THE

VOYAGE OF H.M.S. CHALLENGER.

A SUMMARY OF THE SCIENTIFIC RESULTS.

FIRST PART.

REPORT

ON THE

SCIENTIFIC RESULTS

OF THE

VOYAGE OF H.M.S. CHALLENGER

DURING THE YEARS 1872-76

UNDER THE COMMAND OF

CAPTAIN SIR GEORGE S. NARES, R.N., F.R.S.,

AND THE LATE

CAPTAIN FRANK TOURLE THOMSON, R.N.

PREPARED UNDER THE SUPERINTENDENCE OF

THE LATE

Sir C. WYVILLE THOMSON, Knt., F.R.S., &c.

REGIUS PROFESSOR OF NATURAL HISTORY IN THE UNIVERSITY OF EDINBURGH

DIRECTOR OF THE CIVILIAN SCIENTIFIC STAFF ON BOARD

AND NOW OF

JOHN MURRAY

ONE OF THE NATURALISTS OF THE EXPEDITION

A SUMMARY OF THE SCIENTIFIC RESULTS

FIRST PART

(WITH APPENDICES)

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EDITORIAL NOTES.

THE Challenger Expedition was organised by the British Government during the years 1871 and 1872 at the suggestion of the Royal Society. The ship was fitted out under the direction of Admiral G. H. Richards, at that time Hydrographer of the Admiralty, and she sailed from Sheerness in December 1872.

The special object of the Expedition was the scientific exploration of the physical, chemical, geological, and biological conditions of the great ocean basins. In addition to a full complement of specially selected Naval Officers, the Expedition comprised a scientific staff of six civilians, under the direction of Professor C. Wyville Thomson.

After circumnavigating the globe, and carrying on deep-sea and other investigations in many regions of the ocean, the Challenger returned to England in May 1876, and the crew was paid off after the ship had been in commission for over three years and seven months.

Numerous scientific observations were successfully recorded in all branches of oceanic research. Large zoological and other collections were sent home from various ports during the voyage, and were brought home in the ship. Soon after the return of the Expedition considerable correspondence took place between the authorities at the Admiralty, the Treasury, the British Museum, and the Royal Society, with reference to the disposal of the collections, the best way of discussing the observations and the method of publishing the scientific results of the Expedition. It was ultimately decided that the land and other incidental collections made by members of the Expedition during the voyage should be at once handed over to the British Museum for incorporation in the national collections. It was further determined that the records of the various observations and the marine collections should remain in the meantime in the hands of those who had taken part in the

Expedition, and that a temporary Government department, with a small annual grant, should be created, the duty of which should be to direct the discussion of the physical and biological observations, the examination of the collections, and the publication of the scientific results, so far as these had a bearing on the science of Oceanography. It was arranged that the whole of the Official Report on the Scientific Results of the Expedition should be published by Her Majesty's Stationery Office, and that the typical collections should be ultimately deposited in the British Museum. Sir C. Wyville Thomson was appointed director of this temporary Government department, and I became the first assistant.

These arrangements took effect in the spring of 1877. Shortly afterwards Sir C. Wyville Thomson's health unfortunately broke down; he continued in ill health until his death in March 1882, and delay was thereby caused in the progress of the work. But the style of the publications had been settled by him, a considerable part of the collections had been sent to Naturalists for examination and description, and a few Zoological Memoirs were published before 1882. Sir Wyville Thomson had not been able, however, to decide on any definite and complete scheme with reference to the scope of the Report as a whole, nor was he able to undertake the preparation of any manuscript in connection with the Narrative of the Voyage and the special Zoological Memoirs he had himself proposed to write.

After I succeeded to the direction in January 1882, the work connected with these publications was carried on in consultation with a Committee of the Royal Society. During the six succeeding years, rapid progress was made with the investigations and memoirs dealing with the observations and collections of the Expedition, forty-six volumes, containing the Narrative of the Cruise and a large number of special memoirs having in this interval issued from the press.

In the year 1889 Her Majesty's Treasury declined to ask Parliament to renew the annual grant for the continuation of the work relating to the scientific results of the Expedition, the time estimated for the completion of the publications having expired. However, after some correspondence, in which I offered to finish the Report at my own expense, the Government agreed to set apart the sum of sixteen hundred pounds for the completion of the official publications in the same style as that in which they had hitherto appeared. This sum has been the only payment from Government funds in connection with the Challenger Expedition during the past six years:—the price of each volume of the Report has been fixed so as to repay the expenditure of Her Majesty's Stationery Office for printing, provided that the whole edition of seven hundred and fifty copies be sold.

The present volumes complete the official publications on the Scientific Results of the Expedition. They contain a historical review of the progress of Oceanography, a summary account of the observations and results obtained at each of the Challenger observing stations at sea, lists illustrating the geographical and bathymetrical distribution of marine organisms, and an index of the genera and species described or recorded in the Report.

Two important special memoirs which, owing to unavoidable delay in preparation, could not be published in the Zoological and Physical series are appended to these summary volumes. The first is a Memoir by the Right Hon. T. H. Huxley and Dr. Paul Pelseneer on the rare Cephalopod *Spirula*, one specimen of which was procured by the Expedition. The second is a Memoir by Dr. Alexander Buchan on Oceanic Circulation, which is accompanied by an extremely interesting series of maps showing the specific gravity and temperature of the ocean at different depths.

The several special Memoirs on Zoological, Physical, and Chemical subjects which make up the larger part of the Challenger Report were published separately, and in volumes, as soon as completed, with very little attempt at any systematic arrangement. It will be seen on reference to the following list that the whole Report is now bound up in a series of Fifty large Royal Quarto Volumes containing about twenty-nine thousand five hundred pages, illustrated by over three thousand lithographic plates, copper plates, charts, maps, and diagrams, together with a very large number of woodcuts. It was originally the intention, on the completion of the Report, to print new title-pages, with instructions for rebinding the several series of Memoirs in systematic order. This intention has been abandoned after consultation with many scientific authorities. Fourteen years have elapsed since the first volumes were published, and in scientific literature there are so many references to the Memoirs in their present bindings, that any advantages to be gained from rebinding would not make up for the inconveniences and confusion thereby introduced. In order to facilitate reference to the several Memoirs, a systematic list of the contents of the whole Report is appended to these notes, as well as a list of the separate volumes and their contents.

The completed Report contains Memoirs from seventy-six authors who, for the most part, are natives of Great Britain and her colonies, but scientific men of nearly all civilized countries are represented among the contributors. In addition to the authors whose names appear on the title-pages of the Special Memoirs, many other investigators have taken part in the various physical and chemical researches, in the examination of the collections, in the preparation of the illustrations, in the editorial work, and in various other ways have contributed to the elaboration of the Scientific Results of the Expedition.

From beginning to end the history of the Challenger Expedition is simply a record of continuous and diligent work. There were few opportunities for any brilliant exploits during the voyage. The daily and hourly magnetic and meteorologic observations, the handling of the ship during the tedious deep-sea investigations, the work connected with boat excursions and expeditions on land, in addition to the usual operations of the marine surveyor and navigator, all demanded from the naval officers and seamen an amount of constant care and attention, far surpassing what is required during an ordinary commission of one of Her Majesty's ships. The labour connected with preserving, cataloguing, and packing the biological and other collections on board ship was enormous, so also was that involved in their subsequent examination on the return of the Expedition, and their distribution to specialists in many parts of the world. All this was, however, accomplished with success, and the typical collections have now been deposited without any mishap in the British Museum. The majority of the authors of the Special Memoirs have spent years in the examination of the collections and in the preparation of their manuscript and illustrations for the press, without other remuneration than either a copy of the Challenger Publications or a small honorarium to cover the outlay necessitated by their researches. The payments to the Civilian Staff have been very moderate, and in my own case at least have not covered actual expenditure in connection with the work of the Expedition.

The great difficulty in carrying through an undertaking of this nature arises from considerations of time. The researches of the specialist tend ever to become more elaborate: in no case were the authors of the larger Special Reports able to terminate their work within the original estimates as to time and bulk. The limitations in reference to expenditure imposed on me by the Government often rendered it imperative to curtail the investigations, and to cut out matter from the Memoirs when in other circumstances I would gladly have fallen in with the views of contributors and collaborators.

The care exercised in all the arrangements connected with these publications is indicated by the fact that every Special Memoir which was commenced has been completed and published. The plan and proportion of the several parts of the Report have been largely determined by the complicated and changing conditions under which the work has been carried on, and this in turn accounts for an apparent want of unity in the contents of the volumes as issued from the press during the past fourteen years. Great care has been taken to insure accuracy in statement and to make the Report, in the first instance, a faithful record of the observations, investigations and scientific results immediately bearing on the work of the Expedition. The researches and publications connected with the Expedition might have been extended in several directions with advantage to science had the allotted time and funds permitted; as it is, a few collections have not been thoroughly examined, and some observations have not been fully discussed.

In June, 1872, I was appointed one of the naturalists of the Challenger when the Expedition was being fitted out. During the past twenty-three years my time has been wholly taken up with the work of the Expedition and in the study of those subjects which the Expedition was organized to investigate. The direction of the whole of the work connected with the publication of the Scientific Results passed unexpectedly into my hands, and I have done my best in the circumstances to place on permanent record a trustworthy account of the labours of this famous Expedition. It has been my earnest endeavour to complete the publications in a manner worthy of the naval position and scientific reputation of this great Empire. Notwithstanding the troubles, personal sacrifices and regrets necessarily connected with the work, it has been a pleasure and an honour to have taken part in explorations and researches which mark the greatest advance in the knowledge of our planet since the celebrated geographical discoveries of the fifteenth and sixteenth centuries.

For the assistance and advice I have received during the progress of this great undertaking I now desire to convey my thanks to my colleagues on the Expedition; to the contributors of the Special Memoirs; to my colleagues on the editorial staff; to Sir W. H. Flower, Director, and the officers of the British Museum (Natural History), especially Dr. A. Günther and the Zoologists and Botanists of the Biological Departments; to W. T. Thiselton Dyer, Esq., C.M.G., Director of Kew Gardens and Herbarium; to Admiral W. J. L. Wharton, Hydrographer, and the officers of the Hydrographic Department of the Admiralty; to T. Digby Pigott, Esq., C.B., Controller, and the heads of the different departments of Her Majesty's Stationery Office; as well as to many scientific men interested in the science of Oceanography.

JOHN MURRAY.

CHALLENGER OFFICE,
45 FREDERICK STREET, EDINBURGH,
January 28, 1895.

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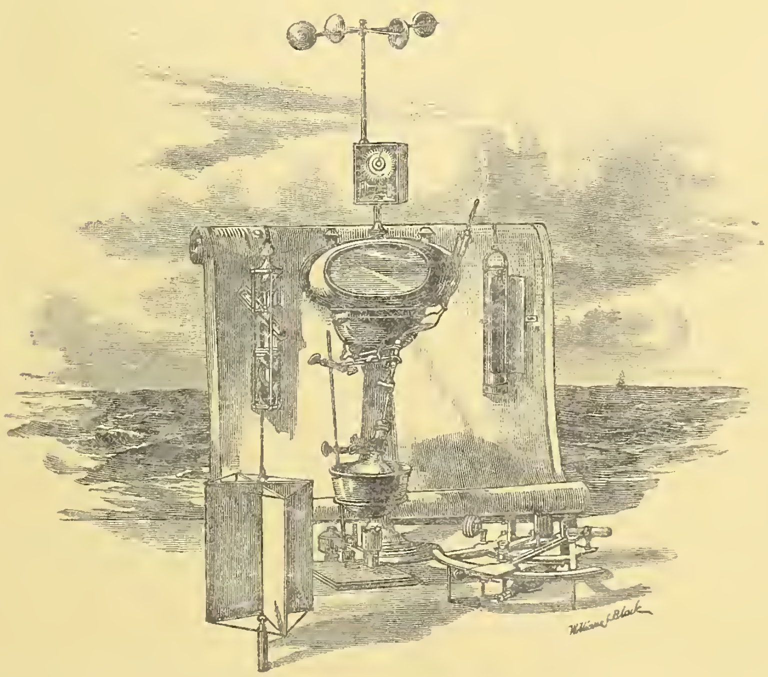


Anemometer, Thermometer, Current Drag, Sextant, and Carbonic Acid Apparatus.

A SUMMARY

OF THE

SCIENTIFIC RESULTS

OBTAINED AT THE

SOUNDING, DREDGING, AND TRAWLING STATIONS OF H.M.S. CHALLENGER

FIRST PART.

BY

JOHN MURRAY,

ONE OF THE NATURALISTS OF THE EXPEDITION, DIRECTOR OF THE WORK CONNECTED WITH THE PUBLICATION OF THE SCIENTIFIC RESULTS OF THE EXPEDITION, AND EDITOR OF THE CHALLENGER REPORT.

PREFACE.

The literature of the natural sciences during the past few years exhibits, in a remarkable way, the profound influence our fuller knowledge of the deep sea has had on all general conceptions concerning the modifications the surface of the earth is now undergoing and has undergone in past geological times. This could not well be otherwise. Whenever science is enriched by a large addition of new facts, a change in theoretical views invariably follows. No complete theory of the earth was possible so long as we were ignorant of the conditions prevailing over the three-fifths of the globe covered by the waters of the ocean. It may fairly be said that since the discoveries of Columbus, Gama, and Magellan in the thirty years from 1492 to 1522, there has been no addition to the knowledge of the surface of our planet that can in any way compare with that acquired by the Challenger and other deep-sea expeditions during the past quarter of a century.

The difficulties connected with the exploration of the deeper waters of the great Ocean Basins arise from the fact that the vast majority of the observations are from the nature of the case indirect. At the surface of the ocean direct observation is possible, but our knowledge of the conditions in deep water, and of all that takes place beneath the surface, is wholly dependent on the correct working of instruments, the actions of which are, for the time, hid from sight. A few years ago the apparatus necessary for the successful exploration of the deep sea had not been invented. Thanks to the rapid development of many branches of science, and the introduction of numerous instrumental improvements, thoroughly trustworthy results can now be obtained in the most profound depths.

In the Narrative of the Cruise of the Challenger the proceedings of the ship at sea, the methods employed in deep-sea investigations, the general character of the observations, the excursions of the naturalists on land, the surveying operations of the naval officers, and the other events of the voyage have been duly chronicled. In the Physical and Chemical Reports the continuous magnetic and meteorologic observations and the researches into the temperature, the specific gravity, and the chemical composition of sea-water, are published with abundant illustration. In the extensive series of biological memoirs the new and rare organisms discovered by the Expedition are described and figured in great detail. A special volume has been devoted to a discussion of the composition and distribution of Deep-Sea Deposits. A very large part of the Challenger Report thus consists of Special Memoirs, containing a great accumulation of facts, and many important generalisations in nearly all the branches of Oceanography.

The area covered by the ocean is so vast, and the positions at which complete sets of observations have been made are relatively so few, that it is frequently hazardous, from the information in our possession, to frame general statements with reference to the conditions prevailing over wide areas of the deep sea. Even when such statements are prepared by those who have a competent knowledge of all the known observations on the subject, they do not necessarily supply the information desired by students engaged in the study of Oceanological problems. Particular observations are usually of more value to the scientific man engaged in a new research than any general statements.

The Naturalist frequently wishes to know what observations exist with reference to the physical surroundings and biological associations of some animal in which he is interested. The general student or the chemist and geologist, desirous, it may be, of investigating the composition of sea-water or of deep-sea deposits, often asks for similar information from a particular locality and depth, and he finds it difficult to gather any very satisfactory knowledge of these various details from an examination of the Special Memoirs without great labour.

It has appeared to me that, in the present state of science, the most useful and valuable form of summary of the work of the Expedition which I can attempt is a concise statement of the observations carried out, and of the scientific results obtained, at each of the several Challenger Observing Stations at sea. In the following pages, accordingly, summaries of this nature are presented in the belief that these detailed accounts of what has been accomplished at definite localities will not only prove of great assistance to all engaged in the study of oceanic phenomena, but will also serve as a guide to the future explorer who desires to fill up gaps in our knowledge, and to contribute to the rapidly advancing science of Oceanography.

Many of the organisms captured in the dredge and trawl did not for various reasons reach the authors of the Special Memoirs. These were chiefly delicate animals, mutilated beyond specific identification by being hauled through the water from great depths, or by expansion of air and other gases relieved from great pressure. A complete list of the animals captured at each station was at the time, however, entered in the Station Book and in the journals of the naturalists together with notes as to the condition of the specimens when taken from the trawl. In the following summaries, the organisms now referred to are always reported in the station lists, in addition to those described in the Special Memoirs.

In like manner the names and general character of the organisms taken daily and sometimes hourly in the surface and sub-surface tow-nets were, after microscopic examination by the naturalists on board ship, entered in the note-books, along with numerous observations concerning the relative abundance of species and other matters of general or special interest. These remarks are now published, except where they have been rendered obsolete by subsequent discoveries.

In the preparation of these accounts of the work done, and the results obtained, at the Challenger Stations, I have made use of the official log and note-books, the published reports, and my own journals. I have also had in my possession the manuscript journals of my colleagues the late Professor H. N. Moseley and the late Dr. R. von Willemoes-Suhm; whenever I have made extracts from these, the authority has been given.

At many stations representative of different regions and depths of the ocean, very complete lists of Diatoms, Radiolaria, Foraminifera, and Pteropods, are furnished both from the collections taken in the surface-nets, and from the deposits at the bottom. Had it not been for the space they occupy, similar lists might have been inserted from many more stations. The lists of Diatoms have, in the great majority of cases, been supplied to me by Mr. Thomas Comber from an examination of the surface gatherings and the samples of deep-sea deposits. The lists of Foraminifera have been prepared from an examination of my own preparations, and from collections selected from the desposits by Mr. Frederick Pearcey, assistant to the naturalists on board the Challenger, and for several years an assistant in the Challenger Office, but I have also made use of a manuscript note-book which belonged to the late Mr. H. B. Brady. The lists of Radiolaria from the surface waters and from the deposits have been supplied to me by Professor Haeckel and Dr. Dreyer from a study of the Challenger collections.

The station summaries are preceded by a historical introduction in which I have endeavoured to trace, and with the aid of a series of maps to illustrate, the gradual development of our knowledge concerning the ocean from the dawn of history down to the time of the Challenger Expedition. For assistance and advice in this portion of the work I desire to acknowledge my indebtedness to the late Professor W. Robertson Smith, to Dr. J. Sutherland Black, Mr. George Murray, and especially to my colleague Professor A. Renard, in collaboration with whom notes concerning the progress of knowledge bearing on Oceanography were collected seven or eight years ago for our joint work on Deep-Sea Deposits; many of these notes have been made use of in writing the Historical Introduction to these volumes.

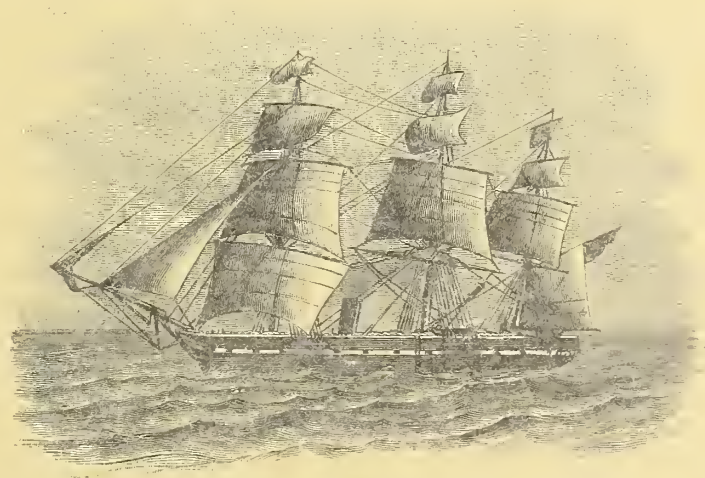
The station summaries are followed by lists setting forth the geographical and bathymetrical distribution of the animals captured in the various trawlings and dredgings. Many theoretical considerations are suggested by these lists and the observations set forth in the body of the work, but for various reasons I have in this place merely indicated in the concluding paragraphs the nature of some of these interesting speculations.

This summary account of the observations and scientific results of the Challenger Expedition is brought to a close by a complete index of the genera, sub-genera, species, and varieties of marine organisms captured at the various dredging and trawling stations, which, in a manner, will serve as an index to the whole Report: for on turning to the station list, in which the name of a species occurs, a reference will be found to the memoir in which it is described in detail. I desire to acknowledge the services, in the preparation of this index, of Mr. James Chumley, Mr. A. R. Scott, Miss Sclater, Mrs. Weir, and Mrs. Murray.

The temperature diagrams and detailed charts showing the positions of the Challenger sounding, temperature and dredging stations were originally prepared by Staff-Commander Tizard, F.R.S., of the Hydrographic Office, for the Narrative of the Cruise, and are now reproduced with additional information. I am also indebted to Captain Tizard for supplying me with data for the bathymetrical charts Ia, Ib, and Ic from the latest information in possession of the Hydrographic Department of the Admiralty. In constructing these bathymetrical charts, as well as the maps illustrating the historical introduction, I have had much assistance from Mr. J. G. Bartholomew and Mr. Frederick Bosse.

For many years I have been assisted in the Editorial and other work connected with the Challenger Publications by Mr. James Chumley, and in the preparation of these Summary Volumes for the press, as well as in the correction of the proofs, I cannot speak too highly of the services Mr. Chumley has rendered.

J. M.



H.M.S. Challenger preparing to Sound, 1872.

". . . bearded like the pard.

. . . . . .

Seeking the bubble reputation

—As You Like It.

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Azores to Madeira.

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[1] This sub-heading has been inadvertently omitted on page 416.

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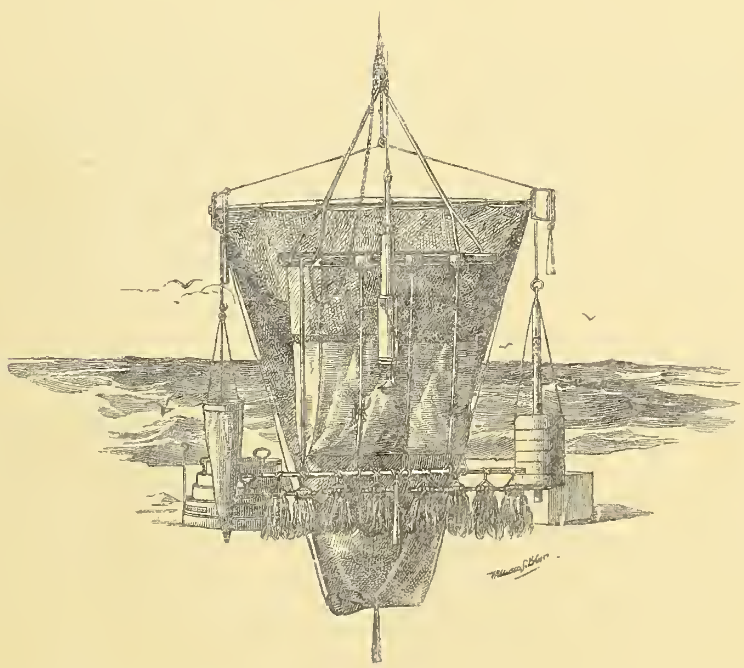


TRAWL, DREDGE, TOW-NET, WATER-BOTTLE, SOUNDING MACHINE, AND SIEVES.

ERRATA.

Page 1310, line 4, insert "T" after *Scrupocellaria macandrei.*

" 1330, " 14 from foot, insert "S" after *Acanthogorgia ramosissima.*

" 1334, " 6, for "N" read "T" after *Pararchaster spinosissimus.*

" 1337, " 10, insert "S" after *Aphrodita echidna.*

" 1345, " 15, insert "T" after *Bittium*, three species undetermined.

HISTORICAL INTRODUCTION.

A.—THE SCIENCE OF OCEANOGRAPHY.

DOWN till the early part of the present century the observation of marine phenomena was almost exclusively limited to the surface and sub-surface waters of the ocean. In the interests of navigation the hydrographer had undertaken a survey of coasts, an examination of oceanic routes useful for commerce, and a discussion of the winds, tides, and currents by which these were affected, but the observations of the biologist, the chemist, and geologist did not extend beyond the shallow water surrounding the dry land, nor deeper than a few fathoms. Our knowledge of the ocean was, literally speaking, superficial. No systematic attempts had been made to ascertain the physical and biological conditions of that vast region of the earth's surface occupied by the deeper waters of the ocean; the apparatus necessary for such investigations had not yet been invented.

PROGRESS OF KNOWLEDGE CONCERNING THE OCEAN.

The desire to establish telegraphic communication between Europe and America gave the first direct impulse towards a systematic exploration of the deep sea. The mprovement in methods and apparatus within recent years has been so rapid that it is now possible to examine the most profound depths of the ocean with great precision. The recognition of oceanography as a distinct branch of science may be said to date from the commencement of deep-sea researches.

The oceanographer takes account of everything relating to the ocean; his investigations deal with the form and divisions of all marine areas on the surface of the globe, the winds that blow over the surface waters, the contours of the ocean bed from the sea-level down to the greatest depths, the temperature, the circulation, the physical and chemical properties of sea-water, the currents, tides, waves, the composition and distribution of marine deposits, the nature and distribution of marine organisms at the surface, in the intermediate waters, and on the floor of the ocean, as well as the modifications brought about in living things by the conditions of their existence, the relations of man to the ocean in the development of fisheries, commerce, civilisation, navigation, hydrography, and maritime meteorology. All this vast assemblage of knowledge, which embraces some aspects of astronomy, geography, geology, physics, chemistry, and the biological sciences, makes up the modern science of oceanography.

THE MODERN SCIENCE OF OCEANOGRAPHY.

Work of the Challenger Expedition.

The Challenger Expedition has played a very large part in all the recent advances in oceanographical knowledge. The Official Reports on the Scientific Results of the Expedition deal more or less directly with all those branches of knowledge which, we have seen, constitute the science of oceanography. In order to fully appreciate the results at which science has arrived in our own time, it is essential to cast a retrospective glance at the ideas and opinions held by past generations of explorers and philosophers. It is therefore proposed to preface this volume, containing a summary account of the work done on board the Challenger, with a somewhat detailed account of the gradual development of knowledge concerning the ocean. Even a rapid chronological exposition of the march of ideas on the science of the ocean cannot completely ignore the progress of cognate sciences. Discoveries in astronomy and physics have often had more influence on the progress of oceanography than the most perilous and distant voyages. Facts observed by the ancients have sometimes directed the thoughts of modern investigators; during periods of apparent lethargy great ideas have germinated in some superior minds.

B.—OCEANOGRAPHICAL VIEWS OF THE ANCIENTS.

The marvellous expeditions of the heroic ages created great enthusiasm among the poets of antiquity. Their narratives of the first nautical expeditions are of great interest to the historian and literary man, for the ancients knew well how to clothe these primitive records of civilisation and commerce with all the charm of their language and brilliant imagination, but they teach us nothing from the point of view of the science of the sea. The Pacific islanders, at the present time, are probably in the same phase of development as were the civilised nations at the birth of navigation. The Polynesian is able to steer his boat to a safe port in a known group of islands, but he knows only one route, and he departs not from it. Should a current carry him away, he is forced to wander helplessly over the surface of the boundless ocean. His knowledge is quite local and there is no scientific union among its different parts. The sea, for him, is simply a means of transport, and a vast reservoir for the supply of his alimentary wants. In the infancy of humanity, as to-day among savages, there was no geography, and consequently, no scientific notions on oceanography. It is only as man rises from savagery and through barbarism to a state of civilisation, and as commercial relations are established, that ideas, at first vague and uncertain, can be traced concerning the phenomena of the ocean.

Knowledge of Primitive Peoples.

Views of the Hebrews.

The sacred writings contain very few topographical details. The conceptions of the Jewish people about nature were extremely vague. The Hebrews were not a maritime people, and consequently we do not find in biblical literature any very definite notions regarding the sea. The following passages: "He hath compassed the waters with bounds ;"[1] "I take the wings of the morning and dwell in the uttermost parts of the sea ;"[2] "He set a compass (circle) upon the face of the depth ;"[3] all seem to indicate that the Jews held the same general opinions as to the distribution of land and water as prevailed among the Greeks of the Homeric period. The expression in Genesis, "Let the waters under the heaven be gathered together unto one place,"[4] and a passage in Esdras : "Upon the third day thou didst command that the waters should be gathered in the seventh part of the earth, six parts hast thou dried up and kept them,"[5] have been cited to show that they believed that only a seventh part of the surface of the world was covered by the waters of the ocean. Some of these passages were cited by Columbus in the fifteenth century to prove that the Atlantic could not be of any great extent. The book of Esdras, however, was written after the time of Christ, probably quite late in the first century of our era, and is no evidence for old Jewish belief. The author of Esdras merely shares a view widely held in his time, according to which the earth was divided into seven zones or climates. The view that the Hebrews believed the land to be much less extended than the ocean cannot be said to be well founded.[6]

Maritime commerce was almost unknown to the Egyptians, who appear to have had at all times an antipathy to everything connected with the sea. We do not find anything in the history of this ancient people which indicates that they took any part in discoveries relating to oceanography ; their ships, as for instance in the voyage of Necho, appear always to have been manned by Phœnician sailors.[7] It is among maritime and commercial nations, who must familiarise themselves with the phenomena of the sea, that we find the first true ideas concerning the morphology of the ocean. THE EGYPTIANS.

Long before the Greeks had emerged from a state of barbarism, and long before the oldest Greek and Hebrew records, the Phœnicians had settled all over the Mediterranean. The earliest notices represent them as a nation of clever navigators, capable of making distant voyages. In pursuit of commerce, they traversed the Mediterranean, that great enclosed sea presenting fewer difficulties to navigation than the Erythræan Sea or Indian Ocean, from whence they are supposed to have originally emigrated.[8] At first they THE PHŒNICIANS.

[1] Job, xxvi. 10. [2] Psalms, cxxxix. 9. [3] Proverbs, viii. 27. [4] Genesis, i 9.

[5] II. (IV.) Esdras, chap. vi. v 41, "Et tertia die imperasti aquis congregari in septima parte terræ."

[6] Humboldt, Examen critique de l'histoire de la géographie du nouveau continent et des progrès de l'astronomie nautique au 15me et 16me siècles, Paris, 1836, tom. i. p. 188. Humboldt states that the Hindus, like the Hebrews, had seven zones and seven climates, but with the Hindus the seven terrestrial zones are separated by seven seas. In this arrangement, however, the total mass of the liquid zones is not limited—among the zones are the bizarre, rather than poetic, seas of *curdled milk*, of *sugar*, and of *clarified butter*.

[7] E. H. Bunbury, History of Ancient Geography, vol. i. p. 3, London, 1883.

[8] As stated above, the Phœnicians knew the Erythræan Sea. Herodotus (I., 1 ; VII., 89) reports that they came from the coasts of that sea to settle down on the shores of the Mediterranean during historical times. This opinion is admitted by several modern historians, among others by Movers (Die Phœnizier, Bd. i., pp. 9-12). The weight of modern judgment appears to be against this view. Kenrick (Phœnicia, p. 52) rejects it. (See also Bunbury, *op. cit.*, vol. i. p. 5, note 3 ; Konrad Kretschmer, Die Entdeckung Amerika's in ihrer Bedeutung für die Geschichte des Weltbilds, p. 12, Berlin, 1892 ; Ency. Brit., art. "Phœnicia," by Prof. A. von Gutschmid ; The Ruined Cities of Mashonaland, by J. T. Bent, London, 1892 ; Rawlinson's Hist. of Phœnicia, London, 1889, p. 53 ; Pietschmann, Geschichte der Phœnizier, Berlin, 1889, p. 113.)

traded as far as Egypt,[1] then to Syrtis, and, establishing colonies everywhere on their route, they arrived at the Pillars of Hercules. At this point there opened before them the great ocean. The Phœnicians are believed to have recognised in the Atlantic an ocean with high tides similar to the Erythræan Sea, and to have conceived the idea of a continuous mass of water surrounding all lands.[2] From Gades and other settlements outside the Pillars of Hercules they braved the great ocean itself; they sailed along the western coast of Africa, discovered the Canaries, and Humboldt considers it very probable that they were acquainted with the Sargasso Sea, into which they had been perhaps driven by easterly winds.[3] They extended their excursions towards the northern parts of the Atlantic, and discovered the Cassiterides,[4] where they went in search of tin, of which they preserved the monopoly by concealing its source from rival nations. In the

Phœnician Voyages.

[1] See Ritter, Geschichte der Erdkunde und der Entdeckungen, Berlin, 1861, pp. 16 *et seq.* The first indications we have of the Phœnicians in Hebrew literature, however, represent them at the time of Solomon as already making voyages to Tarshish, which appears to answer to Tartessus in the south of Spain (see Dr Smith's Dictionary of Biblical Antiquities, vol. iii., article "Tarshish," by Twisleton, cited by Bunbury, *op. cit.*, vol. i. p. 5, note). That Tarshish = Tartessus, Turdetania (basin of Guadalquivir) is certain.

[2] It was at one time believed that the word ocean was derived from a Punic or Hebrew word signifying a circle or circumference, and that the word ocean has thus been preserved, a monument, as it were, to the discoveries of the Phœnician sailors (see Humboldt, *op. cit.*, tom. i. p. 33; Ritter, *op. cit.*, p. 21). This derivation has been wholly repudiated by modern philologists.

[3] Humboldt, *op. cit.*, tom. iii. p. 91; see also M. P. Merrifield on "Gulf-Weed," *Nature*, vol. xviii. p. 708, 1878. The name Sargasso is said to have been first applied to the gulf-weed by the sailors of Vasco da Gama on their return from India in 1499. It is said to be a Portuguese name for *water-cress* (*Nasturtium*) (see Linschoten, *Hist. Orient.*, p. 31). Kretschmer (*op. cit.*, p. 165) and Krümmel (*Reisebeschreibung der Plankton-Expedition*, p. 118) do not admit that the Phœnicians were acquainted with the Sargasso Sea. Columbus, they hold, was the first to visit that part of the Atlantic. The gulf-weed is frequently driven to the eastward of the westermost of the Azores (Corvo and Flores), and it is altogether probable that the Phœnicians were acquainted with the floating gulf-weed, although they may never have ventured so far as the Sargasso Sea, properly so-called. The discovery of Carthaginian and Cyrenian coins in Corvo—the most westerly of the Azores—is often cited as evidence that the Phœnicians had extended their voyages far into the Atlantic. The coins were in the hands of Johan Podolyn, evidently a member of the Gothenburg Scientific and Literary Society, in whose transactions the description of the coins is published with figures. Podolyn received them in 1761 from the Padre Florez, on visiting him in Madrid. The nine coins figured in the paper—two Carthaginian gold coins, five Carthaginian copper coins, two Cyrenian copper coins—were selected by Florez, as the best preserved, from a large quantity first sent to Lisbon and thence to Madrid to the Padre Florez.

These coins had, in November 1749, after some days of westerly storms, been found on the coast of Corvo, in a black earthenware vessel, broken by the storm. They were first sent to a convent on the island, and then some to Lisbon, whence, as said above, the Padre Florez in Madrid received them (Några Anmarkningar om de Gamles Sjöfart, i [illegible] af några Carthaginiensiska och Cyrenaiska Mynt, fundne år 1749, på en af de Acoriska Öarne, af Johan Podolyn; Det Götheborgska Wetenskaps och Witterhets Samhällets Handlingar Wetenskaps Afdelningen, Först Stycket, Götheborg, 1778, [illegible].) Humboldt had no doubt about the truth of these statements, and regrets that no full account was preserved of the vase in which the coins were found. The positive statements about the discovery of Phœnician coins on the Azores by Chateaubriand (*Autobiography*, p. 195), by Daniel Wilson (*New Atlantis*), and in the *Encyclopædia Britannica* and *Chambers's Encyclopædia*, all seem to rest on this paper of Johan Podolyn. H. F. Walker (*The Azores*, London, [illegible]) says there is not the slightest corroborative tradition among the inhabitants of Corvo, and discredits the whole story. Gaffarel would lead us to think that the Phœnicians had even reached America, but this will not bear critical examination any more than those more recent attempts to show that the Phœnicians had reached Central America by the north of Australia and Easter Island in the Pacific (Gaffarel, *Compte Rendu du 1er Congrès des Américanistes*, Nancy, 1875, p. 93; Gaffarel, Etude sur les rapports de l'Amérique et de l'Ancien Continent avant C. Colomb, Paris [illegible], p. [illegible]; T. C. Johnston, Did the Phœnicians discover America? *Geogr. Soc. California*, 1892).

[4] These may have been either the Scilly Islands or the islands in Vigo Bay, on the north-west coast of Spain (see C. I. Elton, Origins of English History, ed. 2, London, 1890).

East the Phœnicians were accustomed to round the southern part of Arabia into the Persian Gulf, and to sail southwards along the eastern coasts of Africa, attracted doubtless by the commerce in pearls.[1] Phœnician names and remains indicate their presence in these regions. It cannot be shown with certainty that they circumnavigated Africa,[2] but it is known that, in the remotest periods of history, they executed voyages over the ocean which might rival some of those of the fifteenth century. (See Plate I.)

THE CARTHAGINIANS.

The same spirit of intrepid commercial enterprise animated the Carthaginians, who continued the traditions of their ancestors, the Tyrians; but, as in the case of the Phœnicians, all their historical monuments have been destroyed. However, a Greek translation of the Periplus of the Carthaginian admiral, Hanno, has been preserved.[3] The date of this voyage, which added much to the knowledge of the Atlantic, cannot be definitely fixed. Pliny says that at the most flourishing period of Punic affairs, "Hanno received the order to make the circuit of Africa."[4] This period corresponds to the sixth century before our era. The whole of that century was marked by a great intellectual expansion among all the peoples of the Mediterranean, and in that movement geography played a considerable part. Hanno is said to have conducted a fleet, composed of sixty vessels, each carrying five hundred men and women, along the western coast of Africa towards the Equator. This colonising enterprise showed, for the first time, the extension of the Atlantic towards the south. Like almost all early voyages, this one was undertaken in the interests of commerce, and to extend the dominion of the nation which sent it forth. In these ancient expeditions we do not find a trace of the true voyager, imbued with the spirit of observation and a desire to discover new facts in nature.

HANNO, 560 B.C.

HIMILCO.

While Hanno explored the western coasts of Africa, another Carthaginian sailor, Himilco, undertook a voyage of discovery in that part of the ocean situated to the north-west of Europe. An account of this voyage was extant in the fourth century of our era, and its main features have been preserved by the poet Festus Avienus. Beyond the Pillars of Hercules, to the west of Europe, the ocean is represented as stretching towards the horizon without limit; a favourable wind never blows, a breath from heaven never fills the sails, the air is enveloped in a mantle of mist, a thick fog covers the sea

[1] The Ophir of Solomon has been supposed to be situated in the south of Arabia, in India, and in the Bay of Sofala on the east coast of Africa. Each of these identifications has been supported by learned critics. In addition to these three principal views, others with more imagination have endeavoured to show that Ophir was situated in Malacca, in Brazil, or in Peru (see Dr K. von Boer, *Wo ist das Salomonische Ophir zu suchen? Historisch Fragen St Petersburg*, 1873; T. C. Johnston, Did the Phœnicians discover America? *Geog. Soc. California*, 1892).

[2] Herodotus, IV. 42. The Periplus of Necho has been the subject of much controversy. Necho or Neco, son of Psammeticus, who reigned from 610 to 594 B.C., on abandoning the canal he had begun to cut between the Nile and the Arabian Gulf, sent an expedition down the Red Sea, which, in the third year, returned by the Pillars of Hercules. The expedition is said to have been manned by Phœnicians. Herodotus states a circumstance which, he says, "I for my part do not believe, but perhaps others may," viz., that, while sailing round Africa, the navigators had the sun on the right hand. If this means that their shadows were thrown to the south in rounding Africa, as seems to be the case, it supports the view that the circumnavigation really took place (see H. Berger, Geschichte der wissenschaftlichen Erdkunde der Griechen, p. 39).

[3] Geogr. Gr. Min., ed. C. Müller, vol. i. p. 14.

[4] Pliny, Hist. Nat., v. 1.

at all times, and sombre vapours there obscure the light of day.[1] Himilco was not able to continue his route through this gloom, across this muddy ocean covered with sea-weed and inhabited by marine monsters. It was through such sombre colours that the ancients viewed the external sea to the west and beyond the coasts of Germany and Britain, to which they gave the names of *Mare cronium, pigrum, concretum, mortuum.* In Theophrastus[2] and in a compilation written about the middle of the third century before Christ,[3] there are other references to Carthaginian discoveries, which seem to indicate that they were acquainted with the weed of the Sargasso Sea. The mention of sea-monsters plunging among the sea-weeds in which the vessels were becalmed shows that the sea-weeds could not have been attached to the shore or to shallows, and is in favour of the view that the Carthaginians had reached the Sargasso Sea.

Character of the Phœnicians

To judge from the few details that have been transmitted to us by classical writers, the knowledge of the ocean possessed by Phœnicians and Carthaginians was of an essentially practical kind. In this phase of maritime exploration, the cruises and mercantile expeditions accomplished little more than an extension of knowledge with regard to the extent and limits of the different seas, the most elementary part of the science. What we know of the Carthaginians has been transmitted through the Romans, while our information regarding the Phœnicians of the eastern basin of the Mediterranean is derived from the Greeks. The Greeks profited by the discoveries of the Phœnicians and eventually drove them from the sea, of which they had so long been the masters. The less bellicose Phœnicians, when they encountered their rivals, sought new routes for their maritime commerce, which for centuries they had carefully concealed, thus preserving to themselves the monopoly of the rare products for which they went in search to great distances across the sea, such as amber, tin, silver, gold dust, pearls, and aromatics. The precautions taken by these peoples to hide their oceanic routes tended not a little to obscure the notions concerning the sea among the ancients. The Phœnicians and Carthaginians excited the imaginations of their rivals, when they attempted to follow them, by exaggerating the dangerous adventures of their distant voyages. Thus originated harpies, griffins of the Pontus Euxinus, Scylla and Charybdis, the gelatinous sea of the north, and other fables. Had the historical records of the Phœnicians been preserved, we should certainly have found in them more than the merest outlines of the knowledge of the sea as a result of their voyages. These sagacious and experienced sailors must have accumulated many important facts relating to the morphology of the ocean. A people that initiated such great enterprises and accomplished such extensive explorations, cannot have been composed solely of clever navigators, eager merchants, and bold explorers. There must have been in their midst men of learning who speculated concerning the origin of the phenomena of the ocean. We know little or nothing of

[1] R. F. Avienus, Ora maritima, vv. 115–130, 406–415.
[2] *Hist. Plant.*, iv. 6, 7.
[3] *Mirab. Auscult.*, p. 136.

their progress in astronomy. Perhaps they also kept this knowledge secret, for there are many indications that they were possessed of many of its practical applications to the art of navigation. At the dawn of history, and before all the other peoples of antiquity, we find them sailing over the open sea without a compass or coast to guide them. They even navigated the open ocean at night. The Phœnicians did this before the time of Homer, while the Greeks and Romans, for a long time after that period, never lost sight of the coasts, and sailed only during the day.[1]

THE GREEKS.

The notions with reference to the sea inherited by the Greeks from the Phœnicians appear to have been extremely vague, even regarding the Mediterranean, which must have been the best known to them. Greek philosophers and navigators first directed attention to the scientific problems of the ocean, and aided in solving them by their progress in branches of knowledge connected with physical geography. Their influence was profound, and traces of the oceanographical ideas of the Greeks survived for centuries in literature. The Greeks, so admirably endowed in most respects, had not a sufficient number of accurate observations to form a solid basis for induction; they did not possess the rigorous methods of modern science, which do not admit of deductions beyond the range of the observations. Their theoretical conceptions cannot, however, be passed over, any more than the ancient Greek myths relative to the earliest voyages of their race. "Popular myths," says Humboldt, "mixed with history and geography, do not altogether belong to the ideal world. If vagueness be one of their distinctive traits, if the symbols which cover the reality be wrapped in a veil more or less thick, the myths closely associated with them show, nevertheless, the first dawn of cosmography. The statements of primitive history and geography are not entirely ingenious fictions; the opinions which have been formed about the actual world are reflected in them."[2]

MYTHICAL VOYAGE OF ARGONAUTS.

The first step in the geographical history of the Greeks is the legendary voyage of the Argonauts, although this myth gives no certain facts regarding the physical geography of the sea. The poetical elaboration of the story took place, according to Grote, between 600 and 500 years before the Christian era. If the voyage has any foundation in fact, it was probably as much a Phœnician as a Greek adventure in search of gold.[3] All that can be said with reference to the poetical accounts of the wars of Troy is that, at the period immortalised by the genius of Homer, the Greeks were so familiar with navigation as to be able to transport an army across the Ægean Sea as far as the Hellespont.[4]

WARS OF TROY.

[1] The Phœnicians steered by the Pole star, which, from this circumstance, was named by the Greeks the Phœnician star (Enc. Brit., art. "Phœnicia"). The Greeks, it is said, steered by the Great Bear (Bunbury, *op. cit.*, vol. i. p. 34).

[2] Humboldt, *op. cit.*, tom. i. p. 112.

[3] The name *argo* is possibly of Phœnician origin (the Semetic word *arek*, long), having reference to the "long ships" or fighting ships as distinguished from the round or cargo ships. The *argo* may have been the first long ship built by the Greeks. The voyage of Argo is readily enough understood as the attempt of a people, ignorant of geography and physics, to combine in one narrative the Phœnician voyages in every quarter of the then known world, (see John Kenrick, History and Antiquities of Phœnicia, p. 92, London, 1855). Alexandrian critics confused the story by transferring the wanderings of Ulysses to the Outer Ocean, while retaining the idea of this ocean such as it was known to them.

[4] Bunbury, *op. cit.*, vol. i. p. 17.

Homer.

Notwithstanding the mythical and poetical elements in Homer, there are some details worth recalling. We find in his works the conception held by the Greeks of his time concerning land and sea. The earth is represented as a large disc with slightly elevated edges; the ocean, an immense external river with rapid currents and unknown boundaries. Homer does not admit that the ocean was a sea; the expression in his verses conveys the idea of a river. In the middle of the disc surrounded by the ocean is placed the Ægean Sea and its archipelagoes. All springs, streams, rivers, seas, and indeed all the waters on the earth were the offspring of the ocean, but the poet gives no indication that he regarded the internal sea as being in communication with the great ocean river. It is doubtful whether, at this period, the Greeks had even heard, through the Phœnicians, of the Erythræan Sea or of the external sea to the westward of the Pillars of Hercules, and they themselves had certainly never navigated these waters. It is scarcely necessary to add that they were absolutely ignorant of the northern and southern oceanic regions.

His cosmographical conceptions.

In the cosmographical conception of Homer the external borders of the ocean river served as a support to the transparent celestial vault. Everything seems to indicate that these conceptions of the world were derived by the Greeks from oriental sources, and these ideas, clothed by their poets in harmonious and mythical form, were perpetuated among the people down to the time of Hecatæus. The poems of Homer abound in admirable descriptions of the sea; from the sea the poet copiously borrows his comparisons and metaphors. This shows that the Greeks were familiar with the varied moods of the sea, and how much its grand phenomena struck their imaginations. It is always the poetic element which fixes their attention. Homer gives not a single geographical detail relative to the sea. He had not even a special name for the ocean, any more than the Greeks and the Romans during succeeding centuries had for the Mediterranean. (See Plate I.)

Scylla and Charybdis.

Even in the time of Homer there are indications that sailors guided their ships, during the night, by observing the constellations,[1] and, also, that the poet possessed very definite notions regarding winds favourable to navigation; thus when he speaks of Ulysses landing at Thrinakia, where he was detained for a month by contrary winds, Homer designates all the winds in a clear and characteristic manner. The whirlpools of the internal seas play a great rôle in the heroic expeditions—viz., those about Scylla and Charybdis. It is certain that the perils of those formidable points have been exaggerated by the imaginations of the poets. Yet the foundation of these legends reposes upon the phenomena presented by the sea in the neighbourhood of the Strait of Messina, where the tides and currents from two seas meet in a narrow channel.[2] The ancient

[1] Odyssey, v. 277.

[2] See in Thucydides for a good description of these dangers (iv. 24). Admiral Smyth (Mediterranean, pp. 178–182) admits that the difficulties in navigating this strait are such as to give rise to the dangerous reputation ascribed to them by the ancients (see Bunbury, *op. cit.*, vol. i. p. 61).

geographers knew all the difficulties of this passage, and correctly brought them into connection with the whirlpools of Homer.[1] The poet himself had no definite idea of their situation; he placed them in the far west, like the islands of Æolus and Circe.

Hesiod.

Hesiod touches on questions relating to the ocean only in an incidental manner; his general notions on land and sea resemble those of Homer. With Hesiod, the ocean stream is a perfect river.[2] Hesiod gives a catalogue of rivers flowing from the ocean and Tethys; it appears from several passages that land exists on the other side of the ocean, and that the extreme limit of the world is not the oceanic stream. Thus, with him, the Hesperides are in a land beyond the ocean.[3] The giant Geryones lived in the island of Erythea, across the ocean.[4] "The islands of the blest" are surrounded by the eddies of the sea. The Greeks were not long in abandoning the Homeric idea as to the ocean limit of the world. We may even see in these passages of Hesiod the first traces of some ancient myths, the most celebrated being that of Atlantis, which supposed the existence of inhabited regions beyond the confines of the land bordered by the ocean stream.

Eighth Century B.C.

Towards the end of the eighth century before our era, the Greeks commenced to employ larger ships in navigation, which permitted them to undertake more distant voyages with less danger; this had a beneficial effect on the progress of oceanography.[5] It was at this period that the range of geographical knowledge was extended by the establishment of Doric and Ionic colonies on the coasts of Southern Italy and Sicily. Soon afterwards colonists from the city of Miletus penetrated northward to the Pontus Euxinus. At the same time, some wandering pirates reached the delta of the Nile, and, in reward for services rendered by them to the king, commercial relations were established between the Greeks and the kingdom of Psammeticus, Egypt having, up to that date, been closed to all foreigners, as rigidly as were China and Japan down to a recent period.

Seventh Century B.C.

A few years after the opening up of Egypt, the oracle of Delphi ordered the inhabitants of the island of Thera to go forth and found a colony on the Libyan coasts. It is said that such was the ignorance of these islanders, at that period, of all that lay beyond the horizon of their habitual voyages, that no person could be found among them who knew where Libya was to which they were required to send colonists; the expedition was, however, organised a little later, and resulted in the foundation of Cyrene about 631 B.C. It happened about the same time that Colæus, the commander of a ship of Samos, was carried by east winds far to the west. After passing the coasts of Sicily, he traversed the

[1] Strabo, i. 2, 36.

[2] τελήεντος ποταμοῖο, referring very probably to its circular course, flowing round, and encompassing all things (Hesiod, Theog., vv. 242, 959.).

[3] Hesiod, *ibid.*, vv. 215, 216.

[4] Hesiod, *ibid.*, vv. 287–294. For the whole passage, see Bunbury, *op. cit.*, vol. i. p. 86.

[5] Thucydides, i. 13. According to this author the Corinthians were the first to build triremes; the Samians learnt the use of them from the Corinthians as early as 700 B.C. (see Bunbury, *op. cit.*, vol. i. p. 108).

Straits of Gades, and, landing at Tartessus, brought home from thence an invaluable cargo. This great Tyrian establishment, as well as the whole western portion of the Mediterranean, had, according to Herodotus, up to that time remained wholly unknown to the Greeks.[1] The Phocæans made frequent voyages to the Western Mediterranean towards the close of the seventh century, and in 600 B.C. the city of Massilia was founded by a colony from Phocæa.[2]

Sixth Century B.C.

Early in the sixth century B.C. the Greeks commenced to form new views with regard to the stream of ocean, and the Cimmerian darkness of the ancient poets. The old legends of the Homeric age were still reproduced at times among the poets of the sixth and fifth centuries B.C., for example, by Æschylus and Pindar, but they are archaic reminiscences, assuredly not confounded with the reality. The navigation of the Straits of Gibraltar was well known to be both dangerous and difficult; this is expressed by an adage found in Pindar[3]:—"Neither wise man nor fool gets beyond the Pillars of Hercules."

Ionian School.

Let us now cast a glance at the conceptions held by the philosophers of the sixth and seventh centuries B.C., and their speculations concerning the physical structure of the world and the phenomena of the sea. Thales of Miletus,[4] chief of the Ionian school, and recognised as the founder of physical science among the Greeks, is distinctly stated by Plutarch[5] to have been acquainted with the spherical form of the earth. This is evidently an error, for Aristotle represents him as teaching that the earth was supported on water, upon which it floated like a log or ship; earthquakes were said to have been caused by the agitation of the water. The speculations of his followers were even more singular than those of the master. Thus, Anaximander,[6] who is credited with the invention of the gnomon, and who was the first to represent the surface of the globe on a map, is said to have held that the earth was of cylindrical form, the inhabited part being the upper end of the cylinder.[7] Anaximenes,[8] a successor of Anaximander, held that the earth was of irregular, quadrangular form—a flat trapezium which was supported by the air beneath it as a consequence of its pressing down on it like the lid of a vase.[9]

Hecatæus.

Hecatæus of Miletus,[10] the most celebrated geographer of the Ionian school, constructed a new map of the world, and surveyed the geographical notions of the Greeks towards the end of the sixth century B.C. He gives some indications of the morphology of the sea, but, like all his predecessors, he admits the existence of the stream of ocean, and considers the

[1] Herodotus, iv. 152.

[2] The Phocæans employed penteconters in these voyages instead of the "round ships," a name applied to ordinary merchant vessels, possibly in view of hostile encounters with the Phœnicians (see H. Berger, Geschichte der Wissenschaftlichen Erdkunde der Griechen, p. 17; Vivien de St. Martin, Histoire de la Géographie, Paris, 1873, p. 73.

[3] Olymp., iii. 80.

[4] Flourished in the first half of the sixth century B.C.

[5] Plutarch, Plac. Phil., iii. 10.

[6] 610 to 547 B.C.

[7] Plutarch, Plac. Phil., iii. 10.

[8] Flourished in the latter half of the sixth century B.C.

[9] Aristotle, De Coelo, ii. 13, sec. 10; Plutarch, Plac. Phil., iii. 10.

[10] Flourished in the sixth century B.C.

MAP showing the PHŒNICIAN COLONIES and supposed extent of PHŒNICIAN VOYAGES AT SEA

VOYAGE OF THE ARGONAUTS according to THE TRADITIONS OF THE ANCIENTS

THE WORLD according to HOMER B.C. 1000

THE WORLD according to HECATÆUS B.C. 500

Caspian to be in communication with the external sea. The Nile takes its source in the same external ocean. It is not necessary to dwell on other cosmographical conceptions of the Ionian school; the spherical form of the earth, which must be regarded as the fundamental principle of all scientific geography, was unknown to them. (See Plate I.)

PYTHAGOREAN SCHOOL.

Pythagoras[1] and his followers, however, regarded the earth as a sphere,[2] not from a study of facts but rather from speculative considerations; they gave the earth a spherical shape, because they held that form to be the most perfect. It is asserted by some writers that Pythagoras taught to his chosen disciples the true doctrine that the sun occupies the centre of the solar system, and that the earth is only one of the planets revolving around it; and it is further affirmed that this knowledge was acquired from the Egyptians and Chaldeans.[3]

FIFTH CENTURY B.C. HERODOTUS.

In the fifth century B.C. there appeared one of the most remarkable writers of antiquity, Herodotus,[4] who abandoned speculative theories and gave his attention to the observation of facts. He may be considered the founder of the science of physical geography, Hecatæus of Miletus being, to some extent, his precursor; for, in addition to the cosmographical ideas we have mentioned above, Hecatæus gives much information concerning the coast towns of the Western Mediterranean. Herodotus had relatively little knowledge of the western regions and seas, while, on the other hand, he gives copious information about the east and north. He had learnt from the Greek merchants of the Pontus Euxinus that, contrary to the view of Hecatæus, the Caspian was entirely isolated from the ocean, and he knew its form and extent. Herodotus gives to the Palus Mæotis[5] an extent nearly equal to the Euxinus, although the latter is at least six times greater. Commentators and geographers, founding upon this estimate of the Greek historian, have concluded that great physical changes have taken place in the region of the Sea of Azov in recent times. Scylax, a century after Herodotus, estimated Lake Mæotis at one-half of that of the Euxinus.[6] Down even to the time of Ptolemy the ancients gave too great dimensions to this little sea. (See Plate II.)

FATHOMS USED TO MEASURE DISTANCES AT SEA.

It is not without interest to note that the estimates of the Pontus Euxinus are made in Herodotus by means of the ὀργυιά,[7] corresponding to the fathom (*brasse*, *faden*), which is always employed by sailors as a measure of depth. "In a long day," he says, "a ship usually accomplishes about 70,000 fathoms, and about 60,000 in the night." This employment of the word ὀργυιά indicates distinctly that this was not only a bathymetrical measure, but also a nautical measure of length, the place of which has been taken by the modern knot of navigation. Herodotus himself translates fathoms into stadia.[8]

The practical spirit of Herodotus concerned itself only with facts, and he dealt

[1] Flourished in the sixth century B.C. [2] Whewell, Hist. of Ind. Sci., ed. 3, vol. i. p. 115, London, 1857.
[3] Harkness, On the Magnitude of the Solar System, *Nature*, vol. l. p. 532. [4] 484 to 408 B.C.
[5] Sea of Azov. [6] Scylax, Periplus, 69. [7] The length of the outstretched arms.
[8] 100 ὀργυιαι, or fathoms, 600 feet = a cable's length = 1 stadium (see Bunbury, *op. cit.*, vol. i. pp. 176 and 209).

deadly blows at the idea of the philosophers and poets, that the earth was surrounded on all sides by the ocean; he himself went too far in the opposite direction, by affirming that the ocean did not extend to the north of Europe and Asia. He says:—"I cannot refrain from laughing a little at all those who undertake to describe the contours of the land without any facts to guide them, for example, who represent the ocean as embracing the entire world in its course, who make it round as if drawn with a pair of compasses."[1] He rejects the notion that the earth has the form of a disc, and that the ocean is a river; he combats this theory everywhere. No person, he argues, was able to say whether Europe was bounded by the sea to the north and east, but it was well known that it was bathed by the Atlantic to the west as Asia was by the Erythræan Sea to the south. Departing from this prudent reserve, he states that there is no manner of doubt that Africa is a peninsula attached to the continent by the isthmus of Suez, and surrounded at the south by the ocean. He evidently accepts this view as the true one, because he believed what had been affirmed with reference to the *periplus* of Necho around the continent of Africa.[2] With Herodotus, then, the external sea and the Erythræan Sea were one ocean, which must be regarded as one of the most important advances in a knowledge of the ocean basins. This is not the only addition this Greek writer has made to our notions of physical geography. He points out the regular tide in the Persian Gulf, a phenomenon which did not fail to strike the Greeks, unaccustomed as they were to any flux or reflux of the sea on their own coasts. He also discusses the formation of alluvium at the entrance of the Nile, and the size and configuration of the three continents.

In one single passage[3] Herodotus employs the word Atlantic to designate the sea to the west, but it appears evident from the incidental manner in which the word is used, that this name, here met with for the first time, must have been well known at the period. On the other hand, we do not find in his writings a special name for the Mediterranean.[4]

Socrates and Plato.

The ideas of Socrates[5] and Plato[6] concerning the habitable world do not touch directly on our subject, except with reference to the myth of Atlantis, concerning which it is necessary to say a few words, as this conception has not been without influence on studies intimately connected with oceanography.

Myth of Atlantis.

In this mythical story, Plato[7] supposes a great extent of land situated in the external sea to have disappeared in one day and one night beneath the waters of the ocean. Since that time, he adds, the Atlantic Sea has ceased to be navigable, its waters having become muddy and charged with clay derived from the engulfed land. Everything appears to show that, according to the ideas of Plato, this narration was a pure fiction; yet in succeeding centuries many attempts have been made to interpret this story by reference to geological phenomena,

[1] Herodotus, iv. 36.
[2] Herodotus, iv. 42 (see page 4 *ante*).
[3] Herodotus, i. 202.
[4] See Bunbury, *op. cit.*, vol. i. p. 221, note.
[5] Born about 469 B.C.
[6] Born 429 B.C.
[7] Plato, Timæus, c. 5. 6; Critias, c. 3. 8.

the theatre of which has been placed in the Atlantic.[1] The myth of Plato was in all probability suggested by the reports concerning the external sea which reached the early Greeks through the Phœnicians, who represented the Atlantic as shallow, muddy, and encumbered with sea-weed.[2] During the fifteenth century of our era, it was even supposed that in the celebrated myth of Atlantis, Plato described America; but there is nothing in Plato's myth to suggest a reference to the New World. Those who believe in the transformation of true oceanic areas into continental areas, and *vice versa*, in recent geological times, have supported their views by a reference to the Atlantis myth.[3] While this transformation has undoubtedly taken place in coast regions and shallow seas, there is little, if any, evidence of such changes in continental and oceanic areas properly so called.

FOURTH CENTURY B.C. SCYLAX OF CARYANDA.

The voyage of Scylax of Caryanda,[4] down the Indus and to the Persian Gulf, must be referred to the early part of the fifth century, but the Periplus of the Mediterranean which bears his name belongs probably to the first half of the fourth century B.C.[5] This Periplus of Scylax shows that the Greeks, at that time, had little knowledge of the sea which bathes the west of Europe. The remarks are limited to saying:—"Beyond the Pillars of Hercules there are many Carthaginian commercial stations, much muddy water, high tides, and open seas."[6] The writer was the first to give us a detailed account of the coasts of the Adriatic; we are also indebted to him for descriptions of the Pontus Euxinus. At the end of the Periplus there is an enumeration of the principal islands known in the Mediterranean, where twenty of them are arranged in the order of their size. In this list the Balearic Islands are not mentioned; a fact which shows how incomplete was the knowledge possessed by the Greeks of this period, regarding even the Mediterranean—the sea best known to them.[7]

THE PHOCÆANS.

Although the Greeks must be regarded as the founders of scientific geography, they are not known before the fourth century to have undertaken oceanic voyages of discovery, which are, in a way, the prelude of oceanographical researches. According to Herodotus,[8] the Phocæans were the first Greeks to trade in the Adriatic, to become acquainted with the Tyrrhenian Sea, and to venture on the waters of the Atlantic. The Phocæan colonists of Massilia (Marseilles) were the first to undertake naval enterprises on an extensive scale. In the fourth century before our era they sent an expedition to the North Sea, under the direction of the illustrious astronomer and mathematician, Pytheas,[9]

PYTHEAS.

[1] Quatre lettres sur le Mexique, par l'Abbé Brasseur; Donnelly, Atlantis, London, 1886; Daniel Wilson, The Lost Atlantis, Edinburgh, 1892.

[2] See *ante*, p. 6.

[3] The idea of Atlantis was developed in ancient times by Theopompus, contemporary and pupil of Ephorus; his geographical knowledge was very imperfect (see Bunbury, *op. cit.*, vol. i. p. 384.)

[4] Flourished at the end of the sixth century B.C.

[5] Niebuhr fixes the date at 360–348 B.C.

[6] Scylax, Periplus, 1.

[7] See Bunbury, *op. cit.*, vol. i. p. 394, and note B, p. 406.

[8] Herodotus, i. 163 (see p. 10, *ante*).

[9] His date is uncertain; he probably lived in the time of Alexander the Great, in the second half of the fourth century.

who, at that distant period, had determined the latitude of Massilia with such exactitude, that twenty centuries afterwards Gassendi found it correct to within a few seconds. It is probable that the knowledge which Pytheas possessed in astronomy recommended him to his fellow-citizens as the chief of this expedition, the object of which was to rediscover the sources of the riches brought from distant parts by the Phœnicians and Carthaginians. Not only did Pytheas succeed in his mission, but his cruises yielded much new information concerning the ocean. A second expedition was sent to explore the coasts of Africa under another scientific man, Euthymenes. The records of this voyage are almost wholly lost, but it was reported that Euthymenes reached a river where crocodiles and hippopotami were seen in great numbers.[1]

Voyage of Pytheas to Britain.

Pytheas sailed round Spain and France to Britain. He appears to have traced out a considerable part of the east coast of Britain and to have visited the German coast on the other side of the North Sea. He brought home accounts of the land, six days' sail beyond Britain, named Thule, a name which he first introduced into ancient geography. He stated that the sea beyond Thule became thick and sluggish, like neither land nor sea, but resembling the substance of the jelly-fish, called *Pulmo marinus*, which he had himself seen; in this description we have the first hint as to the conditions prevailing in Arctic Seas.[2] He is said to have recorded as a fact that the length of the day at Thule was twenty-four hours at the summer solstice, from which he conceived it as lying under the Arctic circle, or parallel of $66\frac{1}{2}°$ N. The Phocæan explorer likewise brought home accounts of the amber coasts, but it does not appear that these accounts, or those concerning Thule, rested on personal observation, or justify us in following those authors who extend the journey of Pytheas to the coasts of Lapland and the Baltic.[3]

Of the two works which Pytheas wrote, his first, a description of the ocean, has not been preserved; it contained his observations on the north-western countries and on the icy sea. The second, which bears the title of Periodus or Periplus, contains his voyage to the amber coasts of the Baltic, and has been partially preserved in Pliny, Strabo, and Polybius. Ancient writers do not appear to have been altogether just in their estimate of the learned Massilian. Many of his facts were regarded as being deficient in exactness; the same was said of the observations of Herodotus and Marco Polo, but at the present day the critic has vindicated these observers. There is no doubt that before the time of Pytheas the chart of the seas to the west of Europe was almost a blank, and that down to the time of Strabo it retained the form given it by Pytheas. He was the first investigator of the Atlantic, and by the extent of his observations, as well as by the nature of his researches, the voyages of Pytheas may be considered as true scientific

[1] Athenæus, ii. 87.

[2] As a matter of fact, this sea is, in addition to jelly-fish, sometimes so encumbered by gelatinous masses of Diatoms that fishermen find it impossible to work their nets.

[3] Elton, Origins of English History, chap. ii.; Rhys, Celtic Britain, London, 1882; Markham, *Geógr. Jour.*, vol. i. p. 520, 1893.

cruises in a part of the ocean which, after him, was penetrated by no navigator for four centuries.[1]

The high tides in the estuaries of Britain are said to have made a profound impression upon Pytheas, and to have first suggested to him a theory of the tides. However this may be, Pytheas undoubtedly gave the Greeks a true notion of the tides in attributing them, two thousand years before Newton, to the influence of the moon.[2]

To Aristotle,[3] who was a contemporary of Pytheas, we are indebted for many important additions to oceanography; an elevated intelligence, like that of the Stagyrite, must necessarily have been attracted to the study of the ocean, in the capacity both of naturalist and of thinker. That the sea was the object of his meditations and researches, is indicated by a legend as to the manner of his death; it is reported that, despairing of ever being able to find the interpretation of the movements of the waters of the Strait of Euripus, he threw himself into the whirlpool. The speculative philosopher often appears beneath his observations, and his works abound in judicious views concerning the phenomena of the sea, bearing at once the stamp of remarkable sagacity and of an earnest and investigating mind. His doctrines relating to the ocean had so much influence that his ideas upon the subject were reproduced among the Romans and down to the close of the Middle Ages. ARISTOTLE.

Aristotle's observations are scattered through his works on Natural History and Physics, and the second book of his Meteorology commences with what may be called a treatise on oceanography. He there deals, in particular, with the relations of land and sea. He regards the earth as a sphere, placed in the centre of the universe, round which other celestial bodies revolve. He establishes its spherical form by the fact that all things gravitate towards the centre, and by reference to the shadow of the earth during eclipses.[4] He regards the habitable world as being confined to the temperate zone; all beyond the tropic to the south is uninhabitable from heat, while the land below the Great Bear is uninhabitable from cold. He adds that there must be in the southern hemisphere a temperate zone corresponding to the northern one, but does not say that it is inhabited. He ridicules the idea that the inhabited world is circular—a notion which appears to have been prevalent in his day as well as in the time of Herodotus. HIS GENERAL VIEWS ON COSMOGRAPHY.

Humboldt believes that the following passage must have had much influence in leading up to the discoveries of Columbus:—"It appears," says Aristotle, "those are not

[1] St. Martin, *op. cit.*, pp. 101–109; Bunbury, Ency. Brit., art. "Pytheas."

[2] Plutarch, Plac. Phil., iii. 17. Timæus, who died about 265 B.C., and who contributed much to the extension of geographical knowledge of the western parts of Europe, was far from giving such an interpretation. He stated that the flux and reflux of the ocean were due to the rising of the great rivers which discharged themselves from the mountains of Gaul. Their risings caused the water of the sea to retire, and when the rivers were no more swollen the reflux occurred (Timæus, Frag., 36; Plutarch, Plac. Phil.).

[3] 384 to 322 B.C.

[4] In these cosmic views Aristotle followed those of the astronomer, Eudoxus of Cnidus, who lived a generation before him.

so very far wrong who suppose the region about the Pillars of Hercules and that about India to be contiguous, and that there is but one sea (in the part opposite to the inhabited world), and they point by way of proof to the elephants, these animals being found in both regions, though at the extremes of the earth, this fact showing that the extremes are really near each other."[1]

Many quotations might be given to shew what correct ideas Aristotle held concerning the general configuration of the world, and the horizontal extension of continents and seas. The habitable world is divided into islands and continents; our world itself is but an island surrounded by a sea called the Atlantic. In a more restricted sense the Atlantic is only a part of the external sea which bathes the western confines of habitable land, the other parts of the environing sea having then special appellations; to the north the Boreal or Cronian, to the east and south the Southern or Erythræan. The surrounding ocean sends arms into the land, forming special and peculiar seas. At the south, the Indian Gulf, the Persian Gulf, the Arabian Gulf, are formed by the Erythræan. At the west the Internal Sea (Mediterranean) penetrates from the Atlantic into the bosom of the land by the narrow passage of the Columns of Hercules. The Mediterranean itself ramifies into several seas, shut in by the diverse peninsulas which project from Europe and Asia. Of these seas the most advanced into the land is the *Pontus*, or the sea *par excellence;* it has parts called whirlpools (βαθέα) so deep that the lead has never reached the bottom. With the exception of these points the depth of the Internal Sea goes on increasing towards the west. The Pontus is deeper than the Lake Mæotis, the Ægean deeper than the Pontus, the Tyrrhenian and Sardinian Seas deeper than all the others.[2] These bathymetrical data, being the first found in the writings of antiquity, have much interest notwithstanding their want of exactness. Before Aristotle, navigators must necessarily have possessed a knowledge of depths, at least at certain determinate points, but Aristotle was the first, apparently, to generalise these bathymetrical notions of the internal seas of Europe.

His Views on the Distribution of Land and Water.

Bathymetrical Data.

As illustrating the slow movements and changes which continents and seas undergo, Aristotle remarks in his Meteorology that the Sea of Azov (Palus Mæotis) was being filled up, and that it would ultimately become land.[3] He mentions the currents which flow from the Sea of Azov into the Black Sea, and from the Black Sea into the Ægean, and attributes the cause of these movements to the inequalities of depth in these seas. It was especially to the seas in the neighbourhood of Greece that he directed his attention; he had no new views in regard to the great external ocean, which he stated, in accordance with the ideas generally admitted in his time, to be muddy and little agitated by winds (ἄπνοα).[4]

Marine Currents in Black Sea and Ægean.

[1] Aristotle, De Cœl., ii. 15; Berger, *op. cit.*, p. 142.

[2] Aristotle, Meteorologica, ii. 12-14; Berger, *op. cit.*, p. iii.

[3] Aristotle, Meteorologica, i. 14, sec. 29.

[4] Bunbury (*op. cit.*, vol. i. p. 398) says it is remarkable that no other notice of the ocean or its tides is to be found in the Meteorologica: indeed, the very name of the ocean only occurs in one passage in this treatise in reference to the opinions of "the ancients" concerning it (Meteor., i. 9, sec. 6).

THE WORLD
according to
HERODOTUS
B.C. 450

THE WORLD
according to
DICÆARCHUS
B.C. 300

The Edinburgh Geographical Institute

He states that the Caspian is entirely isolated.[1] Herodotus, as has been stated, held the same opinion, yet, in spite of all the authority of Aristotle and his predecessor, this correct notion was abandoned from the time of Alexander to that of Ptolemy.

Aristotle's researches on marine animals were of distinct scientific value. He named and described, more or less minutely, one hundred and sixteen species of fishes, about twenty-four species of Crustaceans and Annelids, and some forty Molluscs and Radiates, making a total of one hundred and eighty species inhabiting the Ægean Sea; and the student is still reminded of his study of the anatomy of *Echinus*, by the significant name of "Aristotle's Lantern" applied to its masticatory apparatus. His Researches on Marine Animals.

One of Aristotle's pupils, Dicæarchus,[2] adopted a useful modification in the construction of charts; he divided the known world by a longitudinal line, in the sense of our equator, along which stadia were marked. The maps of Hecatæus and Anaximander were merely representations or pictures, without any scale. Thanks to this graduation of Dicæarchus, it was possible to record in a more precise manner than formerly the various journeyings by land and sea. (See Plate II.) Dicæarchus.

Theophrastus,[3] another disciple of Aristotle, has preserved notices of the little known regions beyond the Pillars of Hercules. He states that the Phœnicians of Gades, driven by east winds, had discovered after four days' navigation, shallow banks covered by certain kinds of sea-weeds, where tunny-fish abounded, a prodigious number of which were captured. He also reports that, at a distance of several days' voyage from the Columns, they discovered a large island, uninhabited, fertile, covered with woods, and with navigable rivers. It was partially colonised by the Carthaginians, but subsequently abandoned. This is the earliest notice of the Fortunate Islands of the west, so often referred to by ancient geographers. The island is spoken of in such a manner as to identify it with Madeira, but some authors have suggested that America is here indicated.

To the time of Aristotle belongs the voyage of Nearchus,[4] who conducted the fleet of Alexander from the mouths of the Indus to those of the Euphrates. This is often regarded as the first navigation of the Indian Ocean, the voyage of Scylax in the same seas being forgotten or disbelieved. Arrian and Pliny[5] have preserved a full and authentic record of this remarkable cruise, which, however, had no great influence on commerce or civilisation, and made no special additions to our knowledge of the ocean. Nearchus.

The Ptolemies—the successors of Alexander in Egypt—showed a remarkable solicitude for the sciences. Among the writings of the many learned men of the Alexandrian school those of Eratosthenes,[6] on geodesy, astronomy, and geography, are specially worthy of notice, from their great influence on the progress of geographical investigation. They, in particular, prepared the way for those of Hipparchus. It appears from the statements Third Century B.C. Eratosthenes.

[1] A different opinion is attributed to him in the treatise De Mundo, but that work is generally regarded as spurious.

[2] 326 to 296 B.C.

[3] Flourished about the commencement of the third century B.C.

[4] Took place in 325 to 324 B.C.

[5] Pliny, Hist. Nat., vi. 23 *et seq.*

[6] 276 to 196 B.C.

of Strabo that Eratosthenes made it one of his special objects to reform the map of the world,[1] and to construct it on more scientific principles; his methods were strictly scientific, and he may be regarded as the father of systematic geography. Eratosthenes adopted the views held by Aristotle and Euclid[2] regarding the figure and position of the earth, looking upon it as a sphere placed in the centre of the universe, around which the other celestial bodies revolved every twenty-four hours, the sun and moon having independent motions of their own. For all practical purposes, then, his views did not differ greatly from those of the modern geographer, except in the difference between the geocentric and heliocentric standpoints. He estimated the distance between Syene and Alexandria at 5000 stadia, and regarding this as one-fiftieth of a great circle of the sphere, calculated the circumference of the earth to be 250,000 stadia (equivalent to 25,000 geographical miles), a surprising approximation to the truth. From this he estimated that on the parallel of Rhodes and the Pillars of Hercules, the circumference was about 200,000 stadia. The habitable world he regarded as a little more than a third of the circumference in that latitude; the interval of two-thirds he conceived to be filled up by the sea, and observes:—"If it were not that the vast extent of the Atlantic Sea rendered it impossible, one might even sail from the coast of Spain to that of India along the same parallel."[3] This is the first record of theoretical views on the possibility of circumnavigating the globe. He divided the space occupied by the habitable world by lines at intervals parallel to the equator, and he drew a meridian line at right angles to these, passing through Alexandria, thus introducing what we now call parallels of latitude and meridians of longitude. His map was most defective, arising chiefly from the erroneous calculation of distances, for the measurement of ordinary distances was of the rudest description, more especially with regard to journeys by sea. Ancient navigators had no means of reckoning analogous to the modern log; distances by sea were really nothing more than the conversion of the number of days or nights occupied by the voyages into stadia. (See Plate III.).

PARALLELS OF LATITUDE AND MERIDIANS OF LONGITUDE INTRODUCED.

Eratosthenes believed that Africa was surrounded to the south by the sea, as is evident from the frequent employment of the word Atlantic in reference to the Indian Ocean, and Strabo tells us that he considered the Erythræan Sea and the Western Ocean as one and the same body of water.[4]

Eratosthenes had the courage to assert that Homer was ignorant of regions not immediately adjacent to Greece, and he gave much offence by saying that people would never discover the real localities described in the Odyssey—the islands of Æolus, Circe, Calypso—until they had found out the cobbler who had sewn up the bag of Æolus.

Eratosthenes is said to have made most extensive use of a treatise "Concerning Ports," drawn up by Timosthenes, a native of Rhodes, who was admiral of the Egyptian

[1] Strabo, ii. 1, 2. [2] Lewis, Historical Survey of the Astronomy of the Ancients, pp. 187, 188, London, 1862.
[3] Strabo, i. 4, 6; Bunbury, op. cit., vol. i. p. 627 (compare passage from Aristotle, page 15 *ante*). [4] Strabo, i. 3, 13.

fleet under Ptolemy Philadelphus. As that work is totally lost, it is impossible to judge of the real extent of the obligations of Eratosthenes to his predecessor; but it is evident that such a practical guide to the mariner must have contributed materially to the more definite geographical knowledge of seas and coasts. This work of Timosthenes may be regarded as the precursor of the modern Sailing Directions issued by the British and other Hydrographic Offices. Timosthenes also introduced for the first time the arrangement of countries according to the winds that blew from different quarters with reference to Alexandria, that is to say, according to different points of the compass.[1]

PRECURSOR OF THE MODERN SAILING DIRECTIONS.

Some of the conceptions of Strato of Lampsacus,[2] which Eratosthenes adopted, may here be summarised in a few words. He held that the Euxinus and Mediterranean were formerly completely closed seas that stood at a much higher level and that they burst their barriers and gave rise to the Straits of the Bosphorus, the Hellespont, and Gibraltar. As proof of this theory, he cited the presence of marine shells far in the interior of Libya, as well as the deposits of salt in the same region. It is very improbable, to say the least, that the sudden disruption adduced by Strato and Eratosthenes suffices to account for these straits, although the speculation has been revived in modern times.[3] The observations with reference to marine shells have a great significance from a geological standpoint; they constitute one important fact in the science of the earth, but the presence of these shells in the far interior of lands cannot be explained in this manner. It is not without interest to recall that Strato, to support his hypotheses, records the existence in the Strait of Gibraltar of a submarine bank uniting Europe and Africa; it was this tongue of land which formerly joined the two continents. The presence of such a bank has been proved, but at too great a depth to make it at all probable that it was known by soundings to the ancients. The philosopher of Lampsacus and Eratosthenes knew, however, that certain parts of the Mediterranean—for instance, the sea about Sicily and Sardinia—were deeper than the rest of the basin.

STRATO OF LAMPSACUS.

Hipparchus,[4] the greatest astronomer of antiquity, was posterior to Eratosthenes by about half a century, and, although he wrote more as an astronomer than as a geographer, his name is associated with the important reform of introducing projections in the tracing of charts and maps. He clearly conceived the idea, afterwards adopted by Ptolemy, of a map of the habitable world, on which every important point should be laid down according to latitude and longitude, determined by astronomical observations, although the construction of such a chart was, at the time, wholly impossible in practice. He drew circles of the sphere on the maps, representing the meridians by convergent curves. This new method had a great influence upon the study of the distribution of land

SECOND CENTURY B.C. HIPPARCHUS.

MAP PROJECTIONS INTRODUCED.

[1] Strabo, ix. 3; Bunbury, *op. cit.*, vol. i. p. 589.

[2] Flourished in the third century B.C.

[3] See Admiral Smyth, *op. cit.*, pp. 114–122; M. Dureau de la Malle, Géographie Physique de la Mer Noire, de l'Intérieur de l'Afrique, et de la Méditerranée, Paris, 1807; N. Andrussow, Sur l'État du Bassin de la Mer Noire pendant l'Époque pliocène, St. Petersburg, 1892.

[4] Flourished from about 162 to 125 B.C.; said to have been born 190 B.C.

and water; each new point on the globe, when correctly determined, could be placed on the map with great exactness. At this time the science of oceanography may be said to have been founded. The navigator could henceforth direct his vessel into unknown seas, could return by the same or another route, and could point out to others the course he had followed. (See Plate III.).

Hipparchus regarded the whole habitable world as divided into eleven climates or zones of latitude, for each of which he indicated the length of the longest day. He had also a dim idea of connecting distant points by a kind of triangulation similar to that made use of by modern geographers. He did not admit that the Atlantic and Indian Oceans were connected towards the south of Africa, or that the former was united with the sea that bathes the northern shores of Scythia.[1] These views were apparently based on some observations of a Babylonian author, named Seleucus, with reference to the tides, which appeared to Hipparchus incompatible with the idea of a circumfluent and continuous ocean.

Polybius.

The historian Polybius,[2] a contemporary of Hipparchus, in like manner, did not admit it as proved that the habitable world was surrounded by the ocean.[3] This author had more advanced ideas regarding marine sedimentation than his predecessors; he points out that in the Palus Mæotis the rivers bring down considerable quantities of sediment, and estimates the time it would take for the fluviatile alluvium, not only to fill up the Palus Mæotis, but also the Pontus Euxinus or Black Sea.[4] The ideas of Polybius, from a geological point of view, are most reasonable, but the rate of encroachment has been much slower than he supposed during the two thousand years which separate us from the time when he wrote. The modification in these seas has not been very appreciable, for Polybius reports that in his time the greater part of the Sea of Azov was only from 5 to 7 fathoms deep, and the same depths are marked on modern hydrographic charts.

Polybius also gives a detailed evaluation of the dimensions of the Mediterranean. Its length from the Strait of Gibraltar to Seleucia in Syria he gives at about 2440 miles, or 19,520 stadia,—a calculation nearer the truth than that of Eratosthenes, and short of the real length by only 500 stadia—and to it he assigned a width of 3000 stadia. This was considerably less than the reality, and caused him to bring the coasts of Gaul and Liguria much too far towards the south.[5] Polybius had probably received some dim, floating tradition of the populous and fertile regions south of the Soudan, for he states that the immediate neighbourhood of the equator is much less hot than the torrid zones on either side, and that it was habitable—indeed, inhabited.

Crates of Mallus.

About this time Crates of Mallus[6] is said to have constructed the first globe on which the Atlantic Ocean is extended to the south pole. A corresponding ocean is placed on

[1] Strabo, i. 1, 9.
[2] 204 to 122 B.C.
[3] Polybius, iii. 38.
[4] Polybius, iv. 39–42.
[5] See Bunbury, *op. cit.*, vol ii. p. 35.
[6] Flourished about 150 B.C.

THE WORLD
according to
ERATOSTHENES
B.C. 220

THE WORLD
according to
HIPPARCHUS
B.C. 150

The Edinburgh Geographical Institute

the other hemisphere. In the belief that only water could occur in the torrid zone, an oceanic belt ran along the equator. In the four segments thus produced four land areas were placed, only one of which was known to the ancients.

Artemidorus,[1] who flourished about the end of the second century before our era, gives accounts of voyages around the Red Sea, the Black Sea, and the Mediterranean. This author is said to have made much use of the writings of a predecessor, Agatharchides,[2] who correctly referred the inundations of the Nile to heavy rains in Ethiopia. One passage throws some light on the navigation of this time. Agatharchides says that persons sailing in vessels carrying cargoes could, with a favourable wind, reach Rhodes in ten days from the Palus Mæotis. Rhodes was only four days from Alexandria, and ten days' sail up the Nile was sufficient to reach Ethiopia. A voyage of twenty-four days was thus sufficient to pass from the coldest regions of the earth to the hottest. ARTEMIDORUS AND AGATHARCHIDES.

The cruises of Eudoxus of Cyzicus[3] merit a few remarks because of their character as voyages of exploration, being in this distinguished from all others of ancient times, which were undertaken generally with the sole object of carrying on barter or extending dominion. Eudoxus, like many others, thought that the Atlantic communicated with the Erythræan Sea,[4] and, after some successful voyages from Egypt to India, made several voyages from Gades with the object of finding that communication. Cruising along the dangerous coast of Africa without the aid of a compass, he was compelled to return, after repeated attempts, without accomplishing his mission. What is known of his expeditions gives few geographical indications, but Eudoxus was one of the race of discoverers who have, from epoch to epoch, contributed so much to the extension of geographical knowledge.[5] EUDOXUS OF CYZICUS.

Posidonius, who flourished in the first century before our era, was specially attracted by questions of physical geography. He visited Spain in order to see the External Sea with his own eyes, to observe the constellations, to measure the tides, and to judge for himself concerning the popular legend which related that the sun, when sinking into the Western Atlantic, made a hissing noise, as when a red-hot body is plunged into water. Strabo has preserved many scattered notices of the writings of Posidonius, and, especially, gives an analysis of his work on the ocean. Posidonius, having estimated the circumference of the globe at 180,000 stadia, and the length of the habitable world FIRST CENTURY B.C. POSIDONIUS.

[1] See Bunbury, *op. cit.*, vol. ii. p. 61.

[2] Flourished about 116 B.C.

[3] Took place between 117 and 111 B.C.; see Lindsay, *History of Merchant Shipping and Ancient Commerce*, vol. i. p. 81, London, 1874.

[4] Eudoxus, in his first voyage to India, took with him, as pilot, an Indian who had been picked up half-dead on a ship in the Arabian Gulf, having been driven by gales from the coasts of India. In his second voyage, Eudoxus himself was driven on the eastern coast of Africa, beyond Ethiopia, where he found the prow of a ship which was said to have come from Gades; this he brought to Egypt and exhibited in the market-place, and on this circumstance based his belief in the possibility of circumnavigating Africa. Strabo reproaches Posidonius for believing this old wife's story (Strabo, ii. 3, 5; see Bunbury, *op. cit.*, vol. ii. p. 77).

[5] See St. Martin, *op. cit.*, p. 152. In the fifth century B.C., a Persian nobleman, Sataspes, failed, like Eudoxus, in the attempt to round Africa from the Atlantic.

Posidonius on the Size of the Earth

at 70,000 stadia, which he considered half the circumference on the parallel of Rhodes, concluded that a vessel undertaking a voyage from the west of Spain with an east wind ought to arrive at India after a navigation of 70,000 stadia.[1] We thus find him, like Eratosthenes, speculating on the circumnavigation of the world many centuries before Columbus. He did not doubt that Africa could be circumnavigated, and in support of that view he cites the voyages of Eudoxus.[2] During his sojourn at Gades, he observed not only the daily flux and reflux of the tide, but its monthly variations, which he attributed to the influence of the diverse phases of the moon; he showed, indeed, that the high tides always coincided with the full moon, and the lowest with the last or intermediate quarters of the moon.[3]

Posidonius was the first to record the appearance of a new volcanic island in the Lipari group; his description of the appearances which accompanied the formation of the island does not differ from that given by modern observers of similar phenomena. The movements of the land caused by earthquakes and volcanic outbursts taught him the modifications which the surface of the globe might undergo under the influence of these forces. He even went so far as to admit that the Atlantis of Plato might not be a pure fiction, and that an island, equal to a continent, might really sink into the depths of the ocean by the dislocations to which the earth's crust is subjected.[4]

According to Posidonius, the sea about Sardinia was the deepest of known seas; it had been "measured" down to "somewhere about" 1000 fathoms. It would have been interesting to know the methods employed by the ancients in these deep soundings, but the author gives no information on the subject.[5] This may be considered the first account of a deep-sea sounding, and, for that reason, deserves to be noticed. Before we meet with another observation of this nature many centuries pass away; indeed, not till the time of the celebrated Portuguese navigator, Magellan, do we find a renewal of attempts to sound the deep sea.

The Romans

When the Romans had extended their dominions to Egypt, they were able to acquire the geographical knowledge possessed by the school of Alexandria, but the genius of this conquering people was not directed towards scientific researches. The science of oceanography was not advanced among them, as among the Greeks, by the speculations of philosophers, by the observation of natural phenomena, or by commercial relations. It seems natural to expect that the Romans, who had carried their arms throughout nearly all the world known to the ancients, should have left some important documents relating to the physical aspects of nature in the regions over which they had extended their sway; few Latin writers have, however, made contributions to

[1] Strabo, ii. 3, 6. This estimate of the circumference of the globe was accepted by the later Greek geographers, and even by the astronomer Ptolemy, in preference to the more correct one of Eratosthenes.

[2] Strabo, ii. 3, 4. [3] Strabo, iii. 5, 8. [4] Strabo, ii. 3, 6.

[5] Strabo, i. 3, 9; see Bunbury, *op. cit.*, vol. ii. pp. 93–100.

geography. Although the Romans extended their rule over a great extent of coast bordering on the Atlantic, they never organised any voyages of discovery into this outer sea, after the manner of the Carthaginians and Greeks. They have given no definite information concerning the coasts of Africa, and relatively little about the shores of Europe. They were essentially a warlike and practical people, with politicians, jurists, encyclopædists, and historians, but few philosophers who occupied themselves with the operations of nature; the commercial stimulus was awanting to induce them to undertake voyages of exploration. Horace's system of winds, several passages of Virgil on astro-meteorology, the statements concerning geological phenomena in the works of Ovid, and notices of the action of water in modifying the surface of the globe in the work on architecture by Vitruvius, all show a spirit of observation; but, generally speaking, if we deduct what the Romans had received from the Greeks, there is little relating to oceanography that can be regarded as original among the writings of Latin authors. As Vivien de St. Martin remarks, however, never was a period more favourable than the reign of Augustus for the composition of a great work on descriptive geography. The Roman rule, spread as it was over more than half of the then known world, and attached to the remainder by political and commercial relations, created a propitious state of matters for an undertaking of this kind by furnishing to the geographer a ready means of investigation. A man appeared to carry out this work, for which the time was ripe, but this man was a Greek, Strabo,[1] who produced the most important extant geographical work of antiquity.

STRABO.

This celebrated geographer deals in a special way with problems relating to oceanography.[2] All things on the crust of the earth, according to Strabo, are in a continual state of change, and the present relief of the surface of the globe is due to these modifications. Under the influence of earthquakes and volcanic eruptions the land is subjected to movements, oceanic waters invade the land when the bed of the ocean rises, and they retire when the bed sinks; besides, these movements can be more easily produced beneath the sea, where the earth is, as it were, kneaded and made plastic by the water. He states that pelagic islands are of volcanic origin; the greater islands, situated near the land, have been detached from the continents by dislocations; the continents themselves are subject to oscillations, and might have been raised from the bosoms of the various seas. Running water works profound modifications on the surface of the land, but these changes are conditioned by the nature of the country through which streams and rivers pass. Torrents descending from mountains have a great erosive power, and the same is the case with rivers which flow over soft or sandy grounds; both spread out on the plains and transport to the sea immense quantities of alluvial matter. The sediment

HIS VIEWS ON THE SCULPTURING OF THE CONTINENTS.

[1] Born about 60 B.C. The year of his birth cannot be determined with certainty.

[2] In this *résumé* of Strabo's doctrines we have followed H. Fischer, Ueber einige Gegenstände der physischen Geographie bei Strabon, als Beitrag zur Geschichte der alten Geographie, Wernigerode, 1879.

from rivers is not transported to great distances, for matter in suspension is arrested by the movements of the sea; the bed of the ocean is not, in consequence, filled up so rapidly as one would think, but the places near the coasts are loaded with sandy materials, and it is there that the greatest modifications take place. Finally, he attributed to winds an active part in the changes taking place at the surface of the globe. To the combination of all these forces he attributes what has since been called the sculpturing of the continents.

His Views on the Level of the Ocean.

As to the form of the oceanic basins and the relief of the bed of the sea, he believed that there were valleys and mountains as on emerged land. All the seas which are united together, and all the parts of the great ocean which surround the known world, have the same level, the surface of their waters is spherical, and the centre of this sphere coincides with the centre of the earth; this notion cannot but be regarded as a great advance on that of Eratosthenes, who asserted that not only different seas but certain regions of the same sea had different levels, which latter view is now believed to be true to a certain extent, although Eratosthenes did not prove it. Strabo believed that this equilibrium was only established after the Black Sea and Mediterranean had burst their barriers, in the manner described by Eratosthenes and Strato. The continuous current flowing from the Black Sea through the Bosphorus chiefly induced him to adopt this theory, but he rejected the view of those writers who argued that the sediment brought to the Pontus Euxinus by rivers could have any considerable effect in filling up that sea and causing it to overflow. In speaking of waves, Strabo points out that whatever their force may be, it increases as the waves approach the shore—this recrudescence of the wave on the coast does not depend on the force of the wind, for the phenomenon takes place in a calm or with the wind off shore. He likewise points out the relation between the length of the coast-line of a country and its area, and the influence of this purely geometrical fact on civilisation, whose first instrument of transmission is the sea. It is somewhat odd that Strabo makes no mention of currents in the Mediterranean, although these are sufficiently pronounced in some instances. Strabo suggests that besides the world known to the Greeks and Romans, other continents or other worlds might yet be discovered inhabited by different races of men.[1] Enough has been said to show the remarkable correctness of the observations and views of this celebrated Greek; many of them approach the conceptions of modern geology, and have been confirmed by modern research. (See Plate IV.)

Hippalus. The Monsoon Winds.

Strabo does not appear to have been acquainted with Hippalus, an Egyptian navigator, who lived about the same time, and proved the regular alternations in the direction of the monsoons of the Indian Ocean, and profited by the discovery to open up a route across the high seas between the shores of the Red Sea and India.[2] The monsoon

[1] Strabo, l. 4, ii. 5.

[2] *Peripl. Maris Erythræi*, 57, ed. Müller; Pliny, Hist. Nat., vi. 23, sec. 100; Vivien de St. Martin, *Le Nord de l'Afrique dans l'antiquité*, p. 269, Paris, 1863.

wind was called Hippalus in honour of this navigator. Coast routes, followed up to his time, were abandoned, and a fresh impetus was given to voyages in oriental waters.

Pomponius Mela,[1] who belongs to the same epoch, gives a few details referring to the morphology of the ocean. He points out that four seas are, so to speak, deducted from the great ocean that surrounds the world, and penetrate into the bosom of the land; the Scythian Ocean thus forms the Caspian, arms of the Indian Ocean form the Persian and Arabian Gulfs, and, lastly, a fourth sea runs into the land from the west, but is designated by no special name. Up to this period the Romans had no other appellation for the Mediterranean than that of *Mare Nostrum*.[2] Mela does not even employ the name *Mare Internum*, which is sometimes met with in Pliny's writings. Solinus[3] was the first to make use of the word Mediterranean.[4] Mela refers to the existence of the continent of the Antichthones, in the southern temperate zone, separated from the south of Africa and Asia by the Ethiopian Sea, the Red Sea, and the Indian Ocean, but inaccessible on account of the intervening torrid tract. This hypothetical continent includes the island of Ceylon, and is, indeed, in a sense, an immense extension of that island towards the west.[5] (See Plate IV.). POMPONIUS MELA.

The philosopher Seneca[6] applied himself with ardour to the study of nature, and his seven books of Physical Investigations (Quæstiones Naturales) may be considered as presenting a general view of the knowledge of the ancients concerning the natural sciences. He supposes that the world, at its origin, was a chaos, in which the elements dissolved in the water separated out in the course of time. Igneous action, vigorous at first, became extinguished finally, and there remained only water at the birth of the actual world. He divides the waters of the globe into (1) oceanic waters, which are from all eternity, and form the principal mass, the source from which all others are derived; (2) subterranean waters, which circulate in the faults of the subsoil, and appear at the surface in the form of springs; (3) waters which circulate or remain stagnant on the top of the soil; (4) waters in the form of vapours disseminated in the atmosphere. He has very exact notions on evaporation, but he supposes that all the elements can be derived the one from the other, and that water, in particular, may be derived from earth.[7] The course of the water in the air permits it to level the surface of the earth, and to work incessantly in pulling down that which the volcanic forces have built up; although the action of this element is less striking than that of fire, its effect is not less considerable. In virtue, especially, of its continuous action, water affects the solid bodies which constitute the land by dissolving and disintegrating them and transporting them,

FIRST CENTURY A.D. SENECA.

SENECA'S VIEWS ON EVAPORATION AND CHEMICAL ACTION OF WATER.

[1] Flourished about 43 B.C.

[2] "Id omne, qua venit, quaque dispergitur uno vocabulo Nostrum Mare dicitur" (i. sec. 6).

[3] Flourished in the third century A.D.

[4] Solinus, c. 24.

[5] See Bunbury, *op. cit.*, vol. ii. p. 353.

[6] Born a few years B.C.

[7] "Quod fiunt omnia ex omnibus, ex aqua aër, ex aëre aqua, ignis ex aëre, ex igne aer: quare ergo non e terra fiat aqua?"

sometimes far from their place of origin. All rocks, even the hardest, are penetrated by water, which dissolves them, at least partially. Seneca attributes this solvent action to the presence of a gas (*spiritus*). Thermal springs possess the power of dissolving minerals in the highest degree, and among those which offer least resistance he enumerates salt, sulphur, nitre, alum, bitumen, and lime. The matters dissolved by water are deposited again, and this precipitation is especially abundant when the waters are thermal and gaseous. He likewise explains the formation of calcareous tuffs, and points out that the saline substances held in solution by the aqueous element may be absorbed by earthy layers, which, in a way, serve as a natural filter. What has been said above upon the chemical action of water shows that Seneca had clearly recognised those hydrothermic phenomena which play so important a rôle in geology.[1]

Seneca on the Mechanical Action of Water.

His ideas concerning the mechanical action of water are not less just. The hardest rocks cannot resist the destructive effect of a repeated dropping of water, and the erosive effects of water are most pronounced when the forces in play are those of streams, currents, and the waves of the sea, as may be observed in the beds of rivers and on bold coasts. Everywhere water is seen victoriously attacking and destroying rocks; the chemical effects often precede the mechanical. Streams and rivers at all times, but especially during floods, transport clay, sand, and rocks, picked up from the layers which they traverse. The erosive power of waves is, however, even greater than that of running water; cliffs broken and smashed into ruins testify to the work of destruction effected by the sea on coasts. Rivers deposit at their mouths the matter which they carry in suspension, thus forming deltas. In their turn the mineral particles in suspension in marine waters are deposited at the bottom of the sea, often at considerable distances from the coasts. Among the agents which take part in marine sedimentation, tides and currents are enumerated. Seneca points out that all waters, and especially those of the ocean, possess the power of clearing themselves from all impurities; they may, indeed, be said to wash the shores and lay down near them all matters in suspension, so that in the course of centuries the lines of coasts undergo sensible modifications. The surface of the ocean is spherical; its level remains constant in spite of the continuous accession of river-water, nor does the latter modify the saline taste of the sea, and he attributes this constancy in level and saltness to evaporation. At certain intervals, however, the normal height of the ocean undergoes a general but temporary elevation, producing deluges with a sort of periodicity, and causing profound modifications on the surface of the globe. These diluvial inundations do not, however, spread over the whole world; only some regions are thus invaded. Such great phenomena cannot be referred to a single cause; several must unite to produce them, as torrents of rain, earthquakes, and perhaps other causes. The waters of the sea might easily cover the highest moun-

Seneca on the Level of the Ocean.

[1] Dr Nehring, Die geologischen Anschauungen des Philosophen Seneca, Wolfenbuttel, 1873 and 1876, Theil ii. pp. 10–15.

tains, for these have but a slight elevation when compared with the volume of the earth.[1] In one of Seneca's tragedies there is the most remarkable prophecy on record, pointing to the discovery of America, more remarkable than the suggestion of Strabo noted above. An immense land, new worlds, shall in later years, he says, be disclosed in the Ocean.[2]

Pliny the Elder.

Pliny the Elder[3] held, as was generally admitted in his time, that the sea surrounded the world like a girdle, which, he says, is a fact demonstrated by experience, and concerning which it is no longer necessary to indulge in speculations.[4] The whole part of the work in which he deals with the ocean is full of errors and conjectures. He catalogues marine animals into one hundred and seventy-six species,[5] being four less than the number recorded by Aristotle in the Ægean Sea alone. Pleased with his enumeration, he exclaims:—"Surely, then, every one must allow that it is quite impossible to comprise every species of [land] animal in one general view for the information of mankind. And yet, by Hercules! in the sea and in the ocean, vast as it is, there exists nothing that is unknown to us, and, a truly marvellous fact, it is with those things which Nature has concealed in the deep that we are best acquainted!"[6]

His Views concerning Marine Organisms.

Pliny confessed himself unable to give a detailed account of the depth of the ocean. Some parts he stated to be 15 stadia (1500 fathoms) deep, others "immensely deep, no bottom having been found." In explaining very clearly "why the sea is salt," he says:—"Hence it is that the widely-diffused sea is impregnated with the flavour of salt, in consequence of what is sweet and mild being evaporated from it, which the force of fire easily accomplishes; while all the more acrid and thick matter is left behind, on which account the water of the sea is less salt at some depth than at the surface." In this explanation Pliny followed Aristotle.

Periplus of the Erythræan Sea.

To about the time of Pliny must be referred the Periplus of the Erythræan Sea—an important work, evidently compiled for the use of those engaged in the commerce and navigation of the Indian Ocean at that period. The author gives a very characteristic description of the phenomena produced at the embouchures of rivers on the coasts of India, now known under the name of "bores."[7]

Second Century A.D.

Periplus of the Pontus Euxinus.

During the reign of Hadrian, Flavius Arrianus wrote the Periplus of the Pontus Euxinus; this work, which is simply an official report, adds little information of a general kind to what was already known of the Black Sea, but gives copious and accurate details regarding its coasts useful to navigators.

Before considering the work of Ptolemy, a return to the ideas of Hipparchus

[1] The ideas of Seneca upon the geological action of marine and fresh water, summarised above, are found in the first two chapters of the third book of Quæstiones Naturales. Dr. Nehring, *op. cit.*, whom we have followed, has arranged these ideas methodically, in accordance with the rules followed in modern geological text-books.

[2] "Venient annis sæcula seris,
Quibus Oceanus vincula rerum
Laxet, et ingens pateat tellus,
Tethysque novos detegat orbes,
Nec sit terris ultima Thule."—Seneca, *Medea*, 376.

[3] 23 to 79 A.D.

[4] Pliny, Hist. Nat., ii. 66:—"Nec argumentis hoc investigandum, sed jam experimentis cognitum."

[5] Some MSS. have 144 and some 164 species.

[6] Pliny, Hist. Nat., xxxii. 53.

[7] Periplus Maris Erythræi, sec. 45, 46.

Marinus of Tyre.

concerning the ocean must be pointed out. Marinus of Tyre[1] rejected the opinion of his immediate predecessors, and maintained that the habitable world was not surrounded by the waters of the ocean. He held that the continental masses were united to other similar masses still unknown, and that the Atlantic and Indian Oceans were separated from each other. Nor does he appear to have admitted the existence of a sea to the east of Asia; he attributed to that continent an indefinite extension towards the east. It is difficult to conjecture the reasons which induced Marinus to abandon the wiser and more correct views of Eratosthenes on these fundamental points of geography.

Ptolemy.

Ptolemy[2] adopted the views of Marinus, and his great authority gave them a scientific stamp. Ptolemy was an astronomer, and treated physical geography as of secondary importance. In commencing his first book[3] he described geography as being essentially the art of tracing the map of the world in the literal sense assigned by etymology to the word geography.[4] (See Plate IV.).

Ptolemy's Views on the Morphology of the Oceans.

The greater part of Ptolemy's works is taken up by the tables containing the materials which served him in the construction of his maps. In projection he was far in advance of his predecessors, and first used the words latitude and longitude as purely technical terms. Following Marinus, he rejected the hypothesis of an ocean extending to the east of the Asiatic continent; he regarded that great land-mass as stretching indefinitely towards the north and east. Africa was likewise extended without any settled limitation towards the south. Eratosthenes, Hipparchus, and even Strabo, did not know that the east coast of Africa turned suddenly to the south-west beyond Cape Aromata;[5] they believed that the shores of the regions which produced myrrh and incense extended as far as India. Ptolemy adopted this notion, although the merchants of Aden had informed him of the true position of the coasts as far south as Zanzibar. He united the point where the land appeared to him to trend towards the east, by unknown lands, to the Chinese coasts. The Indian Ocean thus formed a great enclosed sea. This *Southern Ethiopia* remained on maps down to the time of the second voyage of James Cook.[6] As we have just seen, Ptolemy's conception of the morphology of the ocean differed from that held by many of his predecessors. With Ptolemy disappeared the great geographers of antiquity.

Continental and Oceanic Theories of the Distribution of Land and Water.

Two principal views prevailed among the ancients regarding the distribution of land and water. The school that may be called Homeric—to which Eratosthenes and Strabo belonged—considered the three continents of the Old World as forming a single island surrounded by the ocean. On the other hand, the adherents of what may be called the Ptolemaic school—to which Hipparchus and Marinus of Tyre belonged—did not admit

[1] Flourished probably about 120 A.D.

[2] Flourished about the middle of the second century A.D.

[3] Ptolemy, i. sec. 1.

[4] "Ptolemæo geographia est ars delineandi tabulas geographicas." See Wildberg, cited by Bunbury, *op. cit.*, vol. ii. p. 54[illegible].

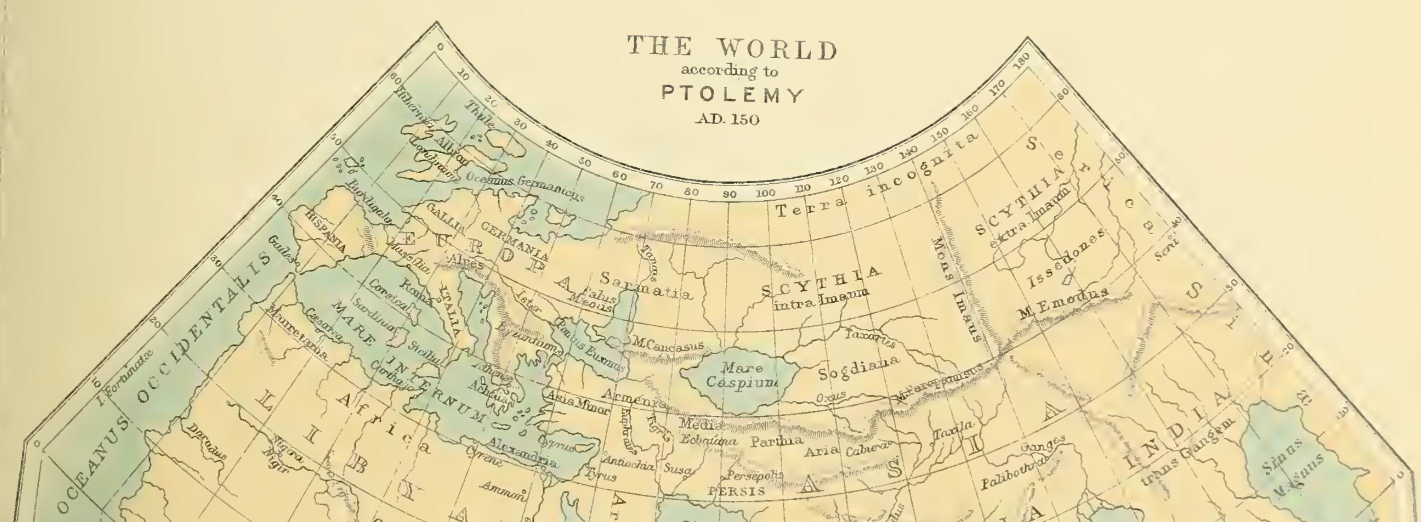
[5] Cape Guardafui.

[6] 1772 to 1775 A.D. (see Peschel, Geschichte der Erdkunde, p. 61, Leipzig, 1877).

THE WORLD
according to
STRABO
A.D. 18

THE WORLD
according to
MELA
A.D. 43

THE WORLD
according to
PTOLEMY
A.D. 150



the extension of the sea around the known world. They considered the Atlantic and Indian Oceans to be great enclosed seas like the Mediterranean; they held that the extreme points of the known land towards the east and the west approached so nearly to each other that a ship, parting from the west, might easily reach the eastern extremity, which they regarded as greatly extended. This error was perpetuated, thanks to the influence of Ptolemy, and led indirectly, fourteen centuries afterwards, to the discovery of the New World by Columbus.

C.—OCEANOGRAPHICAL VIEWS DURING THE DARK AGES, THE MIDDLE AGES, AND THE RENAISSANCE.

FOURTH AND FIFTH CENTURIES A.D.

When the barbarians invaded and overran Europe during the fourth and fifth centuries, ancient society as well as the science and geographical knowledge of antiquity were swept away. The maps of Eratosthenes, of Marinus of Tyre, of Ptolemy were destroyed or buried for centuries beneath the ruins of ancient civilisation. The advanced views of the Greek philosophers concerning the figure of the earth, the motions of the heavenly bodies, and the distribution of land and water, were forgotten and were replaced by the crudest conceptions concerning natural things. It is not necessary to dwell on the errors which were current concerning the ocean during the centuries of decadence; a few examples will suffice to show how great was the retrogression from the advanced ideas of the Greek geographers.

SIXTH CENTURY A.D. COSMAS INDICOPLEUSTES.

In the sixth century Cosmas,[1] like most of his contemporaries, spurned the doctrine of antipodes; it is absurd, he said, for the earth is not a sphere but a quadrilateral plain, 400 journeys, or stations of 30 miles each, in length and 200 in breadth.[2] The degeneracy of geographical ideas is shown by the figures given in the work of Cosmas, who passed in his time for a great geographer.[3]

[1] Surnamed Indicopleustes—navigator of India. In early life he was an Egyptian merchant, and made several voyages to Indian ports; later he adopted a monastic life, and wrote his "Christian Topography."

[2] "Topographia Christiana" in Montfaucon, Coll. Nova Patrum, vol. ii. pp. 113 and 1706.

[3] Plate V. presents a rough plan of the earth as conceived by Cosmas. He thought, as we have said above, that the earth was oblong, twice as long as broad, and that the ocean surrounded the earth. Beyond the ocean was a second earth, reaching everywhere to the walls of heaven. On the eastern side of this transmarine earth he thinks that man was created, and there also the paradise of pleasure is situated. As this is described as being on the eastern shore, our first parents when driven out of Paradise betook themselves to the finite land situated on the shore of the sea. From thence Noah and his sons were carried in the ark, when the deluge occurred, to the land which we now inhabit. Four rivers of Paradise, arising in Paradise, he says, are conveyed by subterranean channels to this our land, and burst forth in certain places. He believes the Caspian to be a sea joined to the ocean, which, as we have shown elsewhere, was a view held by certain of the ancients. Plate V. also represents a conical mountain rising from the hinderpart of the earth; when this is reached by the sun, night is brought about for the inhabitants of the earth. There also the revolutions (periods) of the sun are indicated by lines whence arise the various seasons of the year. Thus, when the sun reaches the lowest line the nights are longer and the winter τροπή or period of the year takes place, the sun passes the greater part of his course behind the mountain; when the sun ascends to the middle line the equinox is caused, and the sun in travelling his course reaches the equinoctial line. Finally, when the sun reaches the uppermost line the summer period takes place and the sun arrives at the tropic. Cosmas denotes the revolutions (periods) of the sun by the words "winter night," "medium night," "summer night," as shown in the figure.

He explains the form of the world by comparing it with the tabernacle of Moses. The stars are transported by angels, who are likewise charged with regulating eclipses. The cause of the succession of day and night is referred to the interposition of a great mountain, behind which the sun disappeared each evening.[1] The firmament extended around the earth, the ocean, and the stars, enclosing them hermetically in its crystal walls.

Wheel Maps of the Middle Ages.

In the seventh century Isidore of Seville, starting from an idea suggested by the scriptural phrase, "the *circle* of the earth," and deriving, by a false etymology, *rotundatus* from *rota*, a wheel,[2] declared consequently that the earth had the appearance of a wheel, hence going back to the Homeric idea of a disc surrounded by the ocean. Thus originated the "wheel maps" which ornament the manuscripts of the Middle Ages. These maps divide the circle of the earth into an eastern part, Asia, and into a western part, which is again subdivided into Europe and Africa. Jerusalem occupies the centre of the world. The north and south diameter is indicated by rivers—the Nile and the Tanais;[3] finally, the Mediterranean occupies the ray perpendicular to this diameter between Europe and Africa. The ocean surrounds the circle. This tripartite division was supported by a text of St. Augustine,[4] which was much used by the cosmologists of the period as a base for their cosmographical conceptions. (See Wheel map, Plate V.).

What has been said above suffices to show the state of ignorance and the infantile conceptions as regards geography, to which the writers of the Dark Ages had descended. The study of Nature was abandoned for the most adventurous speculation; there was a proclivity to twist facts so as to make them agree with what was believed to be religious truth. In this shipwreck of geographical knowledge a few fragments floated; some dim notions of ancient science were preserved among the more learned; it may be said that all the sense that was written regarding Nature during the barbarous period was borrowed from the philosophical works of antiquity—Pliny, Solinus, or Mela being chiefly consulted. The early part of the Middle Ages produced nothing that can be regarded as progress; geography was reduced to a simple enumeration of names of towns. The scientific ideas which animated the times of Strabo and Ptolemy had wholly disappeared.

[1] A similar opinion was held by Anaximenes, who flourished in the sixth century B.C.

[2] "*Orbis* a rotunditate circuli dictus, quia *sicut rota* est," Isidore, Origines, lib. xiv. cap. 2, 1.

[3] The river Don.

[4] De Civitate Dei, xvi. 17:—"Unde videntur orbem dimidium duæ tenere, Europa et Africa, alium vero dimidium sola Asia . . . . Quapropter si in duas partes orbem dividas, Orientis et Occidentis, Asia erit in una, in altera vero Europa et Africa." This system of division bore the technical name of *Divisio* or *Distinctio trifaria*. The ancients had adopted a *quadripartite division*. This theory, propounded by the astronomer Geminus (about 140 B.C.), was taken up by Strabo, who represented the terrestrial globe as divided into four segments by the equator and by a meridian; two of these are to the north and two to the south of the equator. One of the segments to the north comprised the part of the earth known to the Greeks and Romans. All the rest of the globe, that is to say three out of the four segments, were unknown (see *ante*, pages 20, 21, and Vivien de St. Martin, *op. cit.*, p. 169).

It is to be noted, however, that the form and extent of the seas to the north-west of Europe were sketched out from the voyages of the Norsemen, who peopled the islands situated to the north of Great Britain. These hardy mariners enriched the geographical knowledge of the Middle Ages by the discovery of Iceland, Greenland, and North America. Their voyages to the New World at this period were wholly unknown to the nations who did not speak the ancient language of the North.[1] In the second half of the ninth century the Norsemen reached higher latitudes than had been previously attained. In 870 a voyage of discovery, undertaken by Ohthere, made known the north coast of Europe. This Norwegian sailor doubled the North Cape, penetrated into the White Sea, and arrived off the mouth of the Dwina. Almost at the same time the Dane, Wulfstan, explored the Baltic;[2] but it was only in the eleventh century that geographers became really acquainted with this sea. Thus, Eghinard, the historiographer of Charlemagne, did not know that it was enclosed to the north; it was in the time of Adam of Bremen, who wrote in 1075, that Scandinavia was discovered to be a peninsula.

Discoveries of the Norsemen in the Eighth and Ninth Centuries.

When the Arabs had extended their sway by a series of most extraordinary conquests, scientific investigation found a home among them, and geographical knowledge was cultivated. The voyages of the Arabs tended very greatly to develop terrestrial science among a people marvellously endowed and rejoicing in all the vigour of youth. The accounts of the Arabian voyages, which were pushed as far as China, were collected by Abu Zaid about the year 851, and are a storehouse for the history of the geography of the period.[3] Among the navigators of the first half of the ninth century was Soleiman, apparently one of the first Arabs to cross the Bay of Bengal, and pass beyond the Strait of Malacca into the China Sea. The narratives of the merchant Soleiman, and one of his contemporaries Ibn-Wahâb, who visited Pekin, made a profound impression, from being the first account of these strange and little-known countries—an impression which the Arab imagination reflects in Sindbad the Sailor. Soleiman, like his narrator, Abu Zaid, came from Sīrāf, on the Persian Gulf. It was from this great port that the Arabs commenced to count their subdivisions of the seas situated between their own country and China. This part of the ocean comprised seven subdivisions, which are

Voyages of the Arabs in the Middle Ages.

Soleiman.

[1] In the year 1000 Leif Erikson and his companions discovered the coasts of Labrador and Newfoundland (Helluland), Nova Scotia (Markland), and New England (Vinland). It has been alleged that a Norse colony flourished in Vinland for three centuries, during which time a transatlantic trade was carried on with Norway, and Professor Horsford believes he has found some traces of an ancient Norse city on the Charles River, near Boston; but the absence of nearly all the usual traces of a European colony renders this conclusion extremely doubtful (Horsford, Discovery of America by Norsemen, 1888; The Landfall of Leif Erikson, A.D. 1000, Boston, 1892). The settlements formed by Thorfinn and others early in the eleventh century were soon abandoned, and in 1347 we have the last record of a voyage to America (Rafin, Antiquitates Americanæ, p. 84, Copenh. 1837). It has likewise been maintained that these voyages of the Northmen led directly to the voyage of Columbus in 1492, but this has in no way been substantiated; it is doubtful whether Columbus had even heard of these voyages (see Du Chaillu, The Viking Age, vol. ii. p. 519, London, 1889; Reeves, The Finding of Wineland the Good, 1890).

[2] The accounts of these voyages were preserved by Alfred the Great, king of England, one of the most remarkable men of the Middle Ages; born 849.

[3] See Reinaud, Relation des voyages faits par les Arabes et les Persans dans l'Inde et à la Chine, Paris, 1845.

enumerated by Mas'ūdī,[1] an Arabian naturalist and geographer of the tenth century, to whose works we shall presently refer.[2]

The numerous and distant peregrinations of the Arabs need not be followed. It will suffice to state that they were acquainted with the whole of Southern Europe, the southern half of Asia, North-West Africa as far south as 10° north, and the eastern coasts of the same continent as far as Cape Corrientes.[3] In the time of Soleiman they had described in detail the islands in the Strait of Sunda, and everything indicates that they had landed on the Moluccas, Madagascar, and the Canaries. The Arabs must therefore be credited with the discovery of the Great Pacific beyond China, although it is generally maintained that this ocean was first made known by the travels of Marco Polo in the fourteenth century.[4] (For Arab maps of the 11th and 12th centuries, see Plate V.).

Mariners' Compass.

One of the most important results arising from the relations of the Arabs with China is believed to have been the introduction of the mariners' compass. The property of the magnet was known to the Chinese from time immemorial, and they are reported to have applied it to navigation about the fourth century of our era, but this statement is not supported by sufficient evidence. The Arabs are supposed to have learnt the use of this marvellous apparatus in the East, and through them it is said to have passed to the sailors of the Mediterranean. Marco Polo does not, however, mention the mariners' compass, and we have no certain knowledge that it was in use among Chinese sailors at a time long posterior to the Arab voyages of the tenth or eleventh centuries. The Egyptians were accustomed to suspend the loadstone at the end of a string and to observe its motions. In its primitive form among sailors of the west the compass was simply a needle that had been touched with the loadstone and was floated on a piece of cork or on a straw during the night or misty weather. In this form it was in use among northern sailors as early as 1100 A.D., and it may quite well have developed in their hands into a complete nautical instrument. For a long time there appears to have been a prejudice against its use among sailors. Roger Bacon is reported to have said that no master mariner dared use it, so great was the appearance of its being constructed under the influence of some infernal spirit.[5]

[1] Flourished about 915 A.D.

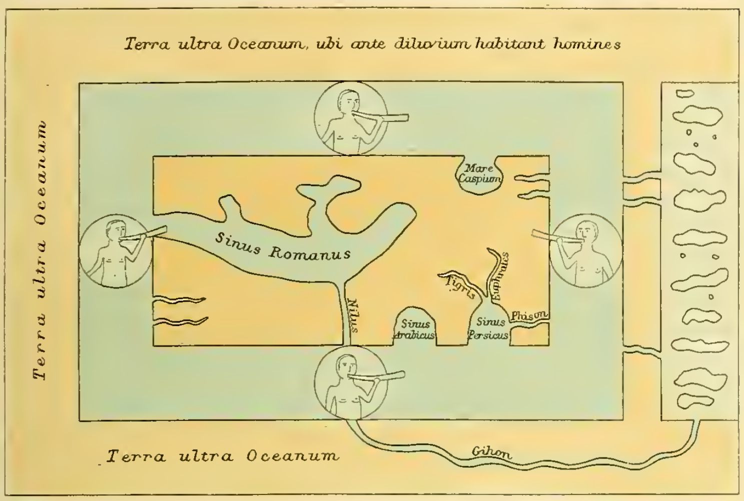
[2] Mas'ūdī, Meadows of Gold and Mines of Gems, translated by Aloys Sprenger, M.D., London, 1841; Les Prairies d'Or, texte et traduction, par MM. Barbier du Meynard et Courteille, Paris, 1861.

[3] See J. T. Bent, *op. cit.*, p. 190.

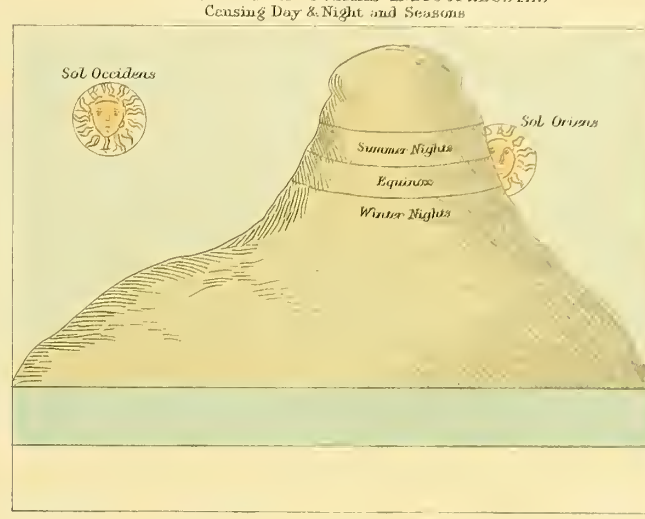
[4] Japan was known to the Arabs as the Wak-wak Islands. For an account of an expedition of a fleet from Japan to East Africa in A.D. 945, see De Goege, *Verslag. kon. Akad. Wet. Amsterdam*, 1881, ser. 2, part x., Afd. Letterkunde, p. 1[illegible]9.

[5] The following is an extract from a letter from Latini to Cavalcanti describing a visit to Roger Bacon at Oxford, apparently in the year 1258:—"This discovery, which appears useful in so great a degree to all who travel by sea, must remain concealed until other times; because *no master-mariner dares to use it*, lest he should fall under a supposition of his being a magician; nor would even the sailors venture themselves out to sea under his command, if he took with him an instrument which carries so great an appearance of being constructed under the influence of some infernal spirit. A time may come when these prejudices, which are of such great hindrance to researches into the secrets of

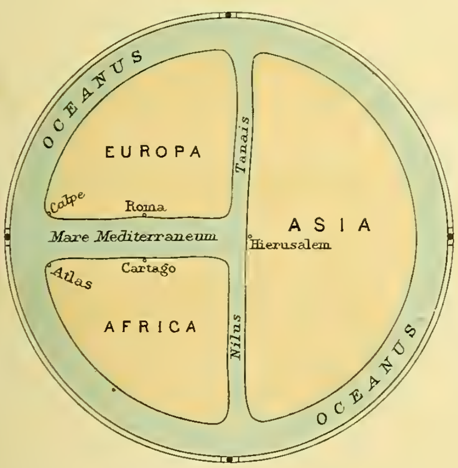
WORLD MAP OF COSMAS INDICOPLEUSTES _VI Cent.



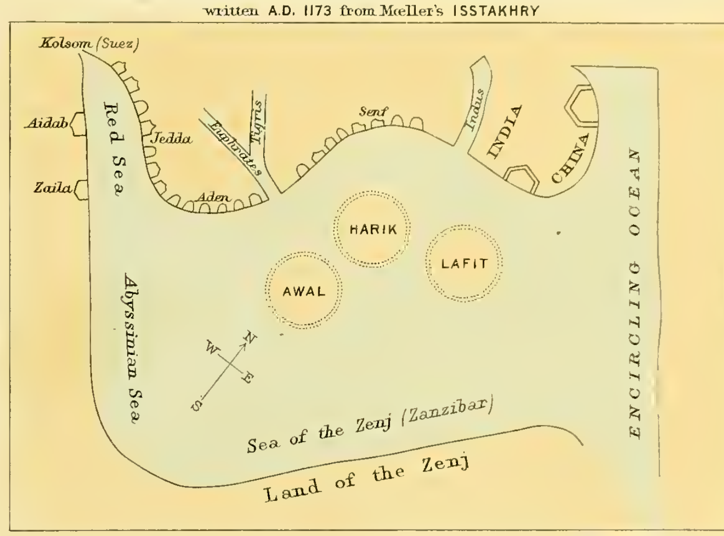
THE MOUNTAIN OF COSMAS INDICOPLEUSTES
Causing Day & Night and Seasons



WHEEL MAP
Imago Mundi XI Cent.



Reduced Facsimile from the GOTHA M.S. OF THE BOOK OF CLIMATES
written A.D. 1173 from Mœller's ISSTAKHRY



QUADRANS HABITABILIS
according to
ABU RIHAN BIRUNENSIS
A.D. 1030

The Edinburgh Geographical Institute

Geographical Notions of the Arabs.

Notwithstanding their frequent voyages in Indian seas, many of the Arabs continued to hold the erroneous idea enunciated by Ptolemy regarding the morphology of that ocean. That celebrated geographer, as we have seen, regarded the eastern coast of Africa as advancing towards the east beyond the peninsula of Malacca to the south of China, instead of taking a southern trend from the promontory of Rhaptum, near Zanzibar. Many Arabs, then, looked on the Indian Ocean as a Mediterranean—an enclosed sea; some of them even regarded the Indus and the Nile as branches of the same river. Cape Guardafui did not exist with them; from that point the African land turned to the east, the coast of Zanzibar was placed opposite the Indus, that of Sofala faced Ceylon, and Madagascar approached so closely to the islands of the Straits of Sunda as to coalesce with Java or Sumatra. Such are the features presented by the Indian Ocean on the planisphere of Edrisi, the best known of oriental geographers, constructed for Roger of Sicily in 1154. This false idea was perpetuated for a very long time among the Christian nations of the Middle Ages.

While Greek theory continued to hamper the Arabs, some writers in the early part of the ninth century, for instance Ibn-al-Fakīh, held just views.[1] The Indian Ocean was sometimes regarded as communicating with the all-encircling ocean by a strait in the extreme east, and sometimes widely continuous with the encircling ocean. Nearly all writers agree that there is a great sea to the east of Asia, Arab merchants having traded as far as Japan and the Corea. Yacut states that the Sea of Zanzibar and the Indian Ocean are identical, and communicate with the encircling ocean. Travellers had told him that they had gone so far to the south that the pole star and great bear were lost to sight, and the south pole and canopus were high in the heavens. All the seas, according to Yacut, except the Caspian, communicate with the encircling ocean which

nature, will probably be no more; and it will be then that mankind shall reap the benefit of the labours of such learned men as Friar Bacon, and do justice to that industry and intelligence for which he and they now meet with no other return than obloquy and reproach" (see Major, *Prince Henry the Navigator*, pp. 58, 59). Vivien de St. Martin (*op. cit.*, p. 247) says it is quite indisputable that the Arabs received from the Chinese the knowledge of the compass. He adds:—"It was through the Arabs that it arrived among the sailors of the Mediterranean at the time of the second crusade, although there is a want of precise information on the subject." Peschel (*op. cit.*, p. 205) is not so affirmative with respect to this matter; he says:—"That the magnet arrived in Europe from China directly or by the hands of the Arabs has never been thoroughly established." To demonstrate that the Arabs had been the intermediaries, it has been usual to found upon the fact that Albertus Magnus (De Mineralibus, lib. ii. tract iii. cap. 6: Lugd. 1651, tom. ii. fol. 243), employs the words *Aphron* and *Zoron* to designate the south and the north, and that these words are of Arabic origin. Peschel, relying on the authority of Reinaud (Aboulféda, p. ccii.) and of Santarem (Hist. de la Cosmographie, tom. i. p. 295), holds that these expressions are borrowed from the Hebrew (see S. Ruge, Geschichte des Zeitalters der Entdeckungen, Berlin, 1881, p. 39). The magnet may possibly have been a Norman discovery. The Italian *bussola* and French *boussole* come, it has been said, from the Flemish *boxel*, hence the expression to box the compass. Flavio Giogo, of Amalfi, in 1307, probably first swung the compass on a pivot. The compass is mentioned as early as 1100 A.D. (see Hallam, *Middle Ages*, vol. iii. p. 394). Alexander Neckham, an English writer of the twelfth century, describes the compass carried by ships (see *Nature*, vol. xiv. pp. 147-148, 1876; Lindsay, *History of Merchant Shipping and Ancient Commerce*, vol. i. pp. xlii., xliii.).

[1] According to Ibn-al-Fakīh (ca. A.D. 900), there are four seas,—(1) the Great Sea, which extends from Maghrib to Kolzom (Suez) and to the Wak-wak Islands of China (Japan); (2) the Mediterranean,—the Western or Roman Sea; (3) the Caspian; (4) the unnavigated sea of Thule, between Rūmia and Khawārezm (Ibn-al-Fakīh, Leyden, 1885, p. 7).

sends two principal branches into the land masses. The eastern branch forms the China Sea, the Indian Sea, the Arabian and Persian Gulfs, and the Sea of Zanzibar: the western branch forms the Mediterranean. The water of these branches is derived from the encircling ocean. Navigation is confined to the branches, no ship having traversed the encircling sea. Yacut states that the inhabited climes are all north of the equator.[1]

Orography and Bathymetry of the Arabs.

The Arabs have left very few documents relating to orography or bathymetry. It is rarely that we find in their writings even an evaluation of the heights of mountains. Ibn Khaldûn, who, in the fourteenth century, wrote his celebrated History of the Berbers, remarks that if the highest mountains are situated near the sea, it must be regarded as a providential arrangement to arrest the invasion of the ocean.[2] The Arabs do not seem to have been aware of the significance of volcanic phenomena from a geological point of view. They admitted, however, that the surface of the globe was subject to changes; that the sea might occupy the place of the land or be confined within narrower limits.

Coral Islands.

We find them recording observations on the formation and destruction of coral islands. Al-Bīrūnī[3] points out that in the Laccadives and Maldives several islands sank beneath the waters, while others were raised above them, so that they became habitable one after the other. He says:—"The name of Dyvah is given to islands that originate in the sea, and appear above the water in the form of sand-banks; these banks in growing extend and unite till they present a solid aspect. At the same time others of these islands by breaking up decompose, melt, and disappear in the sea; when the inhabitants perceive this, they retire to some new island that is on the increase, transport into these their cocoa-nuts, palms, grains, and utensils, and finally establish a new home."[4]

Arab Views regarding the Action of Water.

Notions concerning the geological action of water, and the sediments carried into the sea and then solidified, are met with in the writings of Kazwini.[5] Al-Bīrūnī, whom we have just cited, embraced the idea previously expressed by Megasthenes,[6] according to which Bengal has been formed by the accumulation of sediment deposited by the Ganges. Al-Bīrūnī also shows that he had observed the distribution of materials transported by water. He points out that the larger fragments are laid down at the upper parts of rivers, that gravel is formed in the lower portions of their course, and that, finally, sand and the finer particles are carried into the ocean.[7]

We find in Mas'ūdī examples of the carriage of fluviatile sediments, the accumulation of which causes the sea to retire. He had been profoundly impressed by the sanding-up

[1] Yacut, Geog. Dict., Leipzig, 1866, pp. 501, 504.

[2] Ibn Khaldûn, Histoire des Berbers, trad. de l'Arabe par M. Slane, Paris, 1852, tom. i. p. 194.

[3] Flourished about 1000 A.D.

[4] Alberuni's India, by Sachau, London, 1888, p. 106, and Al-Bīrūni, Reinaud, No. III., "Extrait de l'Ouvrage d'Albérouni sur l'Inde," *Journal Asiatique*, ser. 8, tom. iv. p. 265, 1884.

[5] Kazwini's Kosmographie, nach der Wüstenfeld'schen Textausgabe, aus dem Arabischen von H. Ethe, Leipzig, 1869.

[6] Megasthenes was sent to India by Seleucus about 302 B.C., and was probably the first Greek to reach the banks of the Ganges, certainly the first writer to give an account of the country from personal observation.

[7] Alberuni's India, Sachau, p. 198.

produced by the Tigris and Euphrates; he cites the case of the city of Hira, formerly a seaport, which, after the lapse of three hundred years, was situated far in the interior.[1] The same author devotes a chapter to setting forth the ideas current at that time with reference to the origin of the sea and the cause of its saltness. Side by side with purely hypothetical conceptions, one meets with interpretations and comparisons which show that the Arabs were possessed of tolerably correct notions on many questions relating to the sea. Mas'ūdī admitted the spherical form of the earth and of the surface of the ocean; when one sails on the open sea the low-lying land first disappears, then the mountains sink gradually, and, at last, the summit is lost to sight.[2] He thus supports his views by reference to the classical example; indeed, in all this the Arabs simply followed the Greeks, and especially Ptolemy. MAS'ŪDI.

In speaking of marine animals Mas'ūdī merely relates marvellous accounts of certain creatures; he says that some seas contain animated beings, while others, the Great Ocean for instance, have none.[3] The naturalist appears to better advantage in the passages relating to the origin of the ocean and its saltness, to which reference has been made. "Some maintain," he writes, "that the sea is a remnant of the primitive

[1] Mas'ūdī, *op. cit.* See, in particular, the anecdote of Khaled and Abd-el-Mesīh, vol. i. ch. ix. pp. 248–253.

[2] Mas'ūdī, *op. cit.*, vol. i. ch. viii. p. 213. This demonstration was formerly used by the ancients (see Almagest, lib. i. ch. iii. p. 12, ed. Halma).

[3] Mas'ūdī, *op. cit.*, tom. i. ch. viii. p. 185. See, for example, his account of the unicorn, whale, dragons, and crabs. Notwithstanding all the improbability of the narration in which the Arab writer gives his imagination free play it may not be without interest to quote a passage relative to marine monsters. It shows, at least, the preoccupation they had with reference to animals living in the sea, and the speculations in which they indulged regarding the exploration of the ocean. The following is the legend reported by Mas'ūdī relative to the foundation of Alexandria:—"The building of Alexandria was commenced, and the foundations laid, when, protected by the night, animals rose out of the depths of the sea, and destroyed all that had been done. . . . . . Just at the same rate as the work advanced, and in spite of the presence of the guards charged to drive them away as they came out of the water, the work in the city was every morning destroyed. Alexander was seized with anxiety at this spectacle; he meditated on what he should do to free the city from this great calamity. One night, while he reflected in solitude on these events, a stratagem occurred to him. The next day he called his workmen, and ordered them to construct a box of wood ten arms' lengths long and five wide. All around in the interior of this box plates of glass were fixed, and layers of pitch, resin, and other substances were applied to the wood to prevent the water from penetrating into the interior. They also reserved a place for attaching ropes. Alexander then entered it along with two of his secretaries, clever artists—and commanded that the cover of the box should be closed, and stopped up with similar coatings of pitch, &c. Two large vessels now put to sea. Weights of iron and lead and heavy stones had been fixed to the lower part of the box in order to carry it to the bottom, for, being filled with air, it would otherwise have floated. Then the box was attached by cables between the two ships, which were prevented from separating from each other by planks placed between them; the cables were now allowed to run out, and the box descended to the bottom of the sea. Thanks to the transparence of the glass and the limpidity of the water, Alexander and his companions saw marine animals and species of demons having a human form and a head like that of ferocious beasts. Some held hatchets, some saws or hammers, resembling workmen with tools. Alexander and his fellow-adventurers traced and figured on paper all these monsters, reproducing their exact aspect, their stature, and varied forms. He then shook the cords, and at this signal the box was drawn up by the sailors of the two vessels. Alexander then came out of the box and returned to Alexandria. There he ordered the workmen who wrought in iron, copper, and stone to reproduce these animals according to the drawings he had brought. The figures being finished, he caused them to be placed on blocks along the shore, and proceeded with the construction of the city. Night arrived. When the marine monsters came up out of the water, and found themselves face to face with their own images placed along the edge of the sea, they immediately took to the open ocean, and never showed themselves again."

Saltness of the Sea—Evaporation.

humidity, the greater part of which has been dried up by fire, and the surplus has been transformed under the influence of heat. Others allege that the whole of the primitive humidity, having been submitted to the devouring action of the sun in its revolutions, all the pure parts have been removed, and the present ocean is merely a saline and bitter residue. There are others who assert that the sea is simply the secretions which flow down from the earth scorched by the heat of the sun during its constant revolutions. Some believe that the sea is nothing else than the primitive humidity separated from all coarse and terrestrial principles, just as fresh water mixed with ashes loses its sweetness and retains a saline taste even after it has been filtered. It is also supposed that in water the fresh and salt parts were mixed, and that the sun volatilised the fresh portions because of their subtility, be it that it absorbs these parts itself, be it that once arrived in high regions where cold condenses them and gives them, so to speak, a new form, they change a second time into water. It is held that water being an element, the molecules which are found in the air and under the action of cold have a soft taste, while the molecules which remain on the land take up a bitter flavour under the influence of the heat which penetrates them. Several learned men have held that the mass of water which flows into the ocean either from the surface of the soil or from subterranean passages, having once arrived at that vast reservoir, has absorbed everywhere the saline principles which the earth discharges into it. It is not to be wondered at, then, that the water of the sea preserves always the same weight and bulk, since the subtile parts, which heat removes, change again into dew and water whence arise mountain streams, which fall into rivulets and ponds and flow into the wet places of the land, until they arrive, at last, in the great whirlpool of the ocean. It is thus that absolutely none of the water is lost, and springs are like machines which, drawing water from a river, return it to a rivulet that passes it again to the river. . . . . . It is evident, from experience, that all humid matters endowed with a certain relish, having passed through the retort and still, preserve in their sublimate the same smell and taste, like vinegar, date wine, rose saffron, gilly-flower water, except, however, saline substances, which change the taste and smell, especially when they are submitted twice to the operation of fire and the still."[1]

[illegible]

It will be seen from this quotation, which may be regarded as a correct *résumé* of the knowledge of the Arabs on this matter, that Mas'ūdī possessed exact notions about the phenomena of evaporation, the formation of rain, and, in general, on the aërial circulation of water, and on the saltness and conservation of the same in marine basins. This exposition is, no doubt, disfigured by errors; it lacks precision and definiteness, but the principles expressed are true, and prove the relative state of advancement of Arabian philosophy. In the closing sentences of the above passage the author explains the phenomena of nature by comparison with those which take place in the laboratory. This is, as Peschel has noted, one of the first occasions on which we meet with this truly

[1] Mas'ūdī, *op. cit.*, tom. i. ch. xiv. pp. 277–280.

scientific method of discussion, which has above all things contributed to erect the edifice of modern science.

Arab Speculations on Rise and Fall of the Tides.

If, however, on certain points, like those just referred to, the Arabs were on a level with what was taught by the ancient Greeks, in regard to other matters concerning the ocean their imagination carried them away from the truth. For example, the interpretations they gave of the cause of the rise and fall of the tide were widely removed from the more correct ideas held by the ancients. In the chapter where Mas'ūdī recapitulates the various explanations of tidal phenomena we find one hypothesis only more improbable than another.[1]

Schems' ed-Dîn-Mohammed of Damascus (El Dimishki)[2] advanced a theory in vogue in geological speculations; according to him, when the sun is in the signs of the zodiac in the south, as it is nearer to the earth, it exercises upon that hemisphere a much greater attraction, and, for that reason, the liquid particles are collected in that region. He thus vaguely foreshadowed the existence of the great ocean which is situated in that part of the globe.[3]

Arab Translations from the Greek translated into Latin.

The influence of the Arabs on the scientific knowledge of the later Middle Ages was considerable. This was due to the additions which their learned men made to the knowledge of nature, and, less directly, by the introduction, through their translations, of the works of Greek authors. In fact, it was from the translations from Arabic into Latin that the schoolmen became acquainted with ancient writings, chiefly those of Aristotle and Ptolemy, which played so important a part in the Middle Ages.

Views of the Schoolmen.

The schoolmen gave an impetus to the study of ancient literature, and, although they contributed but little to positive science, it is none the less true that they initiated a knowledge of Arabic and Greek authors, and thus powerfully helped forward the progress of science at the time immediately preceding the great geographical discoveries of the fifteenth century. The ideas of Hipparchus prevailed in the scholastic Middle Ages. The earth was a sphere; the schoolmen did not attempt to measure it as the ancients and Arabs had done, but accepted the calculations of Eratosthenes, and especially those of Ptolemy. In the Iberian peninsula the views of Mela, which were opposed to those of Hipparchus and Ptolemy, were very popular, and had much influence in leading up to the voyages of the Portuguese during the fifteenth century.

Roger Bacon.

Roger Bacon[4] adopted Aristotle's view that there was no great distance between Spain and India opposite to the habitable world. He makes no definite statement

[1] Mas'ūdī, *op. cit.*, vol. i. ch. xi. One story is the following :—"The angel to whose care the seas are confided immerges the heel of his foot into the sea at the extremity of China, and, as the sea is swelled, the flow takes place. Then he raises his foot from the sea, and the water returns into its former place, and this is the ebb. They demonstrate this by an example : if a vessel is only half full of water, and you put your hand into it, the water will fill the whole vessel, and when you take out the hand the water will be as before. Some think that the angel puts only the great toe of his right foot into the water, and that this is the cause of the tide" (p. 295).

[2] Died in 1327.

[3] Schems' ed-Dîn de Damas, Cosmographie, trad. par M. A. F. Mehren, p. 4, Copenhagen, 1874.

[4] 1214 to 1294 A.D.

regarding the distance,[1] but in support of the view that the space is not great he quotes Seneca, the passage in Esdras pointing to the ocean occupying only a seventh part of the earth's surface,[2] and the famous voyages to Ophir mentioned in the Bible.[3] Bacon's arguments and quotations were copied into the popular book by Petrus Alliacus called *Imago Mundi* published early in the fifteenth century. Columbus's own copy of this work is still to be seen at Seville with his annotations on the margin. Here he first became acquainted with the arguments of the Greek philosophers with reference to the probable extent of the habitable world, and their speculations as to the possibility of crossing the Atlantic to the coasts of India. It is probable that the reading of this book and these extracts from Bacon first suggested to Columbus the idea of a voyage across the Atlantic; it is not likely he had any direct acquaintance with the works of Roger Bacon.

Some interesting information regarding the opinions held during the Middle Ages with regard to the distribution of land and water is to be found in a treatise which is now almost universally admitted to be a genuine work of the poet Dante, who may be regarded as the herald of the Renaissance. Dante refers the elevation of the land above the water to the influence of the stars "by way of attraction as the magnet draws the iron, or by way of impulsion, generating impelling vapours, as in certain mountains." The tides are referred to the action of the moon. The sphericity of the earth and the equality of the level of the sea in different oceans are also discussed.[4] In the *Inferno* he makes Ulysses urge his companions to venture on a voyage into the great ocean beyond the Pillars of Hercules.[5]

Dante, 1265–1321 A.D.

Ristoro d'Arezzo regarded the dry land as occupying only one-tenth of the surface of the globe, and held the opinion that the waters of the ocean were accumulated in the southern hemisphere. We have already noted that this view was current among the Arabs. He states this definitely in his interpretation of the Arabian celestial charts. These celestial spheres only show the stars visible at the horizon of Cairo or Alexandria; no stars are represented at the South Pole. Ristoro supposed, from a consideration of these charts, that the earth was formerly completely covered by the sea, that afterwards, by a providential decree, the stars were all grouped in the northern celestial hemisphere, that the ocean waters had been driven towards the south, and, as a consequence of this retreat of the sea, land appeared in our hemisphere. He also pointed out that should the con-

Speculations on Distribution of Land and Water.

[1] R. Bacon, Opus Magnum, edidit S. Jebb, fol. 184, London, 1733. Roger Bacon gives two figures to illustrate the hypothesis that a narrow sea separates the eastern and western portions of the habitable world.

[2] See ante, p. 2.

[3] See Opus Magnum, fol. 183; Peschel, *op. cit.*, p. 202. Albertus Magnus had, before Bacon, expressed the idea that the ocean was not so immense as it was believed to be to the west of Spain. He says:—"Inter horizontem habitantium juxta Gades Herculis et Orientem habitantium in India non est in medio, ut dicunt, nisi quoddam mare parvum" (De Coelo et Mundo, lib. ii. tract. iv. cap. 11; tom. ii. fol. 146, Lugd. 1651). Albertus supports his view upon the text of Aristotle relative to elephants, which we have cited (p. 14).

[4] La Questione dell' Aqua e della Terra di Dante Alighieri, Opp. Lat. di Dante, ed. Siuliani, vol. ii.; see also Gardner, Nature, vol. xlvii. p. 295.

[5] Canto xxvi.

stellations be transported towards the south the state of matters would be reversed, and the sea would invade the emerged land.[1]

An anonymous writer explains the saltness of the sea as resulting from the action of its waters on the land of the coasts, from which they dissolve the saline and bitter parts.[2] Vincent de Beauvais caught a glimpse of the cause of atmospheric precipitation. He knew that the sea constantly lost water by evaporation, and that this was brought back to it again by springs and rivers.[3] Side by side with these correct ideas, many false ones are encountered bearing on meteorological questions, and fanciful interpretations are given regarding the cause of the tides. In general, the schoolmen do not offer any truths in addition to what was known to the ancients.

The ancients, who made so many excellent circumnavigations of the Mediterranean, never constructed general or coast charts of that well-known sea. The marine charts of the Middle Ages therefore demonstrate an immense progress in knowledge with regard to the morphology of the seas. The compass charts, or portulani, a name applied both to the charts and the accompanying sailing directions, made their appearance in Italy in the thirteenth century, and, for the most part, were intended for the navigation of the Mediterranean. Probably the most ancient is that of Petro Vesconti of Genoa, and bears the date 1311.[4] The development of commerce in the Mediterranean after the Crusades, and the knowledge of the compass which permitted voyages on the high seas, rendered the aid of these charts much more necessary than when ships followed courses from island to island, and from cape to cape. It was soon after this that marine maps came into use. These starred charts of the Italians and Catalonians, as well as previous productions of the kind, have no true parallels or meridians. They were traced by the aid of the compass, and were constructed without graduation. They present, however, especially in those parts much frequented by pilots, a remarkable fidelity in the contours and distances, and a surprising exactness in the general forms. The Black Sea, for example, differs but little from its representation on charts of the present day.[5] The charts of this sea used by sailors before the hydrographic exploration of Gauttier at the commencement of this century fell far below the Italian charts of the thirteenth century in exactness. The Mediterranean was represented more accurately on the portulani of the Italians than by Mercator. Several of these charts were designed in the Italian ports, some in the island of Majorca. They not only embraced the Mediterranean and the adjacent internal seas, but

COMPASS CHARTS OR PORTULANI.

[1] Peschel, *op. cit.*, p. 222.

[2] Vincentius Bellovacensis, Speculum Naturale, lib. v. cap. 9.

[3] Spec. Nat., lib. v. cap. 8.

[4] It is believed, says Vivien de St. Martin (*op. cit.*, p. 294), that a Venetian chart of the Black Sea, preserved at Venice in the library of St. Mark, dates from the commencement of the thirteenth century. It is known that the Black Sea was, in a way, a Venetian sea from 1204 to 1259; but he adds that the first dated chart, and consequently unequivocally authentic, is the portulano of the Genoese cartographer Petro Vesconti.

[5] See in Peschel (*op. cit.*, p. 217) for a representation of the Black Sea after a manuscript chart belonging to the library of Munich, dated the beginning of the fifteenth century.

extended into the Atlantic; the coasts of Europe as far as Flanders, the British Islands, and the coasts of Africa as far as Cape Bojador take definite form and are well drawn.

CATALAN CHART, 1375

The most remarkable of these compass-charts is known as the Catalan chart, now preserved in the National Library of Paris. It is a map of the world in six sheets, dated 1375, and is at once a planisphere and a marine chart. The author was a pilot of the island of Majorca. It indicates, in particular, the new islands discovered in the Atlantic and the coasts of the Caspian, and shows the greatest progress in the representation of the Indian Seas. It is on this Catalan chart that India appears for the first time as a peninsula, and the Indian Ocean is no longer a Mediterranean as had been previously represented. The coast of Africa is not limited towards the south, as delineated by Ptolemy and the Arabs.[1]

These charts are works of positive geography from their exactness, and they surpass in this respect the other like productions of the same time, whether maps of the world, planispheres, or written descriptions. In spite of their correctness, however, these portulani cannot be considered true scientific charts. It may be said that an exact knowledge of the coasts of the sea preceded that of the inland portions of the continents and large islands. Almost all peoples in the infancy of their civilisation possess graphic representations of their coasts, which may be regarded as not differing greatly from those possessed by the sailors of the period now under consideration. From the ancient Mexicans, Cortes received charts which enabled the Spanish navigators to find their way along the Mexican coasts; Parry discovered the Strait of Fury and Hecla by directing his course according to a chart drawn by an Esquimaux woman; Ross and M'Clintock, like Parry, made use of charts furnished them by the Esquimaux. However, the compass-charts added greatly to the knowledge of the forms of seas and oceans; the scientific element awanting in them is compensated for by the scrupulous correctness by which they are distinguished.

THE RENAISSANCE — MAPS OF FIFTEENTH CENTURY

A revolution took place through the Renaissance. Learned Greeks arrived in Italy after the capture of Constantinople in 1453, and the introduction of paper permitted the great geographical works of antiquity to be popularised. From the end of the fifteenth century planispheric representations without graduation were abandoned, and, after a lapse of a thousand years, maps were once more constructed on mathematical principles. The re-appearance of Ptolemy's Geography with its clearly drawn maps produced a profound effect in Western Europe. Nordenskiöld[2] says that when this great work was imported from the expiring Byzantine Empire in the fifteenth century it had the effect of an important discovery, which seized on men's minds at first with even more force

[1] On one of these maps, made by Andrea Biancho in 1448, H. Yule Oldham thinks America (the Brazil coast) is represented, but this, like all the evidence for pre-Columbian voyages, except the Norse, is extremely unsatisfactory (see *Proc. Roy. Geog. Soc.*, Nov. 1894).

[2] Nordenskiöld, A. E., Facsimile Atlas to the early history of Cartography, with reproductions of the most important maps printed in the 15th and 16th centuries; translated from the Swedish original by J. A. Ekelöf and C. R. Markham, p. 9, Stockholm, 1889.

than the re-discovery of the New World by Columbus. The influence of Ptolemy's Geography commenced from the time of its translation into Latin, for at that time the knowledge of Greek was slight even among the learned men of the West. The invention of the printing-press enabled seven large folio editions to be published before the end of the fifteenth century. Nearly all the geographical maps published from 1492 down even to 1570[1] were Ptolemy's, with additions from the compass charts of Mediterranean sailors, and sketches showing the more recent discoveries in the Great Ocean. Ptolemy's geographical conceptions prevailed throughout the whole period of great geographical discoveries, and were even imported into the early charts of America. It is interesting to note that *Cattigara*, which was an emporium in the extreme east of Asia in the time of Ptolemy, appears on the western coast of South America in the maps of the sixteenth century, for instance, in the map of Sebastian Münster, published in the Ptolemy of 1540.

During the thirteenth century the great Mongol conquests in Asia and eastern Europe opened up a way from Europe to China, and for nearly a century European missionaries and traders visited these little-known and fabulous countries in the far East. Among others, the three Polos—father, uncle, and son—returned to Venice, after an absence of twenty years, with their coats lined with diamonds, rubies, and other jewels, and spread them before their astonished and envious countrymen. Marco Polo's account of his travels was written down in 1299, but does not appear to have been generally known till about the middle of the fifteenth century. Roger Bacon and Dante, as well as the author of Mandeville's travels who copied from all sources, do not seem to have known about Marco Polo's adventures. The Chinese seas had, as we have pointed out, been visited by Soleiman and other Arab sailors during the ninth century, but these voyages appear to have been wholly unknown in western Europe. Marco Polo gave the first definite information as to the limits of the Asiatic continent towards the east. Ptolemy, it will be remembered, had united the east coast of Africa by unknown lands to the remote portions of Asia, which he regarded as indefinitely extended towards the east in "reedy and impenetrable swamps." The results of Marco Polo's travels are for the first time shown on the Catalan Chart of 1375, as noted above.

The necessities of commerce had, however, a most powerful influence in turning attention towards the Great Western Ocean; in transferring the centre of civilisation and commercial activity from the Mediterranean to the coasts of the Atlantic. The capture of Constantinople by the Turks in 1453 closed the overland trade routes to the east, which, for over a hundred years, had brought trade and wealth to Venice, Genoa, and Western Europe. Turkish pirates so overran the Eastern Mediterranean that

[1] When the first edition of the *Theatrum Orbis Terrarum* by Ortelius was published at Antwerp containing 53 maps in double folio. A second edition appeared the same year, and edition followed edition till 1612, the last containing 228 modern and 38 ancient or historical maps (Nordenskiöld, *op. cit.*, p. 124). (See Plate VI.)

Christian vessels were no longer safe. It became essential to look towards the external ocean for another route to India, Cathay, the islands of spices, and all the charms and riches of the East.

The revelations of Marco Polo concerning the great Eastern Ocean rendered it necessary to make important changes in Ptolemy's map of Asia. There is evidence that this subject was much discussed in European cities, where some few men took an interest in geographical questions. The great Florentine astronomer, Toscanelli, was apparently the first to give definite shape to the new views, and to discuss in a scientific way the subject of transatlantic lands. In the year 1474 he addressed a letter and a map to the King of Portugal, setting forth clearly that it was possible to reach the land of spices by sailing westward. Years afterwards, probably in 1480, Columbus asked Toscanelli for information concerning the way to the land of spices, which it was thought possible to reach by sea direct from Europe. Toscanelli replied by sending a copy of the letter and map he had previously sent to the King of Portugal, and at the same time encouraging Columbus to undertake the voyