fumaroles with a little sulphur (an exceedingly rare mineral at Vesuvius) with abundance of molysite and kremersite.

In the Campi Phlegræi little of novelty has come to light. A tunnel and a deep shaft which is being constructed in Naples to complete the drainage works have brought several interesting sections to light, but not of sufficient completeness to be yet worth recording.

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## *The Marine Zoology of the Irish Sea.—Second Report of the Committee, consisting of* Professor A. C. Haddon, Professor G. B. Howes, Mr. W. E. Hoyle, Mr. I. C. Thompson, Mr. A. O. Walker, *and* Professor W. A. Herdman (*Chairman and Reporter*).

[PLATE I.]

The work has chiefly been carried out by the three last-named members of the Committee along with their colleagues of the Liverpool Marine Biology Committee and other naturalists who have been working at the Port Erin Biological Station during the year. The present report is drawn up by the Chairman, with contributions from the various specialists mentioned below in connection with the several groups of animals. The extensive lists and notes received from Mr. Walker and Mr. Thompson should be specially acknowledged.

The limits and more prominent physical features of the region of the Irish Sea which this Committee was appointed to explore were sufficiently described in last year's report, and may be readily seen from the accompanying chart (Plate I.), which is a modification, with some additions, of the chart given in the former report.

The work this year, in addition to the further exploration of the district by dredging, trawling, and tow-netting, for the purpose of adding to the records of the fauna, has consisted largely of the determination of the submarine deposits spread over the floor of the Irish Sea—their nature, probable origin, relation to depth, and effect upon the distribution of the fauna. The reasons for undertaking this extension of the work were—

1. There can be no doubt that the nature of the bottom has a profound influence upon the assemblage of animals at a particular spot, and limits, perhaps, as much as any other factor the distribution of non-pelagic species in the sea.

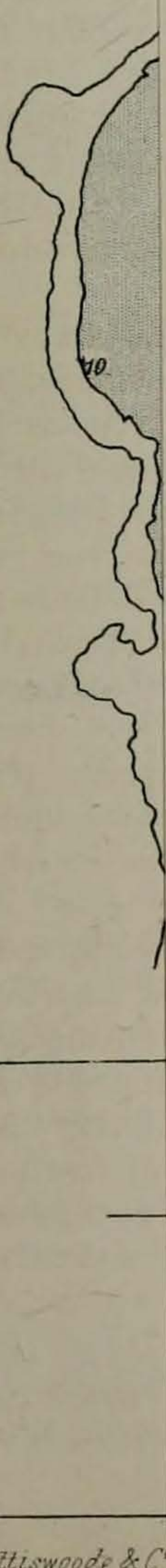
2. That being so, it becomes of importance to determine, if possible, why there is a particular deposit at a special spot, and how much connection there is between the geological formations of a shore and the submarine deposits lying off that coast.

3. Some of the deposits described in our last report proved of such interest to the geologists at the Nottingham meeting that the Committee of Section C supported the application for the reappointment of this committee on the grounds that a collection of typical deposits from the floor of the Irish Sea would be of geological interest. Sir Archibald Geikie asked that such a series should be formed and sent to the Jermyn Street Museum ; so on all the expeditions during this year sample bags of the deposits met with have been preserved, and, after examination, have been sent up to the Geological Survey. These deposits will be discussed in a later part of the report.

The object of the Committee, then, has been, not merely to collect animals, but to investigate the condition of the sea-bottom in the various parts of the area, and correlate, if possible, the fauna with the environment.

IRELA

Newca





Spottiswoode & C°

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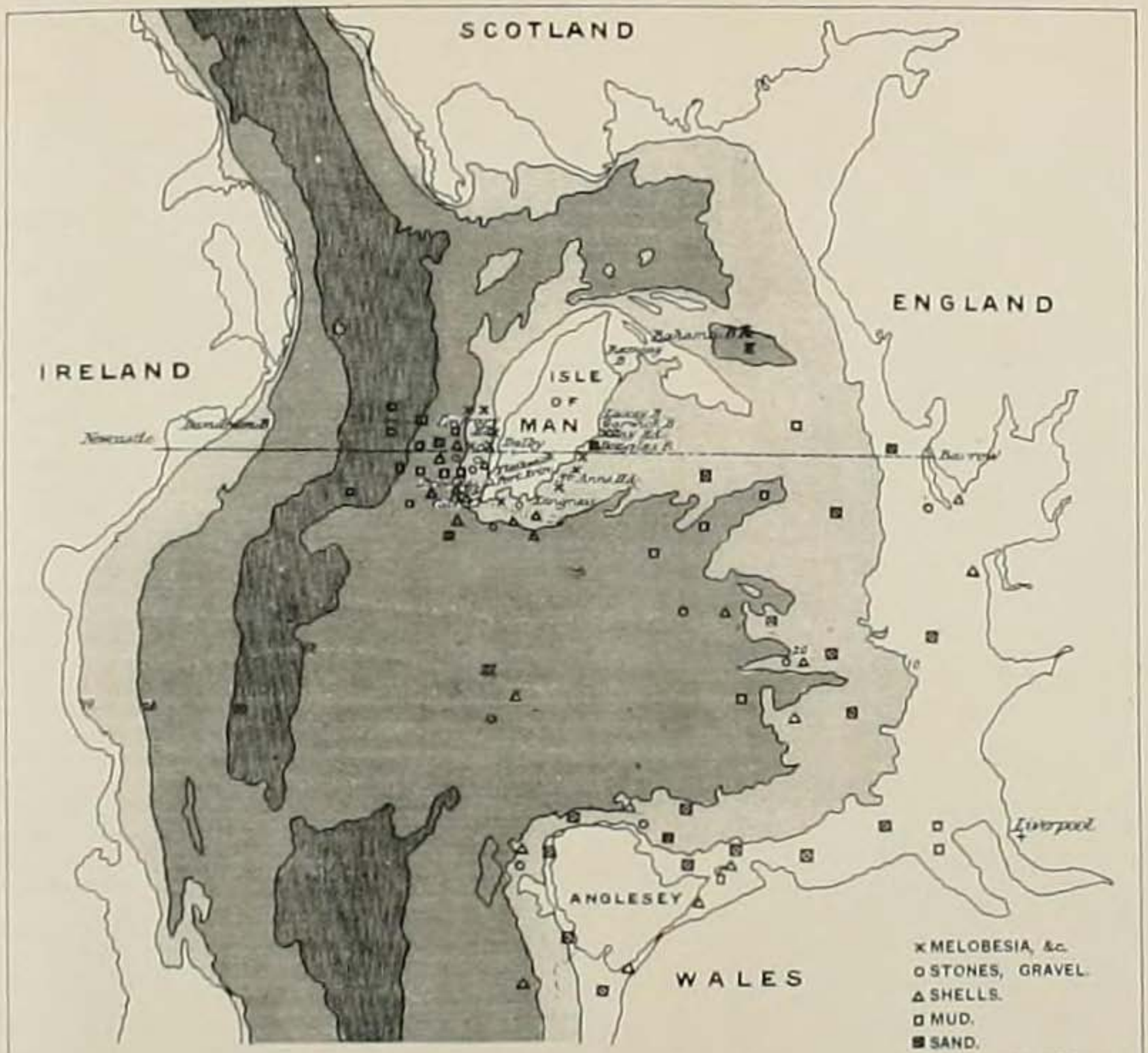
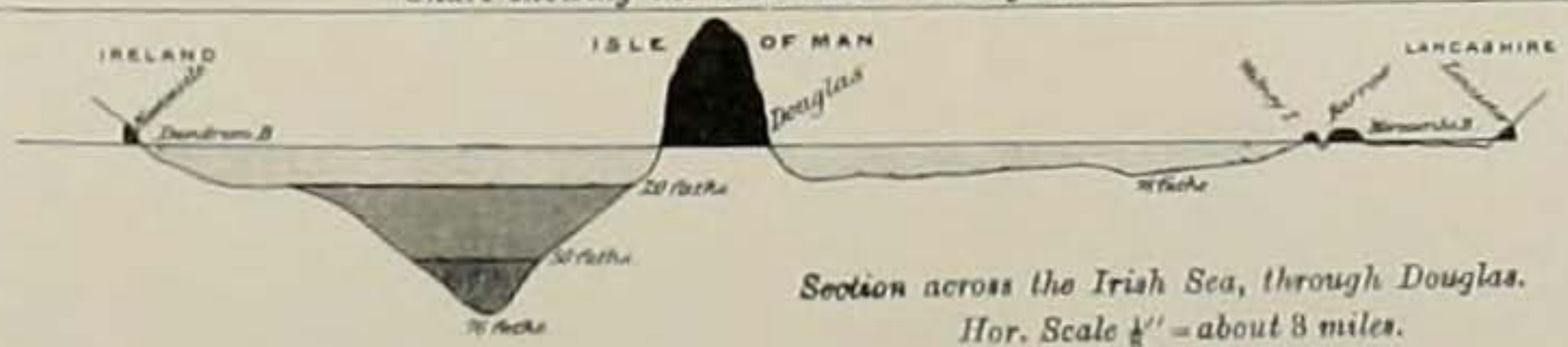



