductive organs being developed first, and the female later on, but he leaves it an open question whether the individual polypides are proterandrous hermaphrodites, or whether the polypides are unisexual and the proterandry refers only to the colony as a whole.

Cellaria fistulosa, Linn.

Some of the specimens of this species have afforded me material for investigating the mode of branching.§ The stems are dichotomously branched, but in some cases a lateral branch may originate in the middle of an internode (see fig. 1). When the branches are young they are rigidly connected by elongated cells, which have mouth opening and avicularia like those of ordinary cells (see fig. 2). As the branch elongates these cells break and display horny

* Lomas, "Proc. L'pool Geol. Soc.," vol. v., p. 241. Mr. Waters quite independently discovered these spicules, and communicated a paper on the subject to the Manchester Lit. and Phil. Soc.

† See "Nature," for Dec. 29th, 1887, p. 213.

‡ And I have seen at the British Museum a similar specimen, brought by Mr. Ridley from the Isle of Thanet.

§ See Lomas, "Research," for August, 1888, p. 22.

tubes beneath, connecting the cells of the branch with those of the parent stem (see fig. 3).

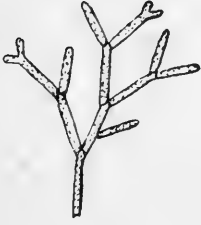


Fig. 1.

Cellaria fistulosa, natural size, showing the mode of branching.

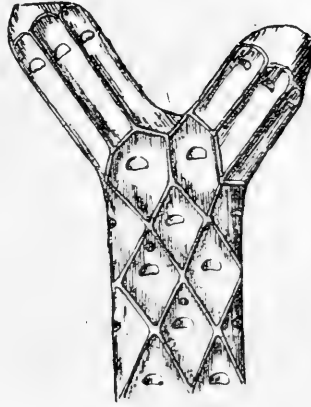


Fig. 2.

Cellaria fistulosa, magnified, showing the arrangement of the cells and the formation of lateral branches.

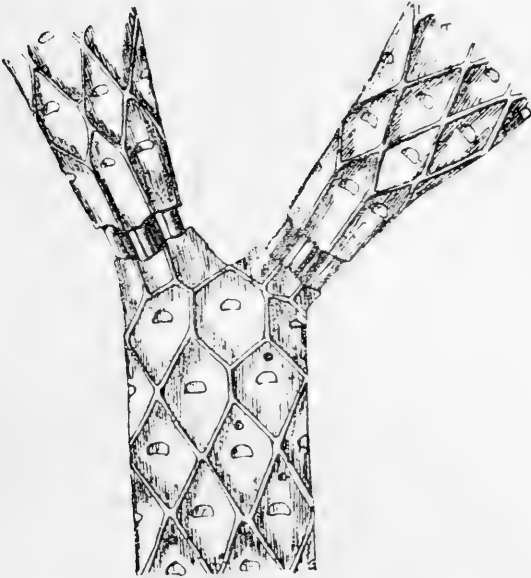


Fig. 3.*

Cellaria fistulosa, magnified, showing lateral branches further developed and separated from the stem by flexible joints.

* I am indebted to Mr. A. N. Tate, F.I.C., &c., editor of "Research," for permission to use these wood-cuts.

TABLE SHOWING DISTRIBUTION OF THE SPECIES
OF POLYZOA IN THE DISTRICT.

SPECIES.	Cheshire Coast and Hilbre Island.	Welsh Coast, Rhyl to Penmachawr.	Menai Straits, Puffin Island and Anglesey.	Lancashire Coast, Liverpool to Fleetwood.	Isle of Man.
Sub-Order I. CHEILOSTOMATA.					
<i>Aetea anguina</i> , Linn.	×	×	×	...	×
<i>A. recta</i> , Hincks	×
<i>A. truncata</i> , Landsb.	×
<i>Eucratea chelata</i> , Linn.	×	×	...	×
α <i>repens</i>	×
β <i>gracilis</i>	×
γ <i>elongata</i>	×
<i>Gemellaria loricata</i> , Linn.	×	×	×	×	...
<i>Cellularia peachii</i> , Busk	×
<i>Scrupocellaria scruposa</i> , Linn.....	×	×	×	×	×
<i>S. scrupea</i> , Busk.....	×	×	×
<i>S. reptans</i> , Linn.....	×	×	×	×	×
<i>Bicellaria ciliata</i> , Linn.....	×	×	×	×	...
<i>Bugula turbinata</i> , Alder	×	×	×	...	×
<i>B. flabellata</i> , J. V. Thomp.	×	×	×	×	×
<i>B. avicularia</i> , Linn.	×	×	×	×
<i>B. plumosa</i> , Pallas	×	×	×	×	×
<i>B. purpuroincta</i> , Norman.....	×
<i>Beania mirabilis</i> , Johnst.....	×
<i>Cellaria fistulosa</i> , Linn.....	...	×	×	...	×
<i>C. sinuosa</i> , Hassall	×
<i>Flustra foliacea</i> , Linn.	×	×	×	×	×
<i>F. carbacea</i> , Ellis and Sol.....	×	...
<i>F. securifrons</i> , Pall.....	...	×
<i>F. papyracea</i> , Ellis and Sol.....	×	...	×
<i>Membranipora lacroixii</i> , Aud.	×	×	×	×	×
<i>M. monostachys</i> , Busk.	×	...	×
<i>M. catenularia</i> , Jameson	×
<i>M. pilosa</i> , Linn.	×	×	×	×	×
<i>M. flemingii</i> , Busk	×	...	×
<i>M. hexagona</i> , Busk.....	×	...	×

SPECIES.	Cheshire Coast and Hilbre Island.	Welsh Coast, Rhyl to Penmaenauv.	Menai Straits, Puffin Island and Anglesey.	Lancashire Coast, Liverpool to Fleetwood.	Isle of Man.
<i>M. lineata</i> , Linn.....	×	...	×
<i>M. craticula</i> , Alder.....	×
<i>M. spinifera</i> , Johnst.....	×
<i>M. dumerilii</i> , Aud.	×
<i>M. rosselii</i> , Aud.	×
<i>M. aurita</i> , Hincks.....	×
<i>M. membranacea</i> , Linn.....	×	×	×	..	×
<i>Micropora coriacea</i> , Esper	×
<i>Cribrilina radiata</i> , Moll.	×
<i>C. punctata</i> , Hass.	×
<i>C. annulata</i> , Fabr.	×
<i>Membraniporella nitida</i> , Johnst....	×
<i>Microporella ciliata</i> , Pallas	×
<i>M. malusii</i> , Aud.....	×
<i>M. impressa</i> , Aud.	×
<i>M. violacea</i> , Johnst.....	×
<i>Chorizopora brongniartii</i> , Aud.....	×
<i>Schizoporella linearis</i> , Hass.....	..	×
<i>S. spinifera</i> , Johnst.	×	×
<i>S. auriculata</i> , Hassall	×	..	×
<i>S. hyalina</i> , Linn.....	×	..	×
<i>S. unicornis</i> , Johnst.	×
<i>Mastigophora hyndmanni</i> , Johnst..	×
<i>Hippothoa distans</i> , McGill	×	..	×
<i>H. divaricata</i> , Lamx.....	×
<i>Lepralia pallasiana</i> , Moll.....	..	×	×
<i>L. foliacea</i> , Ellis and Sol.....	×	..	×
<i>L. pertusa</i> , Esper.	×
<i>Umbonula verrucosa</i> , Esper.....	×
<i>Porella concinna</i> , Busk	×
<i>P. compressa</i> , Sow.....	×
<i>Smittia landsborovii</i> , Johnst.	×	×
<i>S. reticulata</i> , McGill	×
<i>S. trispinosa</i> , Johnst.....	×
<i>Phylactella collaris</i> , Norman	×
<i>Mucronella peachii</i> , Johnst.....	×
<i>M. variolosa</i> , Johnst.....	×	..	×

SPECIES	Cheshire Coast and Hilbre Island.	Welsh Coast, Rhyl to Penmaenmawr.	Menai Straits, Puffin Island and Anglesey.	Lancashire Coast, Liverpool to Fleetwood.	Isle of Man.
<i>M. coccinea</i> , Abild.	×	..	×
<i>M. ventricosa</i> , Hassall	×
<i>Cellepora pumicosa</i> , Linn.....	×	×	×	×	×
<i>C. costazii</i> , Aud.	×	×	×	×
<i>C. armata</i> , Hincks	×
<i>C. avicularis</i> , Hincks	×
<i>C. dichotoma</i> , Hincks	×
Sub-Order II. CYCLOSTOMATA.					
<i>Crisia cornuta</i> , Linn.....	×	×	×	×	×
var. <i>geniculata</i>	×	×
<i>C. eburnea</i> , Linn.	×	×	×	×	×
<i>C. denticulata</i> , Lamk.....	×	..	×	..	×
<i>Stomatopora expansa</i> , Hincks	×
<i>S. major</i> , Johnst.....	×
<i>S. incrassata</i> , Smith	×
<i>S. johnstoni</i> , Heller.....	×
<i>S. granulata</i> , M-Edwards	×
<i>Tubulipora lobulata</i> , Hass.	×
<i>T. flabellaris</i> , Fabr.....	..	×
<i>Idmonea serpens</i> , Linn.	×	×	×	×	×
<i>Diastopora patina</i> , Lamk.....	..	×	×	..	×
<i>D. suborbicularis</i> , Hincks	×
<i>D. obelia</i> , Johnst.	×	×
<i>Lichenopora hispida</i> , Flem.....	×	×
<i>L. verrucaria</i> , Fabr.	×
Sub-Order III. CTENOSTOMATA.					
<i>Alcyonidium gelatinosum</i> , Linn. ...	×	×	×	..	×
<i>A. hirsutum</i> , Flem.....	×	×	×	..	×
<i>A. mytili</i> , Dal.....	..	×	×	..	×
<i>A. parasiticum</i> , Flem.....	×	×	×
<i>Flustrella hispida</i> , Fabr.	×	×	×	..	×
<i>Arachnidium hippothooides</i> , Hincks	×
<i>Vesicularia spinosa</i> , Linn.....	×	×	×	×	×
<i>Amathia lendigera</i> , Linn.....	×	×	×	×	×

SPECIES.	Cheshire Coast and Hilbre Island.	Welsh Coast, Rhyl to Penmaenmawr.	Menai Straits, Puffin Island and Anglesey.	Lancashire Coast Liverpool to Fleetwood.	Isle of Man.
<i>Bowerbankia imbricata</i> , Adams ...	×	×	×	...	×
<i>B. pustulosa</i> , Ellis and Sol.	×	×	...	×
<i>Farella repens</i> , Farre.....
<i>var. elongata</i>	×	...
<i>Buskia nitens</i> , Alder	×
<i>Cylindraceium dilatatum</i> , Hincks...	...	×	×
<i>Anguinella palmata</i> , Van Ben.....	×
<i>Valkeria uva</i> , Linn.
<i>form uva</i>	×
<i>form cuscata</i>	×	×	...	×
<i>V. tremula</i> , Hincks.....	×
<i>Mimosella gracilis</i> , Hincks	×
Sub-Class ENTOPROCTA.					
<i>Pedicellina cernua</i> , Pall.....	×
<i>P. gracilis</i> , Sars.	×	...	×	×
<i>Ascopodaria nodosa</i> , Lomas	×

SECOND REPORT on the NUDIBRANCHIATA of the
L. M. B. C. DISTRICT.

BY W. A. HERDMAN, D.Sc., F.L.S., F.R.S.E.,

PROFESSOR OF NATURAL HISTORY; AND

J. A. CLUBB,

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With Plate XII.

[Read 10th May, 1889.]

IN Professor Herdman's Report upon the Nudibranchiata, in the first volume of the "Fauna," published in 1886, forty-two species were referred to as having been found in this district. We have now, as the result of the last three years' exploration of the neighbourhood, and especially as a consequence of the establishment of the Biological Station on Puffin Island, to place on record some additional localities for many of these species, including some of the rarer ones, some information in regard to their relative abundance and times of spawning, and we have to add to the list *Fiona marina*, a rare species new to the district.

We also include in this report some anatomical and histological observations upon a few of the species of the neighbourhood, especially upon the hepatic cæca of *Dendronotus* and the apertures in the cerata of *Eolis*; and we append a short note upon some British specimens of *Hero formosa*, Lovén, a Scandinavian Nudibranch.

The greater part of the practical work for this report has been carried out by Mr. Clubb, in the zoological laboratory of University College; while Prof. Herdman has suggested the lines of investigation, has examined all the specimens and sections, and has discussed the results.

NUDIBRANCHIATA.

Sub-Order. ACANTHOBRANCHIATA.

Family. DORIDIDÆ.

Archidoris tuberculata, Cuv.

This species is not uncommon on the shore at Puffin Island. It is very variable in the colouring.

Lamellidoris bilamellata, Linn.

In abundance at Hilbre Island on the 2nd March, 1889, when it was spawning; a month later very few specimens were found.

L. proxima, Ald. and Hanc.

Several specimens of this local species were found at Puffin Island in March, 1888, and on 18th February, 1889.

The radula of this species is as described and figured by Alder and Hancock, except that the large lateral spines in our specimens have their points directed forwards and lying parallel to one another, in place of pointing outwards laterally as is shown in Alder and Hancock's figure.* The exact shape of these large spines differs considerably in different parts of the series.

Acanthodoris pilosa, Müller.

Specimens were found on the shore at Puffin Island on 11th June, 1887, in March, 1888, and on 18th February, 1889, and at Hilbre Island on 2nd March, 1889. Among the latter were some dark coloured and speckled specimens approaching the black form previously recorded. Those found at Puffin Island include white, grey and nearly black forms.

* Ray Society, "British Nudibranchiata." Part vii., pl. xlvi., fig. 8.

Family. POLYKERIDÆ.

Goniodoris nodosa, Montagu.

In April, 1888, Dr. Hanitsch collected half-a-dozen specimens on the South Spit, at Puffin Island.

We find that there may be a second smaller denticulated ridge on the large lateral spines of the radula in this species.

Polycera ocellata, Ald. and Hanc.

We have found this species on both the North and South Spits, at Puffin Island, near low water mark, on 11th June, 1887, on 24th March, 1888, and on 25th May, 1889. Some of the specimens closely approach *Polycera lessoni* in their characters.

Ancula cristata, Alder.

A specimen of this species was found at Hilbre Island, on 2nd March, 1889, which was entirely of a hyaline transparent white colour, without any yellow markings on the dorsal papillæ, and with no opaque white pigment on any part of the body. On the 16th May, 1889, this species was very abundant at Hilbre Island, and was spawning. Thirty specimens were collected, and about twenty-five specimens were counted on an area of rock about one foot square.

Sub-Order. POLYBRANCHIATA.

Family. TRITONIIDÆ.

Tritonia plebeia, Johnst.

Two specimens found at Hilbre Island, on 2nd April, 1889, differed considerably in their colouring, the one being yellowish brown, as figured by Alder and Hancock, while the other was marked with blues and greys.

We have found this species on the Beacon rocks, Puffin

Island, on 26th June, 1887, and on both the North and South Spits in May, 1889.

Dendronotus arborescens, Müller.

The variations in the abundance of this species at Hilbre Island were commented upon in the last report. In September, 1888, it was so abundant that forty to fifty specimens were collected in about fifteen minutes, while at the next visit to Hilbre, in the beginning of March, 1889, only a few specimens were seen, and in April none were found.

As Professor Herdman has recorded in the "Second Annual Report upon the Puffin Island Biological Station,"* a number of specimens collected at Hilbre Island were carefully taken to Puffin Island, last September, and placed in suitable spots on the South Spit. They disappeared and have not since been seen, but would hardly be expected to appear again on the shore till later in the summer.

As this species is of large size, and is relatively abundant in this neighbourhood, we have made use of it for anatomical purposes, and shall now place on record some observations we have made as the result of our sections and dissections of a considerable number of specimens.

Alder and Hancock, in their Ray Society Monograph, † gave a general account of the anatomy of *Dendronotus*, illustrated by drawings of dissections of various parts. Recently Dr. Rudolph Bergh, in his Report upon the Nudibranchiata collected during the "Willem Barents" expedition, ‡ gave some further details in regard to the

* Proc. Biol. Soc., L'pool, vol. iii., p. 29.

† *Loc. cit.* Part ii., fam. 3, pl. ii.

‡ "Bijdragen tot de Dierkunde." *Natura artis magistra*, Afl. xiii., viii. p. 25, Amsterdam, 1886.

anatomy of *Dendronotus*, which in some respects supplement and correct the older account.

Both Alder and Hancock and Bergh describe and figure the liver of *Dendronotus* as giving off branched prolongations, which run upwards into the rhinophores (the dorsal tentacles) and other dorsal processes. Alder and Hancock show them as conspicuous prolongations from each side of the liver, while Bergh represents these hepatic cæca as being of large size in the terminal twigs of the cerata or dorsal papillæ, occupying more than half the diameter of the stem and branches. He does not figure their basal parts.

In our specimens from Hilbre Island, however, we do not find, either in dissections or in thin transverse and longitudinal sections, any trace of prolongations from the liver extending actually into the rhinophores and the dorsal papillæ.

Alder and Hancock's description and figures of the anatomy of the liver are not quite correct. They speak of its central trunk lying "above the ovarium, and not below it as in *Eolis*." This is not the case. In *Dendronotus*, just as in some species of *Eolis*, the liver lies *below*, or ventrally to, the ovo-testis, as we show in our transverse section (Pl. XII., fig. 2, *o. t.* and *l.*). Then in their figure 2 (*loc. cit.* fam. 3, pl. 2), they do not represent correctly the three regions since described very fully and accurately by Bergh as the right and left anterior and the posterior lobes.

Bergh, while giving a correct account of the liver itself, has described in addition a system of prolongations into the dorsal papillæ which we are convinced from our sections has no existence. Dissections alone are misleading in this matter, and if the distinguished zoologists whose results we venture to controvert have worked

entirely without the aid of thin serial sections, then it is not surprising that they have been led into error.

Our figure 1 on Plate XII. shows a dissection of *Dendronotus* from the left side, exhibiting distinct prolongations from the liver extending upwards towards the base of the rhinophore and the two succeeding dorsal processes; and as further dissections show distinct cavities branching through these processes, it is not unnatural to suppose that such cavities are the continuations of the hepatic cæca. This, however, is not the case. In our serial sections we can trace the hepatic prolongation towards the rhinophore forwards through sixty-six sections, gradually narrowing until it ends blindly, the last section passing through its anterior wall. At this point it has not nearly reached the base of the rhinophore. Similarly we can trace backwards the next hepatic prolongation in the sections till we reach its blind extremity, which is in the body wall vertically below the first dorsal papilla.

On the right side of the body we can also trace the hepatic cæca going some way towards the rhinophore and the two succeeding cerata, but not entering any of these processes.

In the sections of the cerata themselves we find:—

(1) Large spaces in the mesoderm, containing blood corpuscles (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 cæcum

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 branches of the cerata.

We figure (Pl. XII., fig. 4) a transverse section through one of the cerata of an *Eolis*, with the contained hepatic cæcum, to compare with that of *Dendronotus* (Pl. XII., fig. 3).

At the bases of the dorsal processes in *Dendronotus* the blood spaces, which may be called the ceratal sinuses, communicate with the large anterior and posterior dorso-lateral veins (Pl. XII., fig. 2, *d.l.v.*) which open directly into the auricle. At the point of junction of a ceratal sinus with the dorso-lateral vein, a lateral sinus is found running ventrally through the mesoderm of the body wall, outside the liver. The diagrammatic figure (Pl. XII., fig. 7), constructed from several sections, shows how the hepatic cæcum comes into close proximity with these blood sinuses, and so may have given rise, in dissections, to the appearance of a direct continuity between the liver and the spaces in the dorsal papillæ, a continuity which our sections show does not exist.

Family. MELIBIDÆ.

Doto coronata, Gmelin.

Taken off the north coast of Anglesey, in the "Hyæna" expedition of 1886. This species was present in great numbers on 2nd April and on 16th May, 1889, at Hilbre Island, while none had been seen a month before on the same ground; thirty-four specimens were collected, all from the under surfaces of stones covered with large colonies of the Hydroid *Clava multicornis*.

This species is very variable both in colour and in form in this district. In some of these specimens* the dorsal papillæ have not the usual tuberculated appearance, but are merely irregularly rounded or slightly lobed. One specimen had the third papilla of the left side distinctly bifurcated, the central vessel giving off a branch into each of the forks. In some cases a few of the dorsal papillæ, besides the terminal pair, are of very small size.

A specimen of *Doto coronata*, found on a Compound Ascidian from the shore at Puffin Island, has the tubercles of the dorsal papillæ slender and tipped with black spots so as to approach the character of *Doto pinnatifida*.

Alder and Hancock figure the radula of *Doto fragilis* (pl. xlvi., supplementary) alone, and state that that of *D. coronata* is "like *D. fragilis*, but rather more distinctly denticulated at the sides" (*loc. cit.*). We find, however, in our specimens of *D. coronata* that the plates of the radula are *not* denticulated at the sides.

Doto fragilis, Forbes.

We dredged this species on 24th March, 1888, in the Turbot Hole, off the N.E. end of Puffin Island, and also brought up a specimen on a long line set for fish off the rocks immediately below the Biological Station.

Family. EOLIDIDÆ.

Eolis papillosa, Linn.

This species has been taken in January, March and April, on the South Spit at Puffin Island. We have also found a very light coloured variety in shore pools at Fleshwick Bay, Isle of Man.

* These notes, as to colour and form in the various species, were all made from the living animals.

Facelina coronata, Forbes.

Taken at Puffin Island on the shore in January, March and May, and dredged from the Turbot Hole in March, 1888.

We have found this species at Hilbre Island since the last report on 6th September, 1888, and on 2nd April and 16th May, 1889. Two of the specimens found on the last occasion were of the paler coloured form mentioned by Alder and Hancock.

In his article "Mollusca,"* Professor Ray Lankester states that the supposed communication of the hepatic cæca in the dorsal papillæ, of some of the Ceratonota, with the exterior by means of apertures in the apices of the papillæ requires confirmation. Bergh has recently figured a continuous tubular passage in the case of *Chlamylla borealis* and *Gonieolis typica*, and we now give figures of sections (Pl. XII., figs. 4 to 6) showing the exact manner in which the communication takes place in specimens of *Eolis* from Puffin Island.

The upper end of each dorsal papilla is occupied by a sac containing a large number of cnida or thread cells (Pl. XII., fig. 5, *t.*). This cnidophorous sac is evidently an invagination of the ectoderm, and it communicates with the exterior by a small but perfectly distinct and clearly bounded aperture at its apex, through which the thread cells are sometimes found protruding (see Pl. XII., fig. 5, *ap.*).

The hepatic cæcum (Pl. XII., figs. 4, 5, 6, *h.c.*) occupying the greater part of the dorsal papilla reaches nearly to the lower end of the sac containing the thread cells, and we find in several of our serial sections (Pl. XII., fig. 6, *p.*) a tube with muscular walls leading from the base of the cnidophorous sac, and opening into the apex of the

* "Ency. Brit." 9th edition, vol. xvi., p. 659.

hepatic cæcum by a small terminal aperture, surrounded by a distinct sphincter muscle, so as to allow the lumen of the hepatic cæcum to communicate with the cavity in which the thread cells lie, and therefore with the exterior when the sphincter is relaxed.

Flabellina drummondi, Thomp.

Taken at Hilbre Island on 6th September, 1888, and on 16th May, 1889. In the cerata of this species we find the cnidophorous sac elongated, overlapping the upper end of the hepatic cæcum and joined to it by a long slender recurved tube.

Coryphella rufibranchialis, Johnst.

We have taken this species at Hilbre Island on the 6th September, 1888, and on 2nd March and 16th May, 1889 (large specimens).

Cavolina viridis, Forbes.

We found a specimen of this rare species on the North Spit, Puffin Island, near low water mark, on the 18th February, 1889. It was 7 mm. in length, and had the dorsal process nearest to the middle line in the seventh row on the right side distinctly bifurcated at the tip.

Cuthona nana, Ald. and Hanc.

We have found this species again at Hilbre Island, on 2nd March, on 2nd April, and on 16th May, 1889; and also at Puffin Island in April, 1888.

In this species, as in *Galvina picta*, the auditory sac contains a single large spherical otolith.

The two specimens found at Hilbre in March resemble *Eolis pustulata*, Ald. and Hanc., in one or two points. The one specimen has the rose-red colouring of *C. nana*, but shows the pustulate condition of the white granules characteristic of *E. pustulata*; while the second specimen

presents the more tawny yellow colouring of *E. pustulata*, along with the dark granules found in *C. nana*. Both individuals have the foremost row of dorsal processes in front of the dorsal tentacles, and in both the radula is identical with that of *C. nana*, as figured by Alder and Hancock. These two forms are evidently very closely allied, if indeed they can be considered as distinct species.

Galvina picta, Ald. and Hanc.

We found this species at Hilbre Island, on 2nd March, 1889.

Fiona marina, Forskahl.

Fiona nobilis, Ald. and Hanc.

Three specimens of this species, which is an addition to our fauna, have been found in the district since the last report. Mr. Thompson collected two specimens at Penmaenmawr, in July, 1886; and Mr. Vicars found the third near the end of the Southport pier at low tide in 1887.

We add a table showing the distribution of the species of Nudibranchiata in the four parts of the L. M. B. C. district in which they have been most carefully collected and recorded. The first column includes Hilbre Island, while the third takes in the entrance to the Menai Straits and Bangor: we separate Puffin Island from the preceding region, merely because it may be convenient for those working at the Biological Station to know what species may be found on their shore. Fourteen species have now been found on Puffin Island and the immediate neighbourhood.

NUDIBRANCHIATA.	Estuary of the Mersey.	Isle of Man.	North Wales.	Puffin Island.
<i>Archidoris tuberculata</i>	×	×	×	×
<i>A. johnstoni</i>	×
<i>A. flammea</i>	×
<i>Lamellidoris bilamellata</i>	×
<i>L. depressa</i>	×
<i>L. proxima</i>	×	×
<i>Acanthodoris pilosa</i>	×	×
<i>A. quadrangulata</i>	×
<i>Goniodoris nodosa</i>	×	×	×
<i>G. castanea</i>	×
<i>Triopa claviger</i>	×
<i>Polycera lessoni</i>	×
<i>P. ocellata</i>	×	×
<i>P. quadrilineata</i>	×
<i>Ancula cristata</i>	×
<i>Tritonia hombergi</i>	×	×
<i>T. plebeia</i>	×	×
<i>Dendronotus arborescens</i>	×	×	×	...
<i>Doto coronata</i>	×	×	...	×
<i>D. fragilis</i>	×	...	×
<i>Antiopea cristata</i>	×	...	×	...
<i>A. hyalina</i>	×
<i>Eolis papillosa</i>	×	×	×	×
<i>E. glauca</i>	×	...
<i>Facelina coronata</i>	×	×
<i>Flubellina drummondi</i>	×	...	×	...
<i>Coryphella lineata</i>	×
<i>C. gracilis</i>	×	×
<i>C. landsburgi</i>	×
<i>C. rufibranchialis</i>	×
<i>Cavolina concinna</i>	×
<i>C. olivacea</i>	×
<i>C. amœna</i>	×
<i>C. aurantiaca</i>	×
<i>C. arenicola</i>	×	...
<i>C. viridis</i>	×	...	×
<i>Cuthona nana</i>	×	×
<i>Galvina picta</i>	×	×	×	×
<i>G. tricolor</i>	×	×	...
<i>Tergipes despecta</i>	×	...	×	...
<i>T. exigua</i>	×	...	×	...
<i>Embletonia pallida</i>	×
<i>Fiona marina</i>	×	...	×	...

NOTE ON SOME BRITISH SPECIMENS OF *HERO FORMOSA*,
LOVÉN, BY PROFESSOR W. A. HERDMAN.

Hero is a Scandinavian Nudibranch, which was first made known by Lovén* in 1839, and has been more fully described by G. O. Sars† and by Bergh.‡ At the time of publication of Alder and Hancock's monograph, *Hero formosa* had not been found in British Seas, but Gwyn Jeffreys records§ in 1869, that it had then been dredged off the Northumberland coast by G. S. Brady, in the Clyde district by Robertson, and in the Minch, from a depth of sixty fathoms, by himself.

In 1880, I dredged two specimens of this beautiful animal in Lamlash Bay, Arran, and since then I have dredged a third specimen off Salen in the Sound of Mull from a depth of twenty fathoms. So that altogether I have collected three specimens on the west coast of Scotland. Of these, I have one in the Zoological Museum of University College, Liverpool, the second was given to Dr. A. M. Norman, and the third was sent to Dr. R. Bergh, who has made most excellent use of it in his recently published account¶ of the anatomy of the species.

The remarkable dorsal papillæ of this species have been figured by several of the above mentioned investigators, and their branched condition has been recognised by all. Lately, however, M. A. Vayssière has published a note on

* "Vetensk. Akad. Handl.," 1839, p. 234.

† "Mollusca Regionis Arcticæ Norvegiæ," 1878, p. 316.

‡ "Malacol. Untersuch." Ht. vii., p. 309, 1874.

§ "British Conchology," vol. v.

|| "Additional Notes on the Invertebrate Fauna of Lamlash Bay." Proc. Roy. Phys. Soc., Edin. vol. vi., p. 15, pl. i., figs. 4 to 6, 1881.

¶ Beitr. z. kenntn. d. Æolid., Verh. d. k. k. zool.-bot. Gesellsch. i. Wien, 1888, p. 699.

the systematic position of the genus *Hero*,* in which he states that the dendritic appearance of the dorsal papillæ is due to preservation in alcohol, and that these processes are really fusiform dorsal cirri, like those of *Eolis*, arranged in pedunculated groups.

On reading this paper I re-examined my specimen, which is well preserved, and also my drawings made from the living animal at Lamplash, and I can only say that my published figures (Proc. Roy. Phys. Soc., Edin., vol. vi., pl. i., figs. 4, 5) represent the branched cerata correctly. Possibly M. Vayssière's specimens may belong to another species; if not, I am at a loss to conceive how he can regard the dorsal papillæ as being pedunculated groups of fusiform processes. The branches do *not* all arise together at the top of a peduncle; but the main stem divides, and then the branches sub-divide some three or four or five times in the various papillæ in my specimen,† so that the structure produced is a distinctly dendritic one; and, moreover, this condition is not the effect of contraction, but is as distinct or even more distinct in the living animal than in preserved specimens.

* Comptes rendus, cvii., p. 136, July 9, 1888.

† See also Bergh's figures (*loc. cit.* pl. xix., figs. 9 and 10).

EXPLANATION OF PLATE XII.

<i>a.</i>	Artery.	<i>mes.</i>	Mesodermal tissue.
<i>ap.</i>	Aperture on apex of papilla.	<i>n.</i>	Nerve in cerata.
<i>b.c.</i>	Blood corpuscles.	<i>o.t.</i>	Ovo-testis.
<i>c.s.</i>	Ceratal blood sinus.	<i>p.</i>	Passage from hepatic cæcum to cnidophorous sac.
<i>d.l.v.</i>	Dorso-lateral vein.	<i>r.c.</i>	Renal chamber.
<i>f.</i>	Foot.	<i>rh.</i>	Rhinophore.
<i>f.g.</i>	Foot glands.	<i>s.</i>	Cnidophorous sac.
<i>h.c.</i>	Hepatic cæcum.	<i>t.</i>	Thread cells (cnida).
<i>l.</i>	Liver.	1, 2, 3.	Cerata or dorsal papillæ.
<i>m.</i>	Muscle bands.		

- Fig. 1. Dissection of *Dendronotus arborescens*, from the left side $\times 1\frac{1}{2}$, showing the cæcal processes of the liver running towards the cerata.
- Fig. 2. Transverse section of the body of *Dendronotus* in the region of the second pair of cerata: that on the right side is cut longitudinally. Drawn from Swift's 1 in. obj.
- Fig. 3. Transverse section of one of the third dorsal cerata of *Dendronotus*. Swift, $\frac{1}{4}$ in.
- Fig. 4. Transverse section of one of the dorsal cerata of *Eolis*. Swift, $\frac{1}{4}$ in.
- Fig. 5. Longitudinal section of the extremity of one of the dorsal cerata of *Eolis*, showing the opening of the cnidophorous sac to the exterior. Swift, $\frac{1}{4}$ in.
- Fig. 6. A neighbouring section to the preceding one, showing the communication between the cnidophorous sac and the hepatic cæcum. Swift, $\frac{1}{4}$ in.
- Fig. 7. Diagrammatic transverse section of *Dendronotus*, showing the relations of the short hepatic cæca to the ceratal and lateral blood sinuses.

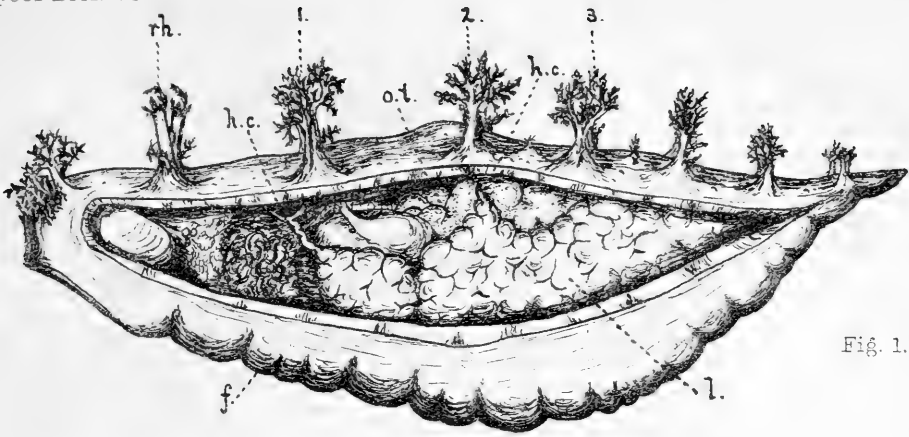


Fig. 1.

Fig. 4.

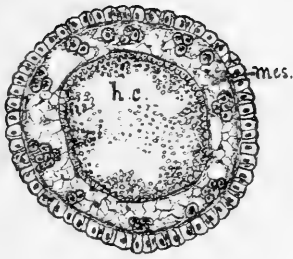


Fig. 3.

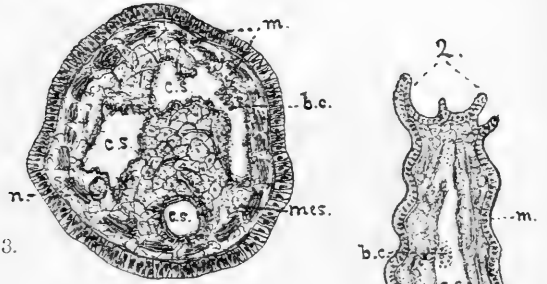


Fig 7

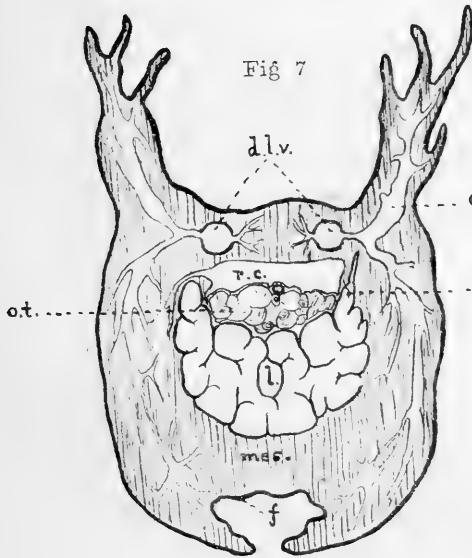


Fig. 2.

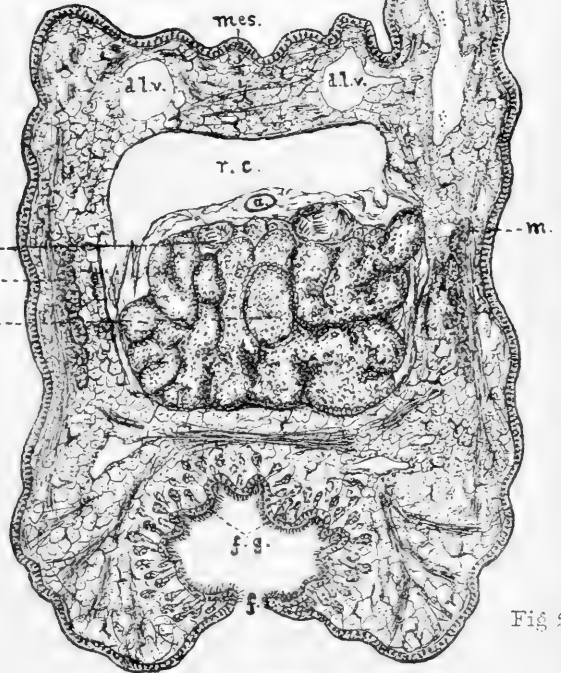


Fig. 5.

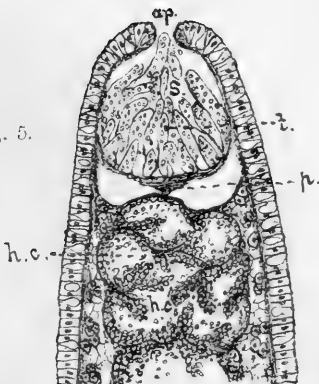
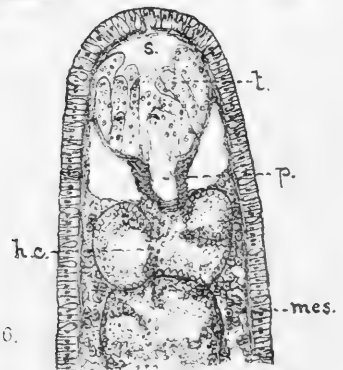


Fig. 6.



1891

SECOND REPORT upon the TUNICATA of the
L. M. B. C. DISTRICT.

BY W. A. HERDMAN, D.Sc., F.L.S., F.R.S.E.,
PROFESSOR OF NATURAL HISTORY IN UNIVERSITY COLLEGE, LIVERPOOL.

With Plate XIII.

[Read 10th May, 1889.]

In the previous report* I recorded forty-seven species, seven of which were new to British seas and two new to science; and this long list appears to have nearly exhausted the Tunicate fauna of the district, since, although a large number of specimens have been collected during the last three years, I am only able now to add four species to the record. Of these, however, two are of great interest:—the one is a *Molgula* new to science, obtained during the “Weathercock” expedition of 1886; while the second, *Molgula citrina*, is a species which was described in 1848 by Alder and Hancock, and has not since been heard of. I have found it on the shore at Puffin Island, and at two or three other localities.

- The successive cruises of the “Hyæna” in Liverpool Bay have yielded a good deal of the material from which the following notes were drawn up, and the shores of Puffin Island have proved to be very rich in Compound Ascidiæ, upon some of which I have commenced investigations which will form the subject matter of a future report.

The following twenty species of Ascidiæ have been

* See “Fauna of Liverpool Bay,” vol. i., 1886, p. 281; and also “Notes on Variation in the Tunicata,” *tom. cit.*, p. 354.

found round the shores of Puffin Island since the opening of the Biological Station in May, 1887 :—

ASCIDIÆ SIMPLICES.

Clavelina lepadiformis.
do., var. *rissoana*.
Ascidiella virginea.
A. scabra.
Styela grossularia.
Polycarpa rustica.
Molgula citrina.

LARVACEA.

Oikopleura flabellum.

ASCIDIÆ COMPOSITÆ.

Polycyclus savignyi.
Botryllus smaragdus.
B. schlosseri.
Botrylloides rubrum.
B. leachii.
B. albicans (?).
Sarcobotrylloides sp. (?).
Distoma rubrum.
Morchellium argus.
Leptoclinum maculosum.
L. durum.
Diplosoma gelatinosum.

I shall adhere to the same classification as that employed in the previous report.

LARVACEA.

Family. APPENDICULARIIDÆ.

Oikopleura flabellum, J. Müll.

This species has now been taken with the tow-net in all parts of our district, but it is the only Appendicularian which has been noticed.

ASCIDIACEA.

ASCIDIÆ COMPOSITÆ.

Family. BOTRYLLIDÆ.

Polycyclus savignyi, Herdman.

Dredged off the north coast of Anglesey, in the "Hyæna" cruise of 1886. A large colony growing over *Hydrallmania* was found on the Beacon Rocks at Puffin Island.

Botryllus schlosseri, Pallas.

On September 8th, 1888, I found on the South Spit at Puffin Island several very large colonies of this species, one measuring 12 cm. by 8 cm., and nearly covered with small colonies of Polyzoa, both encrusting and branched, and of Hydroids, and with many Amphipoda (*Tritata gibbosa*) and Læmodipoda adhering. It has also been found at Puffin Island in February, 1888, and at Black Point, Anglesey, in October, 1887.

There are various specimens of *Botryllus* from:—Douglas Bay, dredged, August, 1886; Puffin Island, shore, June 26th, 1887; and off Port Erin, "Hyæna" expedition, 1888; which were not sufficiently examined when alive, and cannot now be identified with certainty.

Botryllus smaragdus, Milne-Edwards.

Found on the Beacon Rocks, Puffin Island, on June 26th, 1887, and July 24th, 1888. These colonies are very fine, and vary a good deal in their colouring. The pigmented corpuscles in the blood are of various tints of green, blue, yellow, red, and opaque white. The larger lateral tentacles of the ascidiozooids (described and figured in the last report) are occasionally found to be branched at their tips. In several cases I have found an *Acineta* adhering to the tentacles at the base of the branchial siphon; and a small Hydrachnid, coloured dark blue and green like the colony, is found running over the surface.

Botrylloides rubrum, Milne-Edwards.

This species is not uncommon at low tide on the shore at Puffin Island. It is also found, I believe, on the shore at Llandudno. We have brought it up on a long fishing line set off the rocks below the Biological Station.

Botrylloides leachii, Savigny.

A large colony was collected on the South Spit, Puffin

Island, at low tide, on September 8th, 1888. The species was found in October, 1887, at Black Point, Anglesey, opposite Puffin Island; also at Puffin Island in January, 1888, and on February 17th, 1889.

Botrylloides albicans (?), Milne-Edwards.

Some colonies collected on the South Spit, Puffin Island, in January and July, 1888, and on September 8th, 1888, probably belong to this species, but some of them are of a yellower tint than is usual. We find two forms, the one of an amber tint and the other more of a chrome yellow. They may be distinct species, or possibly only local varieties. In the first mentioned the ascidiozooids and the marginal bodies are of an amber colour, the common cloacal apertures are four-lobed and are bordered with lemon yellow, and the ascidiozooids have sixteen tentacles of four sizes.

Sarcobotrylloides sp. (?).

A colony found on the South Spit, Puffin Island, in March, 1888, seems to belong to this genus, separated in 1883 by von Drasche from *Botrylloides*. The specimen was not sufficiently examined when alive to warrant its description here as a new species. Only two species of the genus are at present known, *S. superbum*, von Drasche, from the Adriatic, and *S. wyvillii*, Herdman, from the Færoe Channel.

Family. DISTOMIDÆ.

Distoma rubrum, Savigny.

This beautiful species is common under stones at low water mark and below it on the South Spit, Puffin Island. On September 8th, 1888, I collected colonies up to 5 cm. in diameter containing ova, embryos and large tailed larvæ.

Some of the large colonies are only slightly attached by

the middle of the lower surface, the edges being free all round. The specimens vary considerably in their colour and in the size and arrangement of the ascidiozooids.

This species is also common at the south end of the Isle of Man.

Family. POLYCLINIDÆ.

Morchellium argus, Milne-Edwards.

Not uncommon under stones on the South Spit, Puffin Island, about low water mark. The peduncles of most of the colonies are quite sandy on the surface, and sections show that there are sand grains in the interior also, so that the test is beginning to assume an appearance like that characteristic of the genus *Psammaplidium*.*

This species was also found, in October, 1887, at Black Point, Anglesey, opposite Puffin Island, and was dredged off the Anglesey coast in the "Hyæna" expedition of 1886.

Amaroucium proliferum, Milne-Edwards.

Collected at Douglas in August, 1886. Some specimens were also dredged off the north coast of Anglesey during the "Hyæna" expedition of 1886.

Family. DIDEMNIDÆ.

Leptoclinum candidum (?), Savigny.

Some very fine specimens were dredged from the "Hyæna" on May 20th, 1888, between the Calf of Man and Port Erin from a depth of twenty fathoms. They are attached to a worm tube and to a specimen of *Hyas araneus*.

Leptoclinum maculosum, Milne-Edwards.

A large specimen was obtained on the South Spit, Puffin Island, on September 8th, 1888, at low water mark, and another in July, 1888.

* Zool. Chall. exped., Report upon the Tunicata, part ii. p. 237.

Leptoclinum durum, Milne-Edwards.

A small colony of a pale brown colour, probably belonging to this species, was collected on the shore at Puffin Island, on September 10th, 1888.

Family. DIPLOSOMIDÆ.

Diplosoma gelatinosum, Milne-Edwards.

Some colonies were obtained at Douglas in 1886, and also on the shore at Puffin Island on July 3rd, 1887. They contain stellate calcareous spicules scattered through the test.

ASCIDIÆ SIMPLICES.

Family. CLAVELINIDÆ.

My original contention that this group, the "Social Ascidiæ," ought to be considered as a family of the Simple Ascidiæ, *Clavelina* being united to *Ciona* by such intermediate forms as *Ecteinascidia* and *Rhopalona*, has received powerful support lately from the investigations of Sluiter into the species of *Ecteinascidia*, and of Roule upon *Rhopalona neapolitana*. Roule has discovered that *Rhopalona* is in every respect similar to *Ecteinascidia*, except that it does not produce buds.

Clavelina lepadiformis, O. F. Müller.

This species was formerly recorded from Hilbre Island and the Isle of Man. I can now add the following localities at which it has been taken:—Off Colwyn Bay, on July 9th and September 7th, 1887, dredged by Mr. A. O. Walker, in two fathoms; off Groudle Bay, north of Douglas, Isle of Man, dredged by Mr. J. Clubb in August, 1886; under stones on the South Spit, Puffin Island, collected on July 3rd, 1887, and September 8th and 9th, 1888.

The variety *rissoana* (sometimes considered as a distinct species, *Clavelina rissoana*, M.-Edw.), which differs from the ordinary form in having the pigmented lines on the thorax of a pure white colour in place of being some shade of yellow, was found on the South Spit, Puffin Island, in January, 1888.

Perophora listeri, Wiegmann.

We had previously obtained this species only from the Isle of Man. Shortly after the publication of the First Report, however, we dredged some colonies during the cruise of the "Hyæna," along the north coast of Anglesey (the locality in which it was found by Edward Forbes and McAndrew in 1843), in May, 1886; and we also dredged some fine colonies, attached to *Hydrallmania falcata*, on the "Weathercock" expedition of September, 1886, about twenty miles S.E. of the Isle of Man, from a depth of twenty-five fathoms.

Family. ASCIDIIDÆ.

In 1882, in the "Challenger" Report, I divided this family into three sub-families:—the Hypobythinæ, the Corellinæ and the Ascidinæ. Roule subsequently formed two sections, the Cionæ and the Phallusiæ in the last sub-family. The Cionæ includes the genera *Ciona* and *Rhopalona*, and the Phallusiæ the genera *Ascidella*, *Ascidia* and *Phallusia*.

ASCIDINÆ.

Ciona intestinalis, Linn.

This species was recorded in our former report from Hilbre Island and the Isle of Man. It has since been found as follows:—

During the "Weathercock" expedition of 1886, about a

dozen large specimens were dredged from twenty fathoms, about twenty miles S.E. of the Isle of Man. In January, 1888, a specimen was collected on the shore at Puffin Island. In the dredgings made from the "Hyæna," on May 20th, 1888, between the Calf and Port Erin, several specimens were obtained from a depth of twenty fathoms. Some of these were very transparent.

A number of very large specimens were dredged in November, 1888, from a trawler, at about twenty miles north of Puffin Island, depth twenty fathoms. These last, and also the "Weathercock" specimens obtained from the centre of the Irish Sea, are very fine, some of them extending to 8 cm. in length, and have a very powerful muscular system. The longitudinal muscle bands of the mantle are especially large, and the anterior ends of the specimens are more completely retracted than I have ever seen before, being invaginated to such an extent that a deep pit is formed, at the bottom of which are found two small pits formed by the branchial and atrial siphons having been turned completely outside in (see Pl. XIII., fig. 13).

In some of the specimens the colour of the pigment has not been changed by the alcohol, and the ocelli are still bright red. One has a specimen of *Saxicava rugosa* partly imbedded in the test; the Mollusc usually found in Ascidians is *Modiolaria marmorata*.

Many of these specimens might be referred to Roule's sub-genus *Pleurociona*,* as they lie flat and are attached to large shells or other objects along the greater part of the

* Roule, "Revision des espèces de Phallusiadées des Cotes de Provence," Recueil Zoologique Suisse, t. iii., no. 2, p. 239, 1886. Roule describes a new species, *Pleurociona edwardsi*, which appears to differ little if at all from *Ciona intestinalis*. Besides the condition of attachment of the body, the membrane which separates the viscera from the peribranchial cavity is said in *Pleurociona* to be oblique in place of perpendicular to the longitudinal axis of the body.

left side of the body. In some cases the test is prolonged, especially at the posterior end, to form extensive expansions, and stolon-like processes.

Most of these specimens of *Ciona intestinalis* have their branchial sacs infested with the parasitic Copepoda *Notodelphys allmani* and *Doropygus pulex*.

Mr. Henry Thomas of Llandudno has kindly sent me a number of specimens of this species which he found growing on the sides of the plunge bath in the Llandudno Hydropathic. Some of these specimens were of very large size, one of the largest observed by Mr. Thomas measuring over four inches in length. Specimens of over two inches long have grown on the sides within a month from the emptying and scrubbing of the bath. This gives some idea of the rate of growth of this species.

Ascidia mentula, O. F. Müller.

In the former report this species was only recorded from the Isle of Man on the authority of Forbes. The L.M.B.C. dredged it from a depth of twenty fathoms off Port Erin, on May 20th, 1888, during the cruise of the "Hyæna." The test is irregular in form and encloses several large specimens of *Modiolaria marmorata*. The tentacles are rather abnormal, being very short and stout, but tapering rapidly. A large Amphipod was found in the branchial sac, and a number of specimens of the parasitic Copepod *Botachus cylindratus* were obtained in the peribranchial cavity.

Ascidia plebeia, Alder.

This species had been found by the L.M.B.C. in 1885 off the south end of the Isle of Man, and it has since been dredged again in the same locality, off the Calf, twenty fathoms, during the cruise of the "Hyæna," on May 20th, 1888, and also off the north coast of Anglesey, where

several specimens were obtained during the "Hyæna" expedition of 1886.

One of the specimens dredged off the Calf of Man resembles *Ascidia depressa* in external form, being flattened and elongated and attached by the whole length to a shell. Some of these specimens are of a rich brown colour, not only on the outside, but also in the mantle, branchial sac and viscera.

The nerve ganglion in this species is placed far behind the dorsal tubercle, consequently this species may be referred to the genus *Ascidia* in the limited sense employed by Roule, and which will be referred to below. The tentacles are in nearly all specimens placed distinctly in two rows, the smaller ones being inserted on a line anterior to the rest. There are seventy-two tentacles in all, eighteen large, eighteen medium sized, and thirty-six small.

In one of the specimens from the Isle of Man there is no dorsal tubercle in the large triangular peritubercular area, but there are a number of small rounded secondary apertures of the duct from the subneural gland into the peribranchial cavity.

The specimens from near the Calf of Man contained in their branchial sacs some Copepoda which Mr. Isaac C. Thompson has identified as *Doropygus poricauda*, *D. pulex*, and *Botachus cylindratus*. The latter was present in large numbers both in the branchial sac and in the peribranchial cavity, and adhered firmly to the walls by its hooked appendages.

Ascidiella venosa, O. F. Müller.

This species, the *Ascidia venosa*, or *Phallusia venosa* of most authors, is an addition to our fauna. Two large specimens and a small one were dredged from the "Hyæna"

between Port Erin and the Calf, depth twenty fathoms, on May 20th, 1888. Each specimen had a large Amphipod (*Leucothoe spinicarpa*, Abildg.) in the branchial sac.

Roule* in 1884 proposed that the large and well-known genus *Ascidia* (= *Phallusia*, Savigny) should be broken up into three smaller genera which he named *Ascidiella*, *Ascidia* and *Phallusia*. He took as the type of the last Cuvier's *Ascidia mamillata*, characterized by having the branchial sac reduplicated at its posterior end; while he separated the two former groups by two chief features, viz: (1) the anterior position of the nerve ganglion close to the dorsal tubercle in *Ascidiella*, and (2) the absence of a dorsal lamina posterior to the œsophageal aperture in the same genus.

I believe that these are to a certain extent natural groups, and I have decided to adopt them here; but I must point out that while *Phallusia* is quite distinct, *Ascidia* and *Ascidiella* are not so easily distinguished as Roule supposes, and his definitions will have to be slightly altered if they are to have a more extended application than to the Ascidiæ of the coast of Provence. For example the present species, which I now place as an *Ascidiella*, while it has the ganglion placed close to the dorsal tubercle, possesses at the same time a well developed prolongation of the dorsal lamina behind the œsophageal aperture, and would consequently not find a place in any one of the three genera as defined by Roule.† I propose, then, to modify Roule's generic characters by leaving the condition of the dorsal lamina out of consideration, and to be guided in arranging the species by the position of the nerve ganglion alone.

* "Recherches sur les Ascidiæ simples des cotes de Provence," Ann. du Musée de Marseille, Zoologie, t. ii., mem. i.

† *Loc. cit.*, and Recueil Zoologique Suisse, t. iii., no. 2, p. 214, 1886.

Ascidiella virginea, O. F. Müller.

This is probably the commonest species of Ascidian in this neighbourhood. It has been found since the former report as follows:—

Several specimens adhering to *Hydrallmania falcata* were dredged off the north coast of Anglesey, in the “Hyæna” expedition of 1886. Half-a-dozen were dredged from the centre of the Irish Sea, in the “Weathercock” expedition of 1886. One specimen attached along its left side to Zoophytes was collected, about half-tide, at the N.E. end of Puffin Island, on December 3rd, 1887. Specimens, some of them attached to *Hydrallmania falcata* by a very small area, were dredged off the N.W. side of Puffin Island in February, 1888. It was also found at the N.E. end of Puffin Island, at extreme low water, in February, 1888. It is found under stones on the South Spit, Puffin Island, at spring tides. Several specimens were dredged off Port Erin in the “Hyæna” cruise of May, 1888; and finally one was obtained under a stone at low tide, at Hilbre Island, on March 2nd, 1889.

Many of these specimens, especially those from between tide marks, are flat, and attached by the left side, have the apertures close together, and bear a strong resemblance to *Ascidiella scabra*, a species which I am inclined to regard as the shore variety of *A. virginea*. Roule has pointed out that at Marseilles *A. scabra* is variable, and passes into the varieties of *A. aspersa*. There is no doubt that several of these smaller species of *Ascidiella* are very closely related forms, and are very variable.

Many of the specimens of *A. virginea* collected in this neighbourhood are very much infested with *Modiolaria marmorata*, as many as six large specimens being sometimes found in one test. I find, however, very few parasitic Copepoda in the branchial sac, possibly on account of the

numerous closely-placed tentacles. In *Ciona intestinalis*, the next commonest species, Copepoda are abundant in the branchial sac. There is a great deal of opaque white pigmentation in the mantle and branchial sacs of many of the specimens from round Puffin Island, and most of them have the stomach and intestine distended with fine mud, while the tentacles and vessels of the branchial sac are coated with the same, showing the muddy condition of the water in which the animals live.

The dorsal tubercle is very variable in this species; one specimen from Puffin Island has it of elliptical form, the horns having united anteriorly.

Ascidiella scabra, O. F. Müller.

This is a species which I regard with a certain amount of doubt. Some specimens found on the shore at Puffin Island may either belong here or to the last species.

Two small specimens of *Ascidiella* obtained at Groudle Bay, Isle of Man, by Mr. Clubb, most probably belong here. Their dorsal tubercles are very like those of *Ascidia plebeia*, but there are no papillæ in the branchial sacs, and their nerve ganglions are placed far forward, close to the dorsal tubercle. The branchial sac contained a parasitic Copepod, *Doropygus pulex*.

A specimen found by Mr. Henry Thomas in the plunge bath at Llandudno Hydropathic, along with a number of specimens of *Ciona intestinalis*, appears to be referable to the present species. It is an abnormal specimen, as it has two atrial apertures placed side by side on distinct atrial siphons. They are almost of the same size, and are each six-lobed. This is an interesting case of the persistence of an early post-larval character.

Ascidiella aspersa, O. F. Müller.

A few specimens of this species were dredged off the

south end of the Isle of Man during the "Hyæna" expedition of 1888.

CORELLINÆ.

Corella parallelogramma, O. F. Müller.

A number of specimens of this form, our only representative of the sub-family Corellinæ, were dredged from the "Hyæna" on May 20th, 1888, between the Calf and Port Erin, from a depth of twenty fathoms. Some of them were adhering to the tests of *Ascidiella virginea*.

Family. CYNTHIIDÆ.

In the "Challenger" Report I divided this family into the three sub-families Bolteninæ, Styelinæ and Cynthinæ. We have no British representative of the Bolteninæ.

STYELINÆ.

Styela grossularia, van Beneden.

In the former report this species was recorded from the Menai Straits and the Isle of Man. It has since been found as follows:—In various dredgings along the north coast of Anglesey during the cruise of the "Hyæna" in 1886; in the "Weathercock" expedition, September, 1886 (on *Pecten opercularis*); under stones on the North Spit, Puffin Island, June 11th, 1887, and July 24th, 1888; off the south end of the Isle of Man, between the Calf and Port Erin, in several hauls of the dredge from the "Hyæna," May 20th, 1888, depth twenty fathoms.

These last specimens were of the small, flat, blister-like form, but many of those obtained off Anglesey from the "Hyæna," in 1886, were elongated antero-posteriorly, and were closely crowded together on aggregated masses of sand grains and shell fragments, while others obtained at

the same time, attached to *Mytilus edulis* and *M. modiolus* and to the test of *Polycarpa pomaria*, were of the depressed form.

Polycarpa pomaria, Savigny.

Only a single specimen of this species had been recorded before from the district. It has since been taken on three occasions. One large specimen was dredged off the north coast of Anglesey in the "Hyæna" cruise of 1886: a small specimen was collected at Hilbre Island on June 4th, 1887; and half a dozen large specimens and some small ones were obtained in the dredgings from the "Hyæna" between the Calf and Port Erin in May, 1888, depth twenty fathoms.

These last are very much mis-shapen from containing large specimens of *Modiolaria marmorata*, but had no parasitic Amphipoda or Copepoda in their branchial sacs, with the exception of one specimen of probably a new species of *Doropygus*, a specimen of which was also obtained along with a *Doropygus normani* in the branchial sac of a *Styela rustica* dredged off Skate Island in Loch Fyne.

Polycarpa rustica, Linn.

A specimen of this species was collected at Puffin Island on July 24th, 1888.

CYNTHINÆ.

Cynthia echinata, Linn.

A single small specimen of this beautiful species was dredged from the "Hyæna," on May 20th, 1888, between the Calf and Port Erin, from a depth of twenty fathoms. It is new to the fauna, not having been taken in the L.M.B.C. district before, and it is our only representative of the sub-family Cynthinæ.

Family. MOLGULIDÆ.

Eugyra glutinans, Möller.

Several specimens were dredged in Port Soderick Bay, Isle of Man, by Mr. Clubb, in August, 1886.

A curious abnormality was noticed in the branchial sac of one individual, the spirally coiled stigmata being interrupted down one of the angles in the case of several meshes. One of these is figured on Plate XIII. (fig. 14).

Molgula occulta, Kupffer.

A dozen specimens, large and small, were dredged by Mr. Clubb, in Port Soderick Bay, Isle of Man, in August, 1886.

Molgula citrina, Alder and Hancock (Pl. XIII., figs. 7 to 12).

This species was named and briefly described, as to its external appearance, by Alder,* in 1848. So far as I am aware, it has not been recorded or referred to for over forty years. The mode of attachment by the posterior end and part of the left side, the smooth test free from sand, the prominent apertures, the translucent amber colour, and the orange mark caused by the viscera showing through, are all characteristic features by which the species can be recognised.

Alder and Hancock's specimens were obtained "on the under side of stones between tide-marks, Cullercoats and Whitley, not common." I have found it during the last few years on the Wardie shore, near Granton, Firth of Forth; at Loch Ranza, Arran; on the south-west coast of Bute; and, in the L.M.B.C. district, at Puffin Island, on the Beacon Rocks, on June 26th and July 3rd, 1887, on June 17th and 18th, 1888, and May 26th, 1889;

* Cat. of the Moll. of Northumberland and Durham, Trans. Tyneside Nats. Field Club, vol. i., p. 104.

and on the North Spit, on July 24th, 1888. Alder gives the size as three-eighths of an inch. Most of the specimens at Puffin Island are rather smaller, about quarter of an inch to five-sixteenths in length, but I have one which measures even in the contracted state, fully half an inch (13 mm.) in its dorso-ventral extent.

The obliquity of the plane of attachment (Pl. XIII., fig. 8, *ad.*) is a constant character, the flattened area being not only more on the left side than on the right, but also more dorsally than ventrally so that the branchial aperture projects more freely than the atrial does. This appears to be solely a littoral species, as I have never taken it except between tide marks. It is found generally under large stones close to low water mark. In its external appearance from the absence of any coating of sand or shell fragments it is very unlike a *Molgula*, and has probably been often mistaken for the young of an *Ascidia*, such as *A. scabra*. An examination of the apertures, however, shows at once that it belongs to the family Molgulidæ (Pl. XIII., figs. 7 and 8).

As in the original account of this species only the external appearance is referred to, I shall add here the characters of the internal organs so as to complete the necessary description of the species:—

The *Test* is thin, but cartilaginous like that of an *Ascidia*. It is semi-transparent, and has no encrusting sand.

The *Mantle* is fairly muscular, but has none of the peculiar short fusiform muscle bundles usually found in the Molgulidæ, except to a slight extent at the sides of the endostyle. The branchial and atrial sphincters are very strong.

The *Branchial Sac* has seven folds on each side. These are all much of the same size, and have three to five internal longitudinal bars each (Pl. XIII., fig. 9, *br.f.*). The

vessels are relatively large. The stigmata are few, and are arranged so as to form well developed spirals. There are a large number of very delicate membranous connections between the vessels. Some of these are very wide and break up the stigmata considerably (Pl. XIII., fig 9).

The *Endostyle* is large and conspicuous.

The *Dorsal Lamina* is a narrow plain membrane.

The *Tentacles* are very large. There are about sixteen altogether: they are of two sizes placed larger and smaller alternately. The smaller ones are about one-third of the size of the larger (Pl. XIII., fig. 10). The latter are very much branched, and the numerous minute twigs are all slightly knobbed at their ends.

The *Dorsal Tubercle* has a simple horse-shoe shape with the opening turned to the side. It lies in a deep peritubercular area (Pl. XIII., fig. 11).

The specimens from Puffin Island contain embryos and tailed larvæ in their peribranchial cavities. The larvæ have a well developed tail, and a single pigmented sense-organ (Pl. XIII., fig. 12).

Molgula hancocki, n. sp. (Pl. XIII., figs. 1 to 6).

External Appearance: Shape ovate, elongated antero-posteriorly, scarcely compressed; posterior end tapering into a mass of matted hair-like filaments. Apertures at the anterior end, near one another, slightly prominent. Slightly covered with sand anteriorly, more closely encrusted in its posterior half (Pl. XIII., fig. 1). Colour lightish yellow. Length 1.5 cm. Breadth 1 cm. Thickness 8 mm.

The *Test* is fairly thick in its posterior part, thinner anteriorly; it is smooth and glistening on its inner surface. The prolongations of the test to which sand grains are attached are long and closely placed at the posterior end,

but short, unbranched and scattered over the rest of the surface (Pl. XIII., fig. 4). There are a few small sparingly branched vessels with elongated slightly dilated ends (Pl. XIII., fig. 3, *v.*). The test in thin sections shows a clear slightly fibrillated matrix in which a few test cells are scattered.

The *Mantle* is not adherent to the test except at the apertures. It is moderately thick. The interlacing muscle bands are slender, but numerous. On the left side of the body, over the viscera, they are very delicate. The siphons are rather large and muscular.

The *Branchial Sac* has five folds on each side. They are all of the same size, and bear each three or four internal longitudinal bars on the surface. The stigmata are not very much curved, and in some places are quite straight (Pl. XIII., fig. 5, *sg.*).

The *Dorsal Lamina* is a plain, short, wide membrane with an irregular free edge.

The *Tentacles* are eight large and eight smaller alternating, and a few very small ones placed irregularly.

The *Dorsal Tubercle* has a simple circular or quadrangular opening (Pl. XIII., fig. 6, *d. t.*).

A single specimen of this new species, which I name in honour of Albany Hancock, who was a distinguished investigator of the British Tunicata, was dredged from a depth of twenty fathoms, at about twenty miles S.E. of the Isle of Man, in the "Weathercock" expedition of September, 1886. It may have been attached by the matted fibres at the posterior end of the test. Most of the adhering sand grains are behind the middle of the body. At first sight it seems as if there were no hair-like processes, and that the sand was attached directly to the test, but on scraping away some of the encrusting grains it is seen (see Pl. XIII., fig. 4) that a comparatively small

number of short unbranched filaments are present. The branchial and atrial apertures are slight prominences.

In external appearance (Pl. XIII., fig. 1) this species is not unlike *Polycarpa comata*, with which it has, however, no close relationship. The body when removed from the test is of rounded outline. The left reproductive mass, nearly enclosed in the very long curved intestine, is seen on the left side (Pl. XIII., fig. 2, *g.*); while the other reproductive mass, the renal organ and the heart, lie upon the right side of the body.

In possessing only five folds on each side of the branchial sac, this species differs from most members of the genus *Molgula* and agrees with *Molgula (Pera) chrySTALLINA*,* Möller, from which species, however, it differs totally in external appearance and in the condition of the test.

The dorsal tubercle (Pl. XIII., fig. 6) is in that interesting, simple condition which I first described† in the cases of *Molgula pyriformis* and *Eugyra kerguelenensis*, and which has since been found in the case of several other species.

The alimentary canal is very long, and is closely folded upon itself throughout the whole length (Pl. XIII., fig. 2, *i.*). The stomach is very far forward, and the double intestinal loop is bent ventrally anteriorly and then dorsally.

* For a description of this species see Traustedt, Vid. Medd. Nat. For. Kopenhagen, 1879-80, p. 27; and for a figure see Verrill, Amer. Jour. Sc. and Arts, 1872, pl. viii., fig. 9.

† Zool. Chall. Exped., Report on Tunicata, part i., pp. 79 and 81, pl. vi figs. 3 and 9.

Fig. 1.



Fig. 3.



Fig. 4.



Fig. 2.

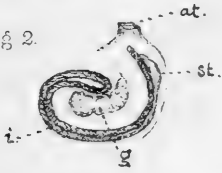


Fig. 5.

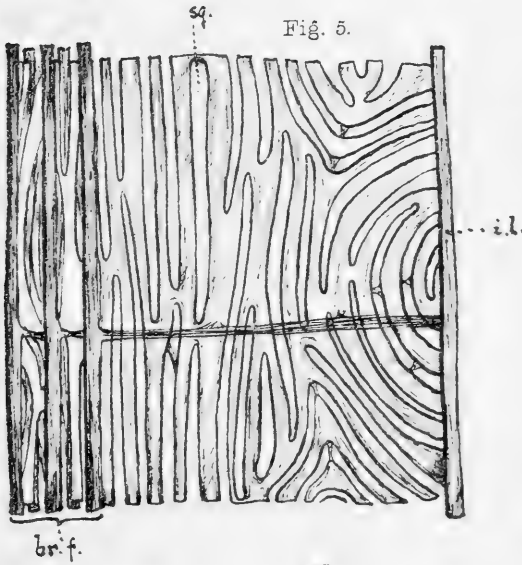


Fig. 6.

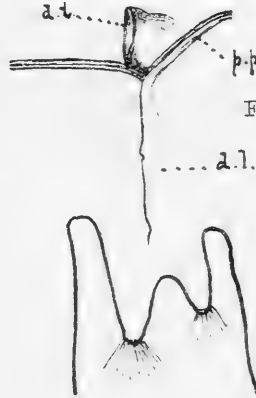


Fig. 13.

Fig. 7.

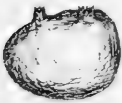


Fig. 8.



Fig. 14.



Fig. 10.



Fig. 11.

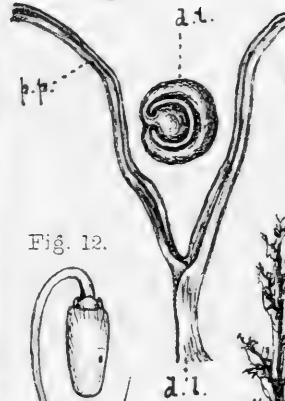


Fig. 9.

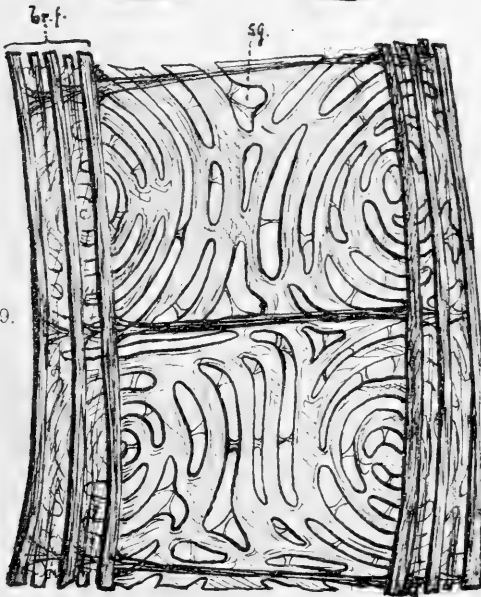


Fig. 12.





EXPLANATION OF PLATE XIII.

Figs. 1 to 6, *Molgula hancocki*, n. sp.

Figs. 7 to 12, *Molgula citrina*, Ald. and Hanc.

Fig. 13, *Ciona intestinalis*, Linn.

Fig. 14, *Eugyra glutinans*, Möller.

<i>ad.</i>	Adhering area.	<i>i.</i>	Intestine.
<i>at.</i>	Atrial aperture.	<i>i.l.</i>	Internallongitudinal bar.
<i>br.f.</i>	Fold of branchial sac.	<i>p.p.</i>	Peripharyngeal band.
<i>d.l.</i>	Dorsal lamina.	<i>sg.</i>	Stigmata.
<i>d.t.</i>	Dorsal tubercle.	<i>st.</i>	Stomach.
<i>g.</i>	Reproductive gland.	<i>v.</i>	Vessel of test.

- Fig. 1. *Molgula hancocki*, n. sp., natural size, from the right side.
- Fig. 2. Part of left side of same, with test removed to show the viscera, slightly enlarged.
- Fig. 3. Section of test of same, highly magnified, S. $\frac{1}{4}$ in.
- Fig. 4. Part of outside of test, showing the short processes and sand grains, magnified, S. 1 in.
- Fig. 5. Part of branchial sac from the inside, magnified, Swift's 1 inch objective.
- Fig. 6. Dorsal tubercle and neighbouring parts, magnified, S. 1 in.
- Fig. 7. *Molgula citrina*, Alder and Hancock, natural size, from the right side.
- Fig. 8. The same from the anterior end, showing the area of attachment (*ad.*).
- Fig. 9. Part of the branchial sac from the inside, magnified, S. 1 in.
- Fig. 10. A large and a small tentacle, magnified, S. 1 in.
- Fig. 11. The dorsal tubercle and neighbouring parts, magnified, S. 1 in.
- Fig. 12. The tailed larva of *Molgula citrina*, magnified, S. 1.
- Fig. 13. Diagram showing the inversion of the anterior end of *Ciona*, natural size.
- Fig. 14. Part of an abnormal mesh of the branchial sac of *Eugyra glutinans*.

REPORT on the SEALS and WHALES (PINNIPEDIA
and CETACEA) of the L.M.B.C. DISTRICT.

BY THOMAS J. MOORE, Corr. Memb. Zool. Soc. Lond.,
CURATOR OF THE FREE PUBLIC MUSEUM, LIVERPOOL.

[Read 10th May, 1889.]

PART I. SEALS :—

In the second edition of Bell's "British Quadrupeds" (Van Voorst, 1874), six species of Seals, including the Walrus, are enumerated as having occurred on the coasts of Great Britain and Ireland. Two of these, the Hooded Seal and the Grey Seal, have occurred in the Mersey, are preserved in the Liverpool Museum, and came under my own personal observation as recorded below. Other notices of Seals in our district are few, vague and unsatisfactory. Byerley, in his "Fauna of Liverpool," 1854, p. 7, mentions only one, *Phoca vitulina*, the Common Seal or Sea-Calf, as having occurred occasionally in the Dee and Mersey, and neighbouring parts of the coast. Dr. Cuthbert Collingwood, in his carefully compiled paper on "The Historical Fauna of Lancashire and Cheshire," says:* "Seals have occasionally come up our rivers. Dr. Leigh mentions a Sea-Calf Seal as taken in the Ribble; and Pennant (Zool., vol. i., p. 177) describes a Pied Seal (*Phoca bicolor*), of which he says, 'this I saw at Chester; it was taken near that city in May, 1766.'" To this Collingwood adds, "This appears to have been an individual of the species *Monachus albiventer* (Gray, Mus. Catal.), a rare Mediterranean species, of which this is the only specimen recorded as captured upon British

* Proc. Lit. and Phil. Soc. L'pool, 1864.

coasts." Much stress, however, must not be laid on these conclusions.

For the correct determination of Seals, examination and comparison of their skulls are absolutely necessary. The colour of the fur varies much in individuals, and in the Harp Seal more than in any others. In this species the adult male has a black face and a black harp-like figure on its back, whence its name. In the female this is with the face brown and less well defined; immature specimens are mottled with greyish black spots, and the young cubs are creamy white. These differences are well displayed in the Museum series of specimens from Newfoundland, presented by Messrs. Bowring, and arranged in a characteristic group. An examination of the skulls from these individuals at once shows their identity. This difficulty in determination applies with much force to attempts to make out the species described or even figured by the older authors, and was much felt by the late Dr. J. E. Gray, in cataloguing the rich collections of the British Museum under his care. He set to work with characteristic energy to work out both the skins and skulls, giving a great impetus both to collectors and describers, and inaugurating a new era. Previously confusion was inevitable, for those whose knowledge was based on personal observation of the creatures in life, however wide and accurate, being cut off from access to the observations recorded in books were at great disadvantage in making their observations accurately known, while those with the fullest command of book knowledge had but scant opportunities of studying from living creatures in their natural state. These remarks apply with even greater force to the study of the Cetacea with respect to which Dr. Gray also applied himself with similar zeal, though not always with equal success.

To return to the Seals: in the absence of published

notes on their occurrence, I applied to Mr. Alfred O. Walker, late of Chester, who has long taken a keen interest in the marine zoology of the district, and he writes me, May 7th, 1889, "I have occasionally heard of Seals being taken in the Dee and Mersey, but have never seen them, and can give you no information as to species." I cannot find a record of the Common Seal, *Phoca vitulina*, even as a visitor, though many particulars are noted of it visiting the Scotch and Irish coasts. Its extreme shyness, and the vast increase in shipping are, doubtless, the causes of its absence here.

PINNIPEDIA.

Family. PHOCIDÆ.

Phoca grænlandica, Fabr.

A specimen identified as the Harp Seal by Sir William Turner and Mr. T. Gough, was captured on the coast of Lancashire, in 1874.*

Halichærus grypus, Fabr.

In 1861 I noted and exhibited a fine recently stuffed specimen of a Seal, caught in the Canada Dock, and presented to the Museum by Mr. George Hulse, turtle merchant, of Liverpool. Owing to the difficulties of determination, alluded to above, I then supposed this to be the Common Seal (*Phoca vitulina*), and it was not till I was able to compare in the British Museum the skull from the stuffed specimen that I found it to be an example of the Grey Seal† (*Halichærus grypus*).

* Journ. Anat. and Physiol., vol. ix., p. 163.

† Bell's "British Quadrupeds," ed. 2, p. 262; Gray's "Museum Catalogue," ed. 2, p. 34.

Cystophora cristata, Erxleben.

On February 24th, 1873, I announced* the capture of a Seal, which was found alive on the Mersey shore at Frodsham Marsh, on the 3rd of February, and was exhibited at Widnes, near Warrington, where I saw it alive and made sketches from it. It was large and powerful, being about six feet in length and in very fine condition, though it had taken very little food. The face, breast and fore flippers were of a blackish colour, the body paler, with a few dark blotches; but the colours were not very noticeable while the creature was wet. From the dilatation of the nostrils, shown under the slightest provocation, I was inclined to consider it to be a Hooded Seal,[†] but considering the extremely rare occurrence of that species on the British coast, I refrained from speaking positively, and waited in hopes of securing the specimen after death for the museum, in which I ultimately succeeded, and a comparison of the skull at the British Museum confirmed my original supposition. The second edition of Bell's "British Quadrupeds" was then in the press, and I wrote to Mr. Edward R. Alston, who was engaged thereon, informing him of the above occurrence, but the notice was too late for reference therein. Two other specimens of the Hooded Seal are certainly known to have been killed in Britain:—one in the Orwell in 1847,[‡] and the other at St. Andrews in 1872.§

The following notes on the Hooded Seal were taken at Widnes, soon after the death of the creature:—General colour brownish; front streak from eyes, front of fore and hind legs, black; belly and throat whitish. Tail and hind

* Proc. Lit. Phil. Soc. Liverpool, vol. xxvii., p. lxxiii.

† Bell's "Brit. Quad.," ed. 2, p. 257; Gray's "Mus. Catal.," ed. 2, p. 41.

‡ "Brit. Quad.," ed. 2, p. 258.

§ "Scottish Naturalist," vol. ii., p. 1.

flippers worn on the upper surface and wherever the surface could rub. Webs of hind feet extended twelve inches when fully stretched, of fore feet seven inches, brownish and hairy beneath. The hair of arm pits and underside of fore flipper longer and thicker than elsewhere. A bare space indicating the navel measured three inches wide and two-and-a-half long. Two inches behind this a pair of orifices, admitting pencil points, indicated nipples. The sexual orifice hidden with long hair. The outer and lower rows of bristles in the moustache longest, increasing in length gradually to the outermost; the extreme one of the lowest row but one being the longest, and measuring five and three-quarters inches. A solitary hair on each cheek between nostril and eye; and four or five slender hairs grouped an inch behind each eye. The hairs, on skinning the creature, were found to have long roots projecting beyond the inner surface of the skin, and were deeply imbedded in the muscle. The moustaches consisted of six rows of bristles, consisting of five hairs in the lowest, seven in the next, eight, seven, six and three in the others. The cheeks and chin, shoulders and loins were white, slightly mottled. The shoulders, paws and belly whitish, the rest of the creature being bare and everywhere black or darkly coloured. Scarcely any indication of the cavity of the hood was noticeable on skinning the head. The total length was five feet three inches.

PART II. WHALES:—

CETACEA.

Sub-Order I. MYSTACOCETI.

Family 1. BALÆNIDÆ.

Megaptera longimana, Rudolphi.

On July 17th, 1863, a large specimen of a whale was observed by some fishermen stranded on a sand-bank at Speke. Its struggles were so evident that no boatmen durst venture near it: all they could do for a length of time was to keep an eye on it. When dead it was secured with ropes and towed to the shore. I visited it on the 22nd, made an external examination, and took correct measurements, as under. It was lying on its back, a position very favorable for examination of the under surface, but hiding all view of the blowers. I believed it to be a specimen of "Johnston's Hump-backed Whale, *Megaptera longimana*," of Dr. Gray's "Catalogue," 1850, p. 26, and it would appear to have been up to that date only once before observed on the British coast, namely, at Newcastle, by Dr. Johnston, and it is remarkable that both specimens were females.

The dimensions are:—	Ft.	In.
Total length in a straight line, from snout to cleft of tail	31	4
Length of gape, about.....	8	0
From snout to the eye	8	0
Length of the eye..	0	3
From snout to commencement of pec- toral fin	11	0
Length of pectoral fin.....	10	0
Extreme width of tail at the tip	11	0

From snout to commencement of dorsal fin, or rather hump	18	0
Length of hump	3	3
From snout to cloaca	21	0

I had no opportunity of examining the viscera, but learned from the butchers that a quantity of shrimps were found in the stomach.

The genus *Megaptera* is distinguished from the genus *Balæna*, or whalebone whales, by the presence of a dorsal fin or hump; by the belly being plaited or deeply grooved, and the plates of baleen being broad and short: which characters agree with this specimen. The longest plate of baleen measures about two feet long by five and a half inches at base, and the plates were so close together that I counted thirty-eight in the length of a foot. The creature was quite black, except the belly, which was mottled and streaked with white, and the pectoral fins were milk-white except a black blotch here and there.

The carcass was purchased by Mr. Brock, of Clement Street, Vauxhall Road, who most liberally presented the skeleton to the Museum, where it was carefully mounted by Mr. Henry Reynolds, the Museum Taxidermist.

Sub-Order II. ODONTOCETI.

Family 2. ZIPHIIDÆ.

Hyperoodon rostratus, Chemn.

Gray (Cat. 1874, p. 331) says, "This is one of the most generally caught whales on our coast." Byerley notes four examples of the common Beaked or Bottle-nosed Whale* which have occurred in our district, to which I have to add a fifth. Byerley's notes are as follows:—

* Bell's "Brit. Quad." ed. 2, p. 421; Gray's "Catal." p. 330; Flower's "List of Cetacea." 1885, p. 9.

“One stranded upon East Hoyle Bank, 1858, and exhibited at Tranmere Slip, after which it was cut up at Hoylake, and 140 gallons of oil obtained from its blubber. The stomach contained great numbers of the horny beaks of some species of cuttle. Although these have been found frequently in the stomachs of whales, in this instance the mode of their arrangement was remarkable, as the beaks were inserted one within another, so as to ride, regularly imbricated, in rows of ten, fifteen, or twenty together. I have pulled as many as seven asunder, and the person who took them from the stomach informed me that they formed rows, in some instances, of an inch and a half. Many were so firmly impacted that they required strong traction to separate them, and sometimes they would break rather than come asunder. This curious arrangement must have been brought about by the peristaltic movements of the stomach. Another specimen was captured at the Little Meols two years ago.”

“August 25th, 1853, a male of this species was stranded upon the East Hoyle Bank; its length was twenty-one feet; from the angle of the mouth to the tip of the snout, twenty inches; from tip of snout to eye, three feet six inches; eye to spiracle, two feet three inches. The pectoral fins were one foot nine inches long and nine inches broad; tail fin or propeller, five feet six inches broad and two feet long; the dorsal fin about ten or eleven feet from the tail; from the vent to the tail, seven feet six inches; orifice of urethra to anal opening, one foot ten inches; the length of the snout was one foot three inches. I had an opportunity of seeing the stomach opened, and observed great numbers, certainly many hundreds, of the cuttle beaks; many were unattached, but others were placed one within another, as in the foregoing instance. Another of the same species, probably his female mate, was seen swimming about the

same locality for three weeks after his capture, and was driven by three fishing boats upon the same bank, which, however, was covered with sufficient water to enable him to flounder off."

On the first of September, 1881, two fishermen named William Dunbobin and Adam Ireland, while fishing in the Lancashire side of the Mersey, near Speke, observed something unusual lying on the beach. On getting to the place they found that a whale had been left by the receding tide. They at once set about capturing the beast, which they succeeded in doing after a smart struggle. I visited it as soon as possible afterwards and found it to be a fine specimen of the Beaked Whale, *Hyperoodon rostratus*, measuring twenty-three feet in length and twelve feet in greatest girth. The skeleton was obtained for the Museum, but owing to unavoidable difficulties was not successfully macerated.

It is somewhat singular that this specimen was captured near the spot where the Whale, said to have been twenty-four feet long, was caught (in October, 1856), whose skeleton was mounted for the Museum of the Liverpool Royal Institution. That skeleton was sold with the rest of the Mammalia collection, and other objects, to the authorities of the Nottingham Museum, to which they were removed a few years since. Fortunately before the removal I was favoured by the Committee of the Institution with the loan of the skull, from which a large series of well executed pencil drawings was made by Mr. John Chard, Museum Draughtsman, under my personal supervision.

Family 3. DELPHINIDÆ.

Phocæna communis, F. Cuvier.

The Common Porpoise is frequent in shoals during stormy and changeable weather. A very young Porpoise,

eighteen inches in length, was brought to me at the Museum, on the 22nd March, 1888. It was the usual black colour on the tail, fins and upper parts, but a rosy pink on the sides and lower parts, especially on the abdomen. It was brought up in a shrimp-net after being down two hours, but lived only about ten minutes after. The same shrimper, John Hanmer, reported to me on the 20th of May, 1889, that when at the North-west Lightship, about an hour after daylight, he observed within ten yards of his boat a shoal of porpoises which he estimated to extend fully three miles.

Dr. Gray pointed out in 1865 (P. Z. S.) a series of short spiny processes on the front edge of the dorsal fin, and named a specimen living in the Zoological Society's Garden, and after death removed to the British Museum, *Phocæna tuberculifera*. It was subsequently found that this peculiarity was known to the ancients and also to Camper. Examples would appear to be not uncommon, for two at least have come under my observation in our own district, namely, one speared a quarter of a mile off the Rock Lighthouse, February 7th, 1867, measuring four feet eight and three-quarter inches in length; and another, four feet four inches in length, taken near the Herculaneum Dock, October 12th, 1881.

Orca gladiator, Lacépède.

At the end of March, 1876, a Cetacean, reported to have been twenty-five feet in length, was captured near West Kirby, at the mouth of the Dee, by a couple of Parkgate fishermen who were out in a small boat. It had evidently come in too far in pursuit of food, and the receding tide effectually prevented its return into deep water. The fishermen secured it by a hook and line, and were soon surrounded by a number of people, the place where it lay

being about half a mile from the village. Though out of water, it still retained some strength, lashing its tail in an alarming manner, and with sufficient violence to break in pieces the iron anchor belonging to the boat. This was, however, of short duration, for a gash in its side with a knife put an end to its struggles. It was soon after cut up and carted away by a person in the neighbourhood, who had bought it for boiling and extracting the oil. This process was so far advanced when I was able to visit the place that I was only able to procure a flipper for the Museum, and to recognise this as belonging to an *Orca** (the Killer or Grampus). Unfortunately the bones of this member were lost in the long process of maceration.

Lagenorhynchus albirostris, Gray.

On the 29th December, 1862, at daybreak, a fresh wind blowing from W.S.W., and the tide being about quarter-ebb, a Cetacean was discovered stranded at Little Hilbre, one of two closely contiguous islands at the mouth of the Dee. It was observed by Mr. Barnett, Inspector of Buoys, who resided on the larger island, and who had noticed others off the shore a few days previously. I had urged Mr. Barnett, on the occurrence of such creatures, to endeavour to secure examples for the Liverpool Museum; and he was, in consequence, kind enough immediately to proceed to the mainland for a suitable conveyance, into which it was carefully removed and brought to Birkenhead Ferry, and thence across the Mersey to the Museum.

The creature was still living, spasmodically breathing at irregular intervals; the body was warm to the hand, and tear-like moisture oozed from its eyes as it lay quiescent in the cart. I was desirous of giving it a fresh chance of

* Bell's "Brit. Quad." ed. 2, p. 445; Gray's Catal., p. 279; Flower's "List of Cetacea," p. 18.

life, and my first anxiety was to obtain a vessel large enough to form a bath for it. This I succeeded, after some delay, in securing in a turtle tank belonging to Mr. Hulse, at the back of the present Sessions' House; but, to my great mortification, the creature gave up the ghost (with considerable violence, too) at the very moment when we were prepared to remove him into the tank. It was then getting dark, and the poor animal had thus lived about eight hours out of water. It was a male; and upon endeavouring to make out the species, I was agreeably surprised to find it approximate most nearly to the description of the White-beaked Bottle-nose (*Lagenorhynchus albirostris*),* as given in Dr. Gray's "Catalogue of Cetacea in the British Museum," p. 99, and in the "Zoology of the Voyage of the *Erebus* and *Terror*," p. 35, the skull agreeing well with the figures in the latter work, pl. 11. I subsequently sent the skull to Dr. Gray for comparison; and he confirmed my supposition of its being an individual of the species above named, namely, *L. albirostris*, which was founded upon a specimen taken at Great Yarmouth in October, 1845, and recorded by Mr. Brightwell in the "Annals for 1846" (vol. xvii., p. 21, pl. 2) under the name of *Delphinus tursio*. This addition to our local fauna was a matter of considerable interest, as its place of capture comes within the range taken by Byerley in his "Fauna of Liverpool," 1854, and in which only two Cetaceans are recorded, namely, *Phocæna communis* and *Hyperoodon rostratus*.

The general colour was a rich black. A long and narrow greyish streak extended on either side diagonally across the ribs; and a similar greyish hue occurred on each side of the dorsal ridge, extending nearly from the fluke to the tail. The beak white, irregularly blotched with blackish,

* *Delphinus albirostris*, Gray, Bell's "Brit. Quad.," ed. 2, p. 472; *L. albirostris*, Gray's "Catal.," p. 272; Flower's "List of Cetacea," p. 22.

the white extending slightly above the constriction of the beak. The under jaw and throat milk-white, which colour extended along the belly, but became less clear as it approached the vent. Its dimensions were as follows:—

	Feet.	Inches.
Total length from snout to cleft of tail...	9	0
Length of gape	0	10½
Length of beak.....	0	2¼
Length of under jaw beyond the upper..	0	0½
Length from snout to eye	1	1½
Length from snout to blow-hole	1	3
To commencement of dorsal fluke	3	11
To end of dorsal fluke.....	5	6
To pectoral fin	1	9
Breadth of tail.....	2	5
Deflection of cleft of tail from a line drawn between its tips	0	6½
Girth in front of pectoral fin.....	3	11
Girth in front of dorsal fluke.....	5	0
Girth behind dorsal fluke	4	3

The body became much attenuated towards the tail. Immediately in front of the dorsal fluke, the vertical and transverse diameters were nearly the same, the former being thirty-one and a half inches, and the latter thirty and a half inches. Half way between the end of the fluke and the commencement of the tail the vertical diameter is thirteen inches, and the transverse six and three-quarters; and immediately before the commencement of it, the vertical diameter was four and a half inches, and the transverse two and a quarter, or exactly one half. The dorsal fluke measured twenty-four inches along its convexity, and was eleven inches high. The pectoral fin at its junction with the trunk was seven inches across, and its greatest length (diagonal) nineteen inches; measured

round the curve it was twenty-one inches. The eye was seven-eighths of an inch long by half an inch. The orifice of the ear was two and a half inches behind the eye in a slightly diagonal direction, and was less in diameter than a puncture by an ordinary pin. The transverse diameter of the blow-hole was one and three-quarters inches, and the longitudinal one inch, the points being directed *forwards*.

The skin was stuffed, though with much difficulty, owing to its want of tenacity; and the contrast of colour became almost imperceptible. The skeleton was mounted in due course, and continues to be exhibited alongside the stuffed skin, a combination rarely possible, but repeated in the case of a Pilot Whale, *Globicephalus svineval*, from the Humber, June 9th, 1862, the skin and skeleton of which are also exhibited close by.

The dimensions of the skull are as follows:—

	Inches.
Total length	19½
Length of nose	9
Width at orbit	10
Width at notches	5¾
Width middle of nose	4½
Length of lower jaw	15½
Width of condyles	9

Teeth $\frac{25}{23}$, $\frac{24}{23}$, curved, and acute where not slightly worn.

Delphinus delphis, Linn.

A specimen of this Dolphin* was found on the Cheshire shore, at New Brighton, February 13th, 1879, minus its tail, evidently cut off by collision with the fan of a screw steamship. Two accurate coloured drawings,† showing

* Bell's "Brit. Quad.," ed. 2, p. 462; Gray's "Catal.," p. 242; Flower's "List of Cetacea," p. 24.

† These drawings agree very closely with the coloured plate given in the Transactions of the Zoological Society of London for 1879, vol. xi., pl. 1, iii

under and side views of the creature, were made while it was quite fresh by Mr. J. Chard, which are of considerable interest. As the finder would not part with the skin, it was only possible to secure the skeleton, which has been carefully mounted for the Museum.

Mr. Alfred O. Walker, of Colwyn Bay, writes, "Some years ago a school of Dolphins passed through Colwyn Bay. I did not see them, but my wife and others did, and described them as Porpoises, but said they spouted and sometimes threw themselves clean out of the water. The station master here saw them, and I remember, told me that he could see the herrings flying up out of the water in front of 'their noses.' This was, no doubt, the spouting. The above facts, according to Bell, are quite characteristic of the species, and as the observers, who informed me of them, did not know there was anything remarkable in 'porpoises spouting,' I think you may fairly book the Dolphin."

Tursiops tursio, Fabr.

Into the northernmost of the two bays formed by the railway embankment connecting Holyhead with Anglesey, a small shoal of Cetaceans found their way on April 14th, 1866, and proceeded so far that they got stranded near Valley, on the Anglesey shore. The workmen at the Valley foundry waded into the water and succeeded in killing and capturing fifteen or sixteen of the animals. I arrived on the spot, with Mr. F. Archer, ten days after, just in time to make a few notes before the remains were

illustration of Prof. Flower's paper "On the External Characters of Two Species of British Dolphins" (*Delphinus delphis*, Linn., and *Delphinus tursio*, Fabr.), no really adequate figure having been previously given in any Zoological publication. This specimen was caught in mackerel nets about twenty miles south of the Deadman Headland, Cornwall, March 13th, 1879, just a month after the stranding of our New Brighton specimen.

all dispersed. All the heads and most of the bodies had already been purchased for the Cambridge and London museums, but I managed to secure for the Liverpool museum one of the decapitated bodies and the head to match. I took the dimensions, &c., of several of the skulls and skeletons, also of a skin which was being prepared for stuffing by two of the foundry men, and these notes I give below. So far as I could determine on the spot, with Dr. Gray's British Museum Catalogue of Seals and Whales, the specimens seemed to belong to the species given above, the Bottle-nosed Dolphin,* which is also the opinion arrived at by Mr. J. W. Clark, of Trinity College, Cambridge, from an examination of the specimens which were conveyed there, and by Mr. E. Gerrard, on examining those which went to London.

Dimensions :—

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.
Length of body.	9 2	8 7	8 0	9 0	9 3	...
Length of head.	1 10	1 10	1 10	1 10	1 8	1 10
Total length.	11 0	10 5	9 10	10 10	10 11	...
Teeth	$\frac{21}{21} \frac{21}{21}$	$\frac{21}{20} \frac{20}{20}$	$\frac{22}{22} \frac{23}{22}$	$\frac{21}{21} \frac{21}{20}$	$\frac{3}{5} \frac{14}{2}$	$\frac{21}{19} \frac{21}{13}$
	All much worn.		First from the snout very small and nearly embedded in the gum.		Very old and many lost, but the first and last of each series remaining.	and several gone.

Two of the largest carcasses lay beheaded on the shore. Putting these and their heads together the total length of the one was eleven feet six inches, and of the other eleven feet eight inches, the tail of the latter being two feet six inches across from tip to tip. All the above were males ;

* *Delphinus tursio*, Bell's "Brit. Quad.," ed. 2, p. 467 ; *Tursio truncatus*, Gray's "Catal.," p. 358 ; *Tursiops tursio*, Flower's "List," p. 26.

the teeth of all interlocked; many were much worn, and the under jaw was in every instance somewhat longer than the upper, and of a white colour. The ribs were thirteen pairs, the last pair hanging free. The stomachs were examined, and their principal contents were remains of fish of various kinds, and in various stages of digestion. There were several large skulls of Conger-eels, and a few of the vertebræ of the Garfish (*Belone*), which are of a pale green colour. There were also a few ear bones of the Codfish tribe, a few Crabs, one small Cuttlefish beak, and the opercula of several Whelks, but *no shells of this Mollusc*, showing plainly that these Cetaceans have the power of crushing and rejecting the shells and swallowing the soft parts.

The following dimensions were taken, as accurately as circumstances would permit, from the skin, which was flattened out for the purpose, and the measurements taken in a straight line representing the vertebræ.

	Feet.	In.
From the snout to the rise of the forehead		
(external "beak")	0	4
From the snout to the end of the gape	1	0
Do. do. eye	1	2
Do. do. blow-hole	1	2½
Do. do. anterior insertion of pec-		
toral flippers	1	10
From the snout to the posterior insertion of		
pectoral flippers	2	4
From the snout to the commencement of dorsal		
fluke	4	0
From the snout to the apex of dorsal fluke.....	5	4½
Do. do. external orifice.....	6	6
Do. do. vent	7	1
Do. do. origin of tail.....	9	1

From the snout to the cleft of tail	9	11
Do. do. tips of tail.....	10	2
Height of the dorsal fluke	0	10

The body as it approached the tail was compressed into a sharp ridge above and below. The pectoral flipper measured in its greatest length (from its tip to its anterior insertion) one foot seven inches, the eye was one and one-eighth inches long; the ear-hole, owing to the condition of the skin, could not be distinguished; the horns of the blower were pointed forward. The whole skin was smooth, and was entirely black, except on the underside, which was white from the chin to beyond the vent. In a younger and smaller specimen, retaining a portion of the skin, and which without the head measured six feet in length, there was much more white, which extended to and over part of the tail. The abortive hinder limbs in this example consisted of a right and a left bone lying in the long axis of the body near the vent, and about twenty-seven inches from the cleft of the tail. They were about two inches and three-eighths long, and a quarter of an inch broad, somewhat curved upwards, flattened forwards, and rounded and thickened behind, where they nearly met.