*Chart showing the area under investigation.*




**Section** *across the Irish Sea, through Douglas.*
*Hor. Scale* $\frac{1}{8}''$ *= about 8 miles.*
*Vert. Scale* $\frac{1}{10}''$ *= 10 faths.*

*Illustrating the Report of the Committee on the Marine Zoology of the Irish Sea.*

## THE DREDGING EXPEDITIONS.

The Committee have organised the following expeditions since the last report :—

I. August 22.—The Committee hired the steam trawler 'Albatross' for dredging from Port Erin to the south and west, round the Calf Island, as follows :

1. Off Halfway Rock and Bay Fine, half a mile from shore, 15 fathoms; bottom small gravel and broken shells. Conspicuous animals :[1] *Antennularia ramosa*, *Sertularia abietina*, *Aglaophenia myriophyllum*, *Cellaria fistulosa*, *Sarcodictyon catenatum*, *Porania pulvillus*, *Galathea intermedia* (with the Bopyrian parasite *Pleurocrypta intermedia*), *Ascidia plebeia*, *A. mentula*, *Cynthia morus*.

2. From off Kitterland to Halfway Rock, half a mile off, 17 fathoms ; bottom stones and large shells, with *Cliona celata* (massive form), *Ophiopholis aculeata*, *Ascidia venosa*, *Cynthia morus*.

3. North of Kitterland, three-quarters of a mile off, 18 fathoms ; bottom small gravel and shell sand, with *Sarcodictyon catenatum*, *Lepralia edax*, *Cellepora pumicosa*, *Echinocyamus pusillus*, *Ophiocoma nigra*, *Xantho tuberculatus*, *Inachus dorsettensis*, *Ebalia Cranchii*, *Ascidia mentula*, *A. plebeia*, *Perophora Listeri*, *Capulus hungaricus*, *Murex erinaceus*.

4. Off the north-west corner of Calf Island, a quarter mile off, 17 fathoms ; bottom stones ; very many *Ophiocoma nigra*, with *Stichaster roseus*, *Ophiothrix fragilis*, *Ocnus brunneus*, *Lineus longissimus*, *Cynthia morus*.

5. South end of Calf Sound, half a mile off, 15 fathoms ; rough hard ground, probably rock *in situ*. Several large stones came up, covered with *Sertularia abietina*, encrusting polyzoa, and *Ciona intestinalis*.

6. North-west of Calf Island, half a mile off, 18 fathoms ; bottom stones with many *Ophiocoma nigra*, with *Sycandra ciliata* (large), *Chætopterus* sp., *Ophiopholis aculeata*, *Solaster papposus*, *Thyone fusus*, *Ascidiella scabra*, and *Ciona intestinalis*.

7. North-west of Calf Island, further out, 20 fathoms, bottom stones, shells, and echinoderm spines, with *Sarcodictyon catenatum*, *Aglaophenia tubulipora*, *Spatangus purpureus*, *Aphrodite aculeata*, *Pectunculus glycimeris*, *Ciona intestinalis*, and *Perophora Listeri*.

8. From off Kitterland to across Port Erin Bay, 2 miles off, 18 fathoms ; bottom large shells, with *Perophora Listeri*, *Ascidia mentula*.

9. West of Port Erin Breakwater, a mile out, 17 fathoms ; gravel and rotten algæ, with *Lyonsia norvegica* (alive).

II. On September 11 some of the Committee dredged from a large rowing boat between Port Erin and the Calf Island ; half a dozen hauls were taken about Aldrick and Bay Fine, half to a mile off shore ; depth 15 to 18 fathoms. The hauls overlapped, so all may be considered one locality. Amongst the animals obtained were : *Folliculina ampulla* (in quantity, alive), *Astrorhiza limicola*, *Antennularia ramosa* and other hydroids, *Sarcodictyon catenatum*, *Antedon rosacea*, *Amphiporus pulcher*, *Terebella nebulosa*, *Halsydna gelatinosa*, *Conilera cylindracea*, *Anthura*

[1] The few species picked out for mention in each haul are not to be regarded as the rarest forms observed. In some cases they are the commonest. They are the forms which at the time seemed to us the most conspicuous and characteristic of the haul—the most noteworthy inhabitants of that ground.

*gracilis* (new to the district), *Eurynome aspera*, *Galathea nexa* (with Bopyrian parasite *Pleurocrypta nexa*, n. sp., Stebbing), *Doto fragilis*, *Velutina lævigata*, *Ostrea edulis*, *Ascidia plebeia*, *Ascidiella venosa*, *A. virginea*, *Cynthia morus*, *Polycarpa pomaria*, *Corella parallelogramma*, and *Syngnathus acus*.

III. March 20–25.—At Easter the Committee spent some days in shore-collecting at the southern end of the Isle of Man, and hired the steam trawler 'Lady Loch' for two days' dredging. On the first day the floor of the sea to the north of Port Erin from Fleshwick to Contrary Head at Peel was worked at twelve stations within four miles of the coast, and at depths from 10 to 20 fathoms. On the second day nine stations off the west of the Calf Island at depths of from 20 to 25 fathoms were dredged.

March 24.—1. West of Fleshwick Bay, a quarter mile off shore, 13 fathoms; bottom fine sand and broken shells, with *Cliona celata*, *Gemellaria loricata*, *Canda reptans*, *Ophiura ciliaris*, *Galathea intermedia*, *Portunus arcuatus*, *Aporrhais pes-pelicani*, *Trochus magus*, *Ascidia virginea*.

2. West of Fleshwick, further north, half mile off shore, 15 fathoms, bottom small gravel and shells, with *Cycloporus papillosa*, *Hyas coarctatus*, *Macropodia longirostris*, *Venus fasciata*, *Lissocardium norvegicum*.

3. West of Fleshwick, further north, half a mile off shore, 15 fathoms; bottom large shells, a little gravel, with *Pecten tigrinus*, *Venus casina*, many common crabs.

4. One mile north of Fleshwick, half mile off shore, 14 fathoms; bottom much fine gravel, with *Pecten maximus*, *Trochus magus*, *Antedon rosacea*.

5. Off the Cronk, a mile off shore, 14 fathoms; bottom small gravel and some *Melobesia*, with *Tellina crassa* (alive), *Thracia prætenuis*.

6. One mile further north, a mile off shore, 10 fathoms; bottom Nullipores (*Melobesia* and *Lithothamnion*), with compound ascidians.

7. West from South Barrule, a mile off shore, 12 fathoms; bottom Nullipores, with *Antedon rosacea*.

8. Off Niarbyl Point, a mile out (several hauls), 12 fathoms; rough hard ground, with *Antedon rosacea*, *Echinocardium flavescens*.

9. Off Glen Meay, 4 miles out, 20 fathoms; bottom 'reamy' (sand and mud), with *Ophiopholis aculeata*, *Porania pulvillus*.

10. Off Glen Meay, half a mile further north, 21 fathoms; with many *Pecten opercularis*, *Cucumaria Hyndmani*, *Ebalia tuberosa*, *Cellaria fistulosa*, *Scalpellum vulgare*.

11. West of Contrary Head, 4 miles off, 18 fathoms; bottom Melobesia and stones, with *Eugyra glutinans*.

12. West of Contrary Head, one and a half mile off, 13 fathoms; bottom muddy sand with some stones and many ophiuroids, with *Cliona celata* (massive form), *Astarte sulcata*, *Pecten maximus*.

IV. March 25.—1. Off Aldrick (south of Port Erin), a mile out, 18 fathoms; bottom dead shells, shell sand, and echinoderm spines, with *Spatangus purpureus*, *Echinocyamus pusillus*, *Porania pulvillus*, *Henricia sanguinolenta*, *Murex erinaceus*, *Xantho tuberculatus*.

2. Off Kitterland, $1\frac{1}{2}$ mile out, 18 fathoms; bottom dead shells with *Ascidia mentula*, *Cynthia morus*.

3. North-west of Calf Sound, 2 to 3 miles off; 19 fathoms, bottom sand and shells, with *Palmipes placenta*, *Luidia ciliaris*, *Stichaster roseus*,

*Thyone fusus and T. raphanus, Cellaria fistulosa, Ascidia plebeia, Polycarpa comata.*

4. North-west of Calf Island, 3 miles off, 20 fathoms ; bottom sand and shell fragments, with *Pectunculus glycimeris, Modiola modiolus, Pecten maximus.*

5. North-west of Burrow Rock, 3 to 4 miles off, 22 fathoms ; bottom shells, with *Pectunculus glycimeris, Lissocardium norvegicum, Pecten maximus.*

6. North-west of Chicken Rock, 5 miles off, 25 fathoms ; bottom dead shells and some sand, with *Sarcodictyon catenatum, Chætopterus* sp., *Ebalia tuberosa, Ascidia plebeia.*

7. One-and-a-half mile off Bradda Head, 18 fathoms ; bottom large shells and broken fragments, with *Asterias rubens* (very large [1]), *Porania pulvillus, Ciona intestinalis.*

8. Two to three miles N.W. of Bradda Head, 21 fathoms ; bottom muddy sand, with many ophiuroids, *Cucumaria Hyndmani.*

9. Four miles N.W. of Bradda Head, 23–25 fathoms (several hauls) ; bottom sandy mud, many ophiuroids.

V. May 27.—The Committee hired the steam trawler 'Lady Loch,' and dredged the following localities :—

1. South-east of Calf Sound, a mile from Kitterland, 20 fathoms ; bottom subangular gravel (? glacial material), many ophiuroids and *Buccinum undatum*, a few large shells, *Mytilus edulis*, and *Venus casina.*

2. South-east of Calf Sound, half a mile further out, 19 fathoms ; some coarse sand and broken shells with the subangular gravel (stones much encrusted) *Spatangus purpureus*, many encrusting polyzoa, *Venus, Trochus, Pecten, Serpula, Echinus*, and *Lithothamnion* fragments.

3. South-east of Calf Sound, further on, 2 miles from Kitterland, 20 fathoms ; bottom white, shelly (calcareous) sand, mainly organic, lamellibranch and gastropod shells, echinoderm spines and plates, *Cellaria fistulosa* and *Cellepora pumicosa.*

4. South-east of Spanish Head, $2\frac{1}{2}$ miles off, 20 fathoms ; bottom sand and broken shells ; a few small stones—Triassic sandstone, slate, and pebble of felsite.

5. South-east of Spanish Head, 3 miles off, 22 fathoms ; bottom more shelly (fragments large), and a few small pieces of slaty rocks.

6. Off the Chasms, half a mile out, 17 fathoms ; bottom muddy sand with much *Lithothamnion* and *Melobesia*, a few shells and small stones, small subangular fragments of slate, grit, Carboniferous limestone (with *Productus*), and pebbles of coarse sandstone.

7. Off the Chasms, a mile out, 19 fathoms ; bottom mud and small gravel (small subangular grit and granite), *Amphidotus* and *Echinus* remains, and some shells.

8. Off the Chasms, 2 miles out, 21 fathoms ; mixed bottom, sandy mud, small subangular stones and shell fragments.

9. South-east of the Old Mines, near Perwick Bay, quarter mile to a mile off shore, 15 to 18 fathoms (two hauls) ; bottom Nullipore and gravel (angular grit, slate, vein-quartz) ; a few shell fragments.

[1] The specimens we dredge are very much larger than those we find on the rocks of the neighbouring shore. Are there two varieties in the species, a smaller shore and a larger deep-water form, or do the individuals move outwards from the shore as they grow older ?

10. Off mouth of Perwick Bay, half a mile off, 12 fathoms; bottom small gravel.

VI. July 8.—The Committee had the use of the Lancashire Sea Fisheries steamer 'John Fell,' and dredged at the following localities :—

1. West of Dalby, 5 miles out, 30 fathoms; bottom mud, with *Antennularia ramosa*, *Ophiura ciliaris* and *O. albida*, *Pecten opercularis* and *P. pusio*, *Turritella terebra*, *Hyas coarctatus*, *Ascidia virginea*, and *Eugyra glutinans*.

2. Six-and-a-half miles west of Contrary Head (Peel), 38 fathoms; bottom fine mud, with *Brissopsis lyrifera*, *Lipobranchius Jeffreysii*.

3. Seven-and-a-half miles west of Niarbyl Point, 45 fathoms; bottom fine mud, with *Calocaris Macandreæ*, *Gonoplax rhomboides*, *Panthalis Oerstedi*.

4. Five-and-a-half miles west of Glen Meay, 34 fathoms; bottom mud, many *Turritella terebra* with *Sagartia Herdmani*.

5. Four-and-a-half miles west of the Cronk, 22 fathoms; bottom broken shells and small stones, with many ophiuroids, *Ebalia tuberosa*, *Eurynome aspera*, *Atelecyclus septemdentatus*, many encrusting polyzoa (twelve species identified), including *Ascopodaria nodosa*, hydroids (fifteen species identified), including *Dicoryne conferta*, new to the district; also the cumacean *Campylaspis macrophthalma*, Sars, new to Britain.

It may be of some use to place on record the course of procedure at each dredging station on these expeditions. The plan for the day is arranged with the captain of the steamer, and when the first locality is reached the spot is determined on the chart, and the depth verified by casting the lead. Then the dredge (measuring 2 feet 6 inches by 1 foot, and weighing from 30 to 40 lbs.) is sent down with a tow-net tied on to the line about two fathoms from the dredge. Very often a smaller dredge with a bag of cheese-cloth is sent over on the other side of the ship. One or more surface tow-nets are also put out. The tow-nets, both surface and deep, are looked after by Mr. I. C. Thompson, who, after hauling them, first turns out their contents into a clear glass jar of sea-water, and then, after noting the general character of the catch and any specially conspicuous forms, strains off the water through a small bag made of very fine miller's silk, and then transfers the 'plankton' left adhering to the silk into a tube containing a special preservative fluid formed chiefly of spirit, glycerine, and water.

When the dredge is brought up it is emptied on deck, and after a note of the general character of the deposit and assemblage of animals has been taken, any specially large or rare specimens are picked out and transferred to buckets or jars of sea-water or to store-bottles of spirit. Then the heap is spread out so as to form a layer not more than one or two inches in depth, and one or two members of the Committee (Professor Herdman and another) now settle down beside it to pass the entire mass in review inch by inch, working it across a small space of bare deck and turning over every shell, stone, and specimen with an iron spoon, so as to ensure that nothing escapes observation and due record in the note-book. In the meantime the contents of the bottom tow-net have been dealt with by Mr. Thompson, and the apparatus has been lowered for a second haul, or the vessel is steaming on to a new locality. Then Professor Herdman selects a fair sample of the deposit for preservation (for the Geological Survey) in a small canvas bag (10 × 5 inches), care being taken to include

some of the characteristic bottom animals—shells, ophiuroids, polyzoa, &c. After this sample has been removed and any special animals required have been picked out and put into store bottles, the whole of the remainder of the haul is passed gradually through our set of three sieves (meshes $\frac{3}{4}$ inch, $\frac{1}{4}$ inch, and $\frac{1}{8}$ inch respectively), which work up and down in a tall iron cylinder filled with sea-water. The sieves are disconnected and examined at intervals, and in this way many of the smaller animals of all groups are detected and picked out. Finally, the water in which the sieves have been plunging is all strained by Mr. Thompson through his fine silk net, and in this way many of the rarer bottom Copepoda are obtained, while the finer sandy and muddy deposits retained by the finest sieve or in the bottom of the cylinder are packed in canvas bags by Mr. Alfred Leicester for further examination at home. These contain, of course, many minute Mollusca, Ostracoda, and Foraminifera. By the time all these processes have been completed the dredge has usually been hauled again, and a fresh heap is lying on the deck awaiting investigation. On a successful trip the members of the party, on an average four to six in number, are kept constantly occupied, each man at his own work, from the commencement of the first haul till the steamer is turned homewards, and after that the packing and labelling of specimens fill up the time until land is reached.

## ADDITIONS TO THE FAUNA.

As most of the expeditions took place round the Isle of Man the material was generally brought back to the Port Erin Biological Station, and sorted out into groups in the laboratory there, and then sent to the specialists. Taking the groups in zoological order the most notable additions as the result of this year's work have been—

Sponges.—Dr. R. Hanitsch reports that the only actual addition to our sponge fauna made during the last few months is *Leiosella* (*Spongionella*) *pulchella*, Sowerby, which was dredged on May 14, 1894, at 14 miles N. by W. from the Liverpool N.W. Lightship. This species was previously known from the coast of Durham, the Skerries, Shetland, the west coast of Ireland, the east coast of Greenland, and the North Pacific. A few other doubtful species await further investigation.

We are indebted for a list of the Hydroid Zoophytes and Polyzoa which we have collected to Miss L. R. Thornely, who has proved that the *Lafoëa pigmæa* of Alder possesses an operculum, and therefore belongs to the genus *Calycella*, and also has Gonothecæ which were previously unknown. The total number of species of hydroids in our area is now eighty-nine, and the last dredging expedition has given us an interesting addition to our fauna in *Dicoryne conferta*, which was growing on an *Aporrhais* shell; it was only known previously from Cullercoats, Orkney, and Shetland. Of polyzoa 123 species and fourteen varieties have now been recorded. The most recent find is *Crisia ramosa*, which was recently described by Harmer from Plymouth, and which we find also at Port Erin.

Mr. E. T. Browne has, during some visits to Port Erin, paid special attention to the Medusæ, and has kindly supplied us with a list of a dozen species, one of which, *Amphicodon fritillaria*, has not previously been recorded for British seas. He has also found on several occasions a Siphonophore (probably *Halistemma*) in Port Erin Bay and *Lesueuria vitrea*, both new to our district, and the *Halistemma*, probably an addition to the British fauna.

Amongst Worms new to the record are the turbellaria *Fecampia* (the pear-shaped white cocoons of this form are not uncommon on stones in pools at Port Erin), and *Stylocoplana maculata* (identified by Mr. Gamble), and the annelid *Gattiola spectabilis* (Johnston) collected at Port Erin by Mr. Beaumont.

Professor G. S. Brady has kindly examined two gatherings of Ostracoda from dredged material, and reports the following species:—
I. Off the Calf Island, 20 fathoms:

*Pontocypris trigonella*, G. O. Sars; *P. mytiloides*, Norman; *Bairdia inflata*, Norman; *Cythere Jonesii*, Baird; *C. emaciata*, G. S. Brady; *Loxoconcha tamarindus*, Jones; *Cytherura cornuta*, G. S. Brady; *C. striata*, G. O. Sars; *C. sella*, G. O. Sars; *Pseudocythere caudata*, G. O. Sars; *Cytheropteron latissimum*, Norman; *Sclerochilus contortus*, Norman; *Paradoxostoma ensiforme*, G. S. Brady; and *Philomedes interpuncta*, Baird.

II. Off Contrary Head, 40 fathoms, the following were found:—
*Cythere tuberculata*, G. O. Sars; *C. emaciata*, G. S. Brady; *C. Dunelmensis*, Norman; *C. antiquata*, Baird; *C. Jonesii*, Baird; *Krithe Bartonensis*, Jones; *Loxoconcha impressa*, Baird; *L. guttata*, Norman; *Cytheropteron latissimum*, Norman; *C. alatum*, G. O. Sars; *Cytheridea papillosa*, Bosquet; *Bythocythere acuta*, Norman; *B. turgida*, G. O. Sars; *Machærina tenuissima*, Norman.

In regard to the Copepoda, Mr. I. C. Thompson has drawn up a general report upon the additions to our knowledge of the group (see p. 325); while Mr. Andrew Scott, 'fisheries' assistant to Professor Herdman, has supplied the following notes upon some new species of *Ectinosoma* and other Copepoda, at which he has been specially working:—

'*Longipedia minor* (T. and A. Scott).—A few specimens of this species were collected by hand-net in the rock-pools at Hilbre Island in March. It is easily distinguished from *L. coronata* (Claus) by its much smaller size.

'*Ectinosoma Normani*, n. sp. (T. and A. Scott).—Several specimens of this *Ectinosoma* were obtained in material from Barrow Channel collected by Professor Herdman in May. When fresh this species has a brilliant red spot on the lower angles of the cephalothorax, and in this respect it agrees with *E. erythrops*, Brady.

'*Ectinosoma Herdmani*, n. sp. (T. and A. Scott).—This species was found in considerable numbers in the stomachs of young dabs (*Pleuronectes limanda*) sent to the fisheries laboratory from Blackpool, as many as sixteen specimens being obtained from a single stomach. We have also obtained specimens of this new species from the Firth of Forth.

'*Ectinosoma gracile*, n. sp. (T. and A. Scott).—One or two specimens of this species were obtained among dredged material collected at Port Erin by Professor Herdman, Easter, 1894.

'*Ectinosoma pygmæum*, n. sp. (T. and A. Scott).—This species was obtained from the same material as the last, and is the smallest *Ectinosoma* known to us: it measures only $\frac{1}{76}$th of an inch (·33 mm.).

'*Bradya minor*, n. sp. (T. and A. Scott).[1]—A few specimens of this new *Bradya* were obtained in rock-pools at Hilbre Island, along with *Longipedia minor*.

[1] The above species of *Ectinosoma* and *Bradya* are figured and described in a revision of the British species of Copepoda belonging to the two genera *Ectinosoma* and *Bradya*, by T. and A. Scott, which is to be published at an early date.

'*Dactylopus rostratus* (T. Scott).—A single specimen was obtained among some dredged material collected at Port Erin by Professor Herdman, Easter, 1894.

'*Pseudanthessius Sauvagei* (Canu).—A few specimens were obtained by washing a number of *Spatangus purpureus* which were trawled in the central area, 21 miles W.N.W. from Morecambe Bay Lightship, on April 3. This rare species was only added to the British fauna last year, when it was found in the Firth of Forth, and the present is the second time it has been observed in the British area.'

Mr. Thompson reports as follows :—

'Eleven species of Copepoda new to the district have been recorded during the past year, viz., *Cyclops magnoctavus*, Cragin ; *Cyclops Ewarti*, Brady ; *Canuella perplexa*, Scott ; *Ameira longicaudata*, Scott ; *Acontiophorus elongatus*, Scott ; *Ectinosoma Herdmani*, Scott ; *Ectinosoma Normani*, Scott ; *Ectinosoma elongata*, Scott ; *Cancerilla tubulata*, Dalzell ; *Lepeoptheirus pectoralis*, and *Anchorella appendix*. Also one species new to science, viz., *Pseudocyclopia stephoides*, n. sp. This crustacean has not yet been described, but its description and figure will be shortly published in the "Transactions of the Liverpool Biological Society." It combines some of the characters of the genus *Stephos* with those of *Pseudocyclopia*, the latter predominating sufficiently to determine its position in that genus.

'Surface tow-nets have been continuously employed during the several marine expeditions undertaken by the Committee, also tow-nets attached to the rope a few fathoms above the dredge. The latter device has proved a success, collecting some good species of Copepoda as well as Cumacea and Amphipoda, which are seldom or never obtained on the surface. Amongst the Copepoda thus obtained were several specimens of *Pseudocalanus armatus*, found along with a shoal of *Pseudocalanus elongatus*. A widely extending shoal of *Anomalocera Patersonii* was observed off the Isle of Man in May, the only occasion on which we have taken this species during the year. On several occasions, notably in the early part of June, the surface organisms have been singularly scarce.

'Special care has been taken to wash and sieve through fine silk as much as possible of the material brought up by the dredge during marine expeditions, and it is by this means that several of the above-mentioned Copepoda new to the district have been obtained, as well as the new species *Pseudocyclopia stephoides*. Large quantities of ophiuroids, chiefly *Ophiocoma nigra* and *Ophiothrix fragilis*, are amongst the dredged material, and it is probably from one or other of these that the two specimens of *Cancerilla tubulata*, Dalyell, a male and female, were taken, as the species is parasitic on ophiuroids. The first record of this rare copepod occurs in Dalyell's "Powers of the Creator," 1851, and it has since been taken by Mr. Gamble at Plymouth, and by Mr. Scott in the Forth, but not before in our district. *Cyclops magnoctavus*, Cragin, was found along with quantities of *Temorella affinis* and *Tachidius brevicornis* in tow-nettings taken by Mr. Ascroft in low-water marine pools at Lytham. These being brackish species, it is evident that a considerable amount of fresh water finds its way into the Lytham pools.

'*Cyclops Ewarti*, Brady, although first taken in the Forth estuary, was suspected by Brady to have a fresh-water origin. Ours are evidently strictly marine, two specimens, both males, having been dredged at 20 fathoms by Mr. Thompson off Port Erin.

'Professor Herdman's fish laboratory has yielded two species of parasitic

Copepoda, viz., *Lepeoptheirus pectoralis*, found on the flounder, taken off Morecambe, and also from *Arnoglossus megastoma*, and *Anchorella appendix* from the gills of the hake.'

Mr. A. O. Walker reports as follows upon the HIGHER CRUSTACEA :—

'Collections have been examined from the following places, viz.—

'1. Off Port Erin at various points, dredged in (usually) 10 to 20 fathoms by Professor Herdman and Mr. I. C. Thompson in August and September 1893, and March 1894.

'2. Off the Little Orme, North Wales, 5 to 10 fathoms, in October 1893 (dredged by A. O. Walker).

'3. In the Menai Straits, near the Suspension Bridge (both above and below), on April 2 and May 31, 1894 (dredged by A. O. Walker).

'The following additions have been made to the list published in last year's report.

'BRACHYURA.

'*Gonoplax rhomboides*, Linn., one specimen on July 7, 1894, on mud, 45 fathoms ; 7 miles W. of Niarbyl, Isle of Man.

'*Atelecyclus septemdentatus*, Mont., two specimens from N.W. of Port Erin, 22 fathoms, on July 8.

'*Pisa biaculeata*, Mont, off Port Erin, Easter, 1894.

'MACRURA.

'*Palæmonetes varians*, Leach, in a small pool by the Afonganol, Colwyn Bay, in company with *Neomysis vulgaris*. The pool had probably been filled by a combination of flood in the little river and a high tide, but seemed to have been long cut off. The pool was full of *Ruppia maritima*. The *Palæmonetes* were 40 mm. long, and females had ova in the pouches ; the *Neomysis*, on the other hand, were small, females with ova being only 14 mm. long.

'SCHIZOPODA.

'*Leptomysis lingvura*, Sars, Colwyn Bay, in tidal pools ; and Port Erin.

'CUMACEA.

'*Nannastacus unguiculatus*, Bate, one specimen from Menai Straits.

'*Campylaspis macrophthalma*, G. O. Sars, one female from $4\frac{1}{2}$ miles west of the Cronk, July 8, 1894, 22 fathoms. This is a Mediterranean species, new to Britain.

'*Petalosarsia declivis*, Sars, 8 miles W. of Fleshwick Bay, 33 fathoms ; 14 miles N.W. of Liverpool N.W. Lightship (A. Scott). This species, first recognised in our district by Mr. Scott, is only known elsewhere in British seas from the Firth of Forth and the Moray Firth.

'ISOPODA.

'*Anthura gracilis*, Mont., off Port Erin.
'*Conilera cylindracea*, Mont., off Port Erin.
'*Cymodoce truncata*, Leach, off Port Erin.

'AMPHIPODA.

'*Lysianax longicornis*, Lucas ; Menai Straits.

'*Nannonyx spinimanus*, n. sp., Menai Straits, differs from the only other known species in the following points : Anterior coxal plates about the same depth as the body ; eyes very large, dark brown ; propodos of first gnathopod with five or six strong denticles on the hind margin ; third joint of last pereiopods but little expanded behind ; maxillipedes also different.

'*Tryphosa nana*, Kr. ; Menai Straits.

'*Socarnes erythrophthalmus*, Robertson ; Port Erin, 15 to 20 fathoms, March 24, 1894 ; Menai Straits.

'*Urothoë brevicornis*, Bate ; off Kitterland, 20 fathoms, one male.

'*Phoxocephalus Fultoni*, Scott ; Port Erin, 15 to 20 fathoms ; Menai Straits.

'*Ampelisca macrocephala*, Lilljeborg ; Port Erin.

'*Metopa Alderi*, Bate ; Menai Straits, large specimens, male and female, 6 mm. This species has not been met with in the L.M.B.C. district, except at Puffin Island.

'*Metopa rubrovittata*, Sars ; Menai Straits, Little Orme.

'*Leucothoë Lilljeborgii*, Boeck ; Port Erin, 15 to 20 fathoms.

'*Monoculodes carinatus*, Bate ; Port Erin, outside harbour.

'*Stenopleustes nodifer*, Sars, erroneously reported last year as *S. Malmgreni*, Boeck. In the specimens taken the elevated lobes on the hind dorsal margin of the first two pleon segments were reduced to a mere emargination of the segment.

'*Lafystius sturionis*, Kröyer, one specimen from the Liverpool Fisheries Laboratory, found under the pectoral fin of a cod.

'*Iphimedia minuta*, Sars ; Colwyn Bay, Port Erin.

'*Eusirus longipes*, Boeck ; Port Erin.

'*Dexamine thea*, Boeck ; Port Erin Harbour.

'*Tritæta gibbosa*, Bate = *T. dolichonyx*, Nebeski, ♂. Very abundant among sponges, Menai Bridge. All the specimens that had the elongated flagellum and furred upper surface of the peduncle of the lower antennæ characteristic of the adult male had also the peculiar notched anterior margin of the propodos of the first gnathopods as in *T. dolichonyx*, while none of the females or young had it. I believe I have once seen an adult male (dug out of the test of an ascidian) with the first gnathopod as in the female. This may possibly be a case of dimorphism.

'*Liljeborgia pallida*, Bate ; Port Erin.

'*Mæra semiserrata*, Bate ; Port Erin.

'*Mæra Batei*, Norman ; Port Erin.

'*Guernea coalita*, Norman ; Port Erin, 15 and 20 fathoms.

'*Leptocheirus pectinatus*, Norman ; Port Erin, Menai Straits.

'*Autonoe longipes*, Lilljeborg ; Menai Bridge.

'*Janassa capillata*, Rathke ; Port Erin.

'*Podocerus cumbrensis*, Stebbing and Robertson ; Menai Straits, Colwyn.

'*Colomastix pusilla*, Grube ; Menai Straits.

'*Corophium crassicorne*, Bruzelius ; Little Orme.

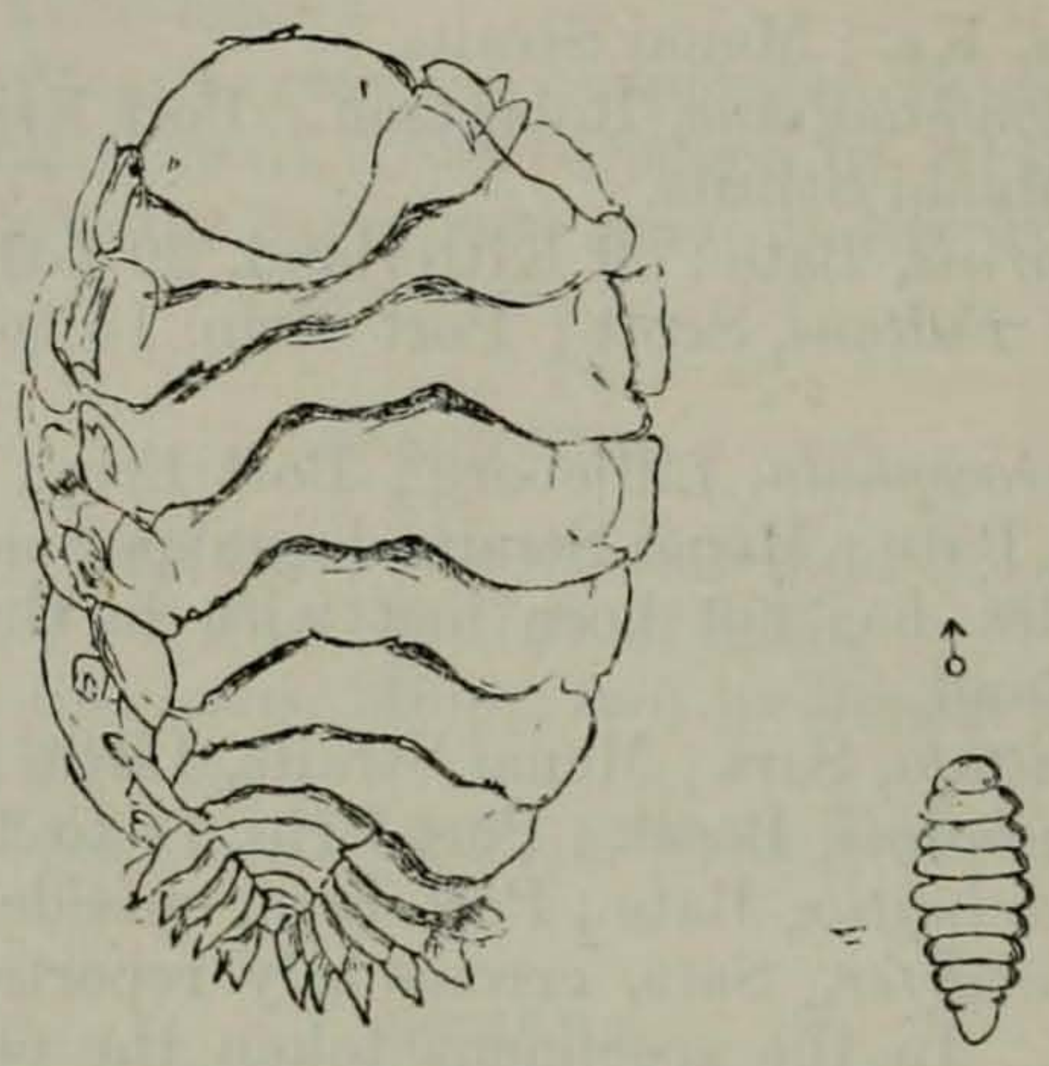
'*Corophium Bonellii*, Milne Edwards ; Little Orme, Port Erin.

'There still remains a quantity of material to be examined.'

The Bopyrians parasitic upon Galatheas, which were referred to in last

report, have since been identified by Rev. T. R. R. Stebbing as *Pleurocrypta galateæ*, Hesse, *Pl. intermedia*, Giard and Bonnier, and *Pl. nexa*, n. sp., from *Galathea nexa* (see fig. 1). They are all on the right-hand side of the hosts' carapace, and all laden with eggs.

FIG. 1.—*Pleurocrypta nexa*, Stebbing, male and female (from a drawing kindly sent by Mr. Stebbing).



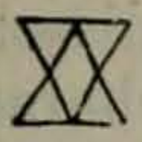

Mr. Alfred Leicester of Southport, who has taken part in most of the expeditions, and has collected and identified the Mollusca, reports that the year's work has added fifty-one fresh records to the lists for the southern part of the Isle of Man, and that of these the following nine are new to our district of the Irish Sea :—*Cardium minimum*, Phil., *Psammobia vespertina*, Chem., *Scrobicularia nitida*, Müll., *Chiton marginatus*, Penn., *Propilidium ancyloides*, Forb., *Rissoa inconspicua*, Ald., *Cæcum trachea*, Mont., *Aclis Gulsonæ*, Ch., and *Philine angulata*, Jeff.

Finally two additions have been made to our list of local fishes, viz., *Zeugopterus unimaculatus*, four specimens trawled 10–12 miles west from Morecambe Bay Lightship in May, depth 23 fathoms ; and *Gobius pictus*, Malm, caught by Mr. Walker in shore pools at Colwyn Bay.

## THE SUBMARINE DEPOSITS.

Turning now to the submarine deposits, the determination and distribution of which the Committee feel to be a very important part of their work, it is still too soon to attempt anything like a detailed account of the floor of the Irish Sea, but still sufficient observations have perhaps been made to warrant the following preliminary account. The accompanying chart (Plate I.) shows the zones of depths in the district, 0–10 fathoms, 10–20 fathoms, 20–50 fathoms, and upwards of 50 fathoms, being separated from one another. At those places where the Committee (or the Liverpool Marine Biology Committee) have obtained samples of the bottom, conventional symbols are placed on the chart[1] indicating, ○ stones, △ shells, ▭ mud, ▣ sand, × nullipore deposits (*Melobesia* and *Lithothamnion*),

[1] One mark frequently stands for a number of different dredgings in the same neighbourhood.

and  shell concretions. The chief conclusions we have arrived at so far are :—

1. The most extensive shallow-water deposit is sand. In most localities along the coast of Lancashire, Cheshire, and North Wales, from the sea-shore out to the 10-fathom contour the bottom is formed of more or less pure quartz sand. Occasionally in spots there are local patches of stones, of shells, or of mud ; but these can generally be accounted for by tidal or estuarine currents, by the entrance of fresh-water streams carrying down alluvium, or by the presence of littoral or sub-littoral boulder clay. These spots are all, however, of small area, and the great extent of the bottom down to 10 fathoms is sand.

2. Further out, however, between 10 and 20 fathoms, the sand becomes greatly mixed with mud, and much diversified by large tracts of shelly deposits or by patches of gravel, and the fauna on the bottom also becomes much more abundant. In some spots, at about 20 fathoms, it is made up over considerable areas almost entirely of ophiuroids (*Ophiocoma nigra* and *Ophiothrix fragilis*), which fill the dredge haul after haul. At two localities off the Isle of Man, viz., along the east coast from Clay Head to St. Ann's Head, and off the west coast between Contrary Head and Niarbyl, at depths between 10 and 20 fathoms, are great nullipore deposits formed of *Melobesia* and *Lithothamnion*, which have a most characteristic appearance, smell, and fauna.

This area of the sea-bottom, from 10 to 20 fathoms, extends across from the north of Lancashire to the Isle of Man, so that opposite Barrow, for example, there is a wide extent of about 50 miles in length of sea-floor at depths of not more than 15 or 16 fathoms (see section at foot of Plate I.).

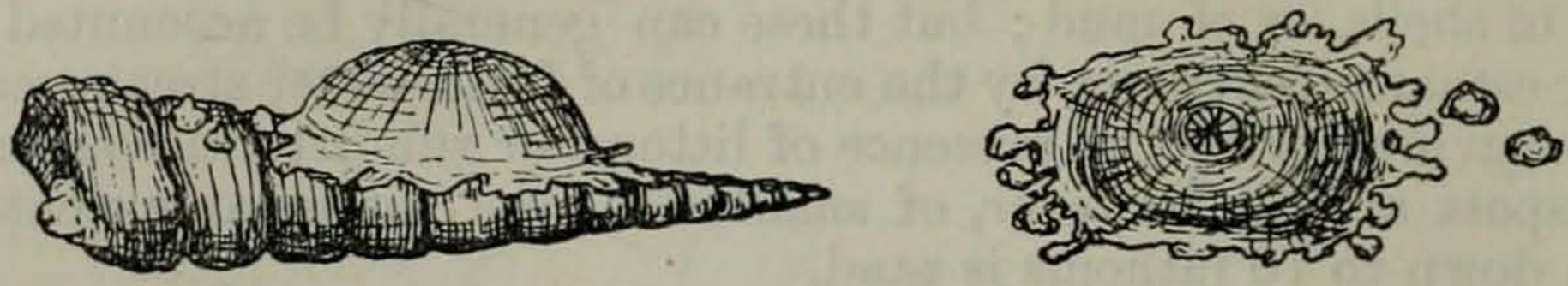
3. Depths of over 20 fathoms are only found to the west, north, and south of the Isle of Man (see Chart, Plate I.) ; and depths of from 20 to 50 fathoms give us the most varied bottom deposits and the richest fauna. As a rule the sand is more or less mixed with mud, and as the bottom goes deeper the amount of mud gets greater. When there is a considerable admixture of mud with coarse sand, that forms what is known to the trawlers as a 'reamy' bottom, and that is the ground upon which the sole and some other fish are generally found spawning.

Shells and other hard parts of animals play an important part in the deposits at depths of about 20 fathoms and upwards. In places the dredge comes up filled with Pecten shells, dead and alive, chiefly *P. opercularis* and *P. maximus*. At other places the deposit is practically composed of the shells of *Pectunculus glycimeris*. These and other shell beds form a rich collecting ground to the naturalist, as they support an abundant and varied fauna. Zoophytes and polyzoa are attached to the shells, and these serve as shelter for nudibranchs and other small mollusca, worms, and ascidians. On the whole the heterogeneous deposits support a richer fauna than do the homogeneous deposits, such as sand or mud, and it is chiefly in the zone of depth we are now considering that the heterogeneous deposits occur.

4. The depths over 50 fathoms contain a pure dark bluish grey mud which is very tenacious, and sets when dried into a firm clay. This is abominable stuff to dredge in and to work with on deck. It clings to everything that touches it : it is almost impossible to see what is in it, and to get the animals out of it uninjured ; it is too solid for the sieves, and the

hose can be played upon masses of it almost indefinitely without dissolving it. The fauna of this zone is, in our district, quite peculiar and characteristic. In its shallower parts, about 50 fathoms, it contains great numbers of living and dead *Turritella terebra*, upon many of which are attached one, two, or three specimens of the little red anemone *Sagartia Herdmani*,

FIG. 2.—*Sagartia Herdmani* (Haddon).



Haddon. In its deeper parts, up to 80 fathoms, are found *Calocaris Macandreæ*, *Hyalinœcia tubicola*, a small *Lumbriconereis*, *Panthalis Oerstedi*, *Lipobranchius Jeffreysii*, *Brissopsis lyrifera*, *Amphiura Chiajii*, and *Isocardia cor*. Great quantities of large sausage-like muddy tubes, formed of stratified layers of interlacing threads of mucus in which the mud particles are closely entangled, are brought up in the dredge. These are almost certainly the tubes of *Panthalis Oerstedi*, and the living annelid has several times been found in the tubes, but most of those we dredge up are empty, and the tubes are certainly far more numerous than the worms. Possibly the explanation is that the *Panthalis* forms a tube as it lies in the mud, and then when it moves away leaves its tube behind it (one can scarcely imagine the animal dragging such a tube through this tenacious deposit), and after a time forms another in a new situation.

These are the leading conclusions we have come to so far in regard to the distribution of submarine deposits in our area. Two further questions now present themselves: first, the biological one—the effect upon the fauna; and secondly, the geological one—the origin of the deposits. In regard to the importance of the nature of the bottom to the animals living upon it there can be no doubt. Probably the nature of the deposit is the most important of the various factors that determine the distribution of animals over the sea-bottom within one zoological area. It is certainly more important than mere depth; a muddy bottom will support a similar fauna at ten fathoms in one place and at fifty fathoms in another. Probably the most important influence in the environment of a lower animal is its food, and once beyond the narrow sub-littoral zone in which algæ flourish—and to which, of course, certain phytophagous animals must be restricted—it is probably chiefly the nature of the bottom which determines the food.[1] Many animals feed upon the deposit, others browse upon the polyzoa and zoophytes which can only attach themselves and grow where there are sufficiently large objects, such as shell valves, from which they can get the necessary stability; while others, again, feed upon their neighbours, which subsist on the deposit or are attracted by the zoophytes, &c.; for example, soles are frequently caught upon ground (known to fishermen as 'sole ground') where *Flustra foliacea* lives in abundance, and the probable connection is that the fish are dependent upon the numerous amphipoda and other small animals which frequent the tufts of *Flustra*. The same locality may vary so much from time to time in the temperature, the salinity, and the transparency of the water, that it is probable that

[1] The only food supply quite independent of the bottom is dead plankton, from the water above, which may reach the bottom uneaten.

none of these factors—so long as the variations do not exceed certain limits—have so much influence upon the fauna as the nature of the deposit has. It is therefore quite to be expected that the fauna should vary from place to place with the nature of the bottom, and that is what we have observed frequently in our work round the Isle of Man. In practically the same water, identical in temperature, salinity, and transparency, at the same depth, with, so far as one can see, all the other surrounding conditions the same, the fauna varies from place to place with changes in the bottom—mud, sand, nullipores, and shell beds, all have their characteristic assemblages of animals.

As to the further, and very important, question of the origin of the deposits, that is partly a geological inquiry, and one which cannot, until we have accumulated a much larger series of observations, be fully discussed; but there are a few matters which may be briefly pointed out as giving some idea of the range and bearing of the question.

1. It is necessary to make a most careful examination of the deposits. For example, all muds are not the same in origin. A deposit of mud may be due to the presence of an eddy or a sheltered corner in which the finer particles suspended in the water are able to sink, or it may be due to the wearing away of a limestone beach, or to quantities of alluvium brought down by a stream from the land, or to the presence of a submerged bed of boulder clay, or, finally, in some places to the sewage and refuse from coast towns.

2. We have kept in view the possibility of some correlation between the geological formations along the beach and the submarine deposits lying off the shore. There is no doubt that the nature of the rock forming the shore has a great influence upon the marine fauna, and has sometimes *some* effect upon the neighbouring deposits. For example, the contrast between the deposits lying off the two prominent headlands, the Great Orme, in North Wales, and Bradda Head, in the Isle of Man, is well marked. The Great Orme is composed of mountain limestone, and the result of its weathering and erosion is that large blocks are found lying scattered outside its base on the fine sand; but there is no deposit of smaller stones, gravel, and resulting sand farther out, probably because in the wearing of the rock and the large detached blocks by the sea a great deal is removed in solution and the rest in suspension as very fine mud—this we have found to be the case round Puffin Island, which is also mountain limestone. Bradda Head, on the other hand, is a schistose metamorphic Silurian rock, which breaks up into large fragments, and these into smaller, and so forms deposits of dark slatey more or less angular gravel, and then very coarse sand, extending for some way out from the foot of the cliff.

The influence of the shore rocks upon the littoral fauna is an important subject upon which we have accumulated some observations; but the matter requires further work and detailed discussion, and must be left over for a future report.

3. Probably the great bulk of the siliceous sand which forms so large a part of the floor of our sea is derived proximately—whatever may have been its ultimate source[1]—from the great deposits of drift which were formed in the neighbourhood during the Glacial period, and large tracts of which may since have been broken up by the sea.

[1] Probably, to a great extent, Triassic sandstones.

4. As examples of a few peculiar and specially noteworthy deposits which are not simply 'terrigenous' in their origin, the following may be mentioned :—

South-east of the Calf Sound, about two miles out, at a depth of 20 fathoms, there is a white shelly sand which seems to be almost wholly composed of animal remains. There are broken fragments of the lamellibranchs *Pecten*, *Anomia*, *Pectunculus*, *Mactra*, *Venus*, and *Mytilus*, of the gastropods *Cyprœa*, *Buccinum*, *Emarginula*, *Purpura*, and *Trochus*, of various calcareous polyzoa such as *Cellaria fistulosa*, *Cellepora pumicosa*, and lepralids, of *Balanus* and *Serpula*, and of various echinoderm plates and spines, and the whole shells of *Echinocyamus pusillus*. The deposit, when it comes up in the dredge, is of a gleaming whiteness, and has a very characteristic appearance. Such a deposit as this would form a rock almost wholly made up of fossils, and might compare well with some Tertiary fossiliferous deposits, such as the Coralline Crag.

A little further north, along the east coast of the Isle of Man, at about a corresponding depth and distance from land, we meet with a purely vegetal deposit formed of the nullipores *Lithothamnion* and *Melobesia*. On the other side of the island, again, between Port Erin and the Calf, at a depth of 18 fathoms, there is a tract of sea-bottom which, when brought up on deck, looks at the first glance like a peculiarly fibrous sand, but a closer examination shows that it is entirely composed of the comminuted plates, and especially the spines of echinids, chiefly *Spatangus*.

The variety that is noticed in submarine deposits round the Isle of Man, from depths of 15 to 35 fathoms, as brought up in the dredge is very striking. It is remarkable how differing proportions in the mixtures of sand, gravel, and shells give rise to very different colours and general appearance in the mass. As seen when tumbled out of the dredge on to the deck, some deposits are white, some yellow, some grey, some reddish, of various tints from pink to ruddy brown, and others darker, of all shades of brown and dark grey. It is curious how, even in a composite deposit made up of many different constituents, there is usually a prevailing tint ; for example, the bottom at Station 6 on May 27, although composed (see p. 321) of mud, sand, nullipores, shells, and stones, was distinctly of a rich ruddy brown tint. The importance of this presence of prevailing colours in the various submarine deposits is obvious in its bearing upon the colours and habits of animals.

Another very remarkable sea-bottom is one which takes the form of irregular calcareous masses, cementing together the dead shells and sand grains which are lying on the bottom, and making lumps like 'clinkers.' Hence the spot where it is found is called by the trawlers the 'Blacksmith's Shop.' It is about 25 miles S.S.W. of the Calf of Man (see Pl. I.), in ordinary clear weather the Chicken Rock Lighthouse just dipping and the stack at Holyhead just rising above the water, and the depth is about 25 fathoms. We have also heard of a similar bottom of cemented shells between Ramsey and North Lancashire. Mr. Leicester has found the following shells in the concretions :—*Pecten opercularis*, *Cyprina islandica*, *Venus lincta*, *Cardium echinatum*, *Nucula nucleus*, *Scrobicularia alba*, *Lucina borealis*, and *Turritella terebra*. There is a fine lump of this deposit in the Biological Station at Port Erin, and we have presented another piece to the Jermyn Street Museum in London. Mr. W. W. Watts, of the Geological Survey, has made a careful examination by thin sections of the latter specimen, and he has

kindly sent the following notes in regard to it :—'The microscopic examination shows that it is practically a fine-grained grit made up of the usual constituents of fragmental rocks cemented together, the cement being in greater quantity than the grains. These grains are chiefly chips of quartz, but I have also seen microcline, orthoclase felspar, plagioclase felspar, brown mica, a few grains of glauconite, and green and brown pseudomorphs, probably after grains of some ferro-magnesian mineral like augite, hornblende, or even possibly olivine—which it is impossible now to say, but I think most probably hornblende. There are one or two opaque grains, and several clear grains containing a good deal of minute magnetite. The grains vary in size within small limits; the largest I have measured is 0·02 inch and the smallest 0·002 inch, but the average size would be about 0·004–0·005 inch in longest diameter. They are therefore minute grains, and, as might be expected, extremely angular, not one in a hundred showing rounded outlines. They are chiefly such grains as would come from the denudation of granitic rocks or sediments derived from them.

'The cement is carbonate of lime, with a small impurity of carbonate of iron, present chiefly in certain layers, but not there in any considerable quantity. The cement is clearly crystalline in immediate contact with the grains, and also where lining cracks and cavities. Elsewhere it is more opaque, and less conspicuously crystalline. The section cuts across numerous shell fragments and a few polyzoa, and where there are any hollow structures, as in the inside of lamellibranchs or gastropods, they are filled up with a substance indistinguishable from the bulk of the concretion.

'The specimen shows no particular reason for the local deposit of cement, and the other constituents are doubtless the ordinary materials of the sea-bed. I cannot find any evidence that the cementing is due to any organic agency, and the thoroughly well-developed crystals of carbonate of lime quite agree with this. It may be that the Carboniferous limestone crops out on the sea-bottom under the deposit, and, if so, there would very likely be submarine springs laden with carbonate of lime which might be precipitated there under less pressure or local loss of carbonic acid. It may be added that Mr. Clement Reid could not see in the specimen any identifiable shells of other than recent age.'

Another possible explanation is that the smaller calcareous particles on the bottom have been dissolved in the sea-water and then re-deposited so as to cement together the larger shells and the sand grains.

As was mentioned earlier in the report, sample bags of all the more important submarine deposits we have come upon have been sent, at Sir Archibald Geikie's request, to the Museum of the Geological Survey in Jermyn Street. They are being examined there by Mr. Clement Reid, F.G.S., who writes the following preliminary note in regard to them :—

'On comparing these samples with British deposits of Tertiary date one finds a marked difference in lithological character. Dredgings from the Irish Sea, and also from the North Sea, are characterised by a much coarser and more gravelly texture than one would expect at such depths—coarser, in fact, than one finds in Pliocene deposits, yielding a similar fauna, indicating similar or even smaller depths. A glance at these dredgings shows the reason of this, for they are largely composed of unworn or little-worn fragments of rock, often entirely encrusted by

organic growth. The stones evidently have not been transported far by water, or they would be well rounded, like the pebbles found in our Eocene beds. The encrusting organisms show also that the fragments have lain undisturbed on the sea-bed, yet they have often been derived from far-distant sources. Though no Glacial striæ were observed, and no undoubted sub-fossil arctic shells have yet been found at these localities, yet there seems little doubt that the bulk of the material on the sea-bottom over this area has been derived from the breaking up of pre-existing Glacial deposits. This may occur at a depth of several fathoms through the gradual washing away of the muddy and sandy matrix of a boulder clay or Glacial gravel. Coarse gravel is thus caused to accumulate at a spot where the currents may be too feeble to transport anything but sand.

'This submarine origin of angular gravel deposits should not be forgotten, for it affects the lithological character of the sea-bottom over most of the area which was formerly glaciated, even as far south as Cornwall. On the other hand, it does not affect, except to a small extent, the sea-bed beyond the former limit of the ice, and it does not affect pre-Glacial deposits. Thus we must always expect to find at similar depths the same fauna associated with deposits of finer texture as soon as we leave the glaciated area, or when we go back into Tertiary times.

'It is also worth noting that the occurrence of a stony bottom at twenty or thirty fathoms—where normally there would be no deposit coarser than sand—will probably lead to a disproportionate increase of all encrusting organisms, and of all organisms needing a solid base. This has certainly taken place, as anyone studying our shoal-water Tertiary deposits will have observed. They contain few stones, and though each stone or dead shell may be covered with encrusting organisms, yet the relative proportion of these to the free forms is far smaller than seems commonly to be the case in the seas that now wash our shores. The sole exception to this rule among the British Tertiary strata is found in the Coralline Crag, in which the contemporaneous consolidation of the limestone was sufficient to provide the necessary solid base for the encrusting and fixed organisms so abundant in that deposit.'

In conclusion, it is clear that this investigation of our modern submarine deposits, their distribution, nature, origin, and associated fauna, has geological applications, and that our results may be of some importance to palæontologists in determining the conditions under which the fauna of a particular horizon existed in the past; but, from our point of view, the matter is a purely Biological one. We consider it of primary importance, in studying the distribution of the marine animals in our district, to investigate as minutely as possible their environment, and that not merely because it gives us some of the factors and possibly the explanation of the distribution, but also on account of the light it may throw upon the habits, variations, and other important characteristics of the species.

The Committee apply to be reappointed, with a small grant to defray part of the expenses of the dredging expeditions.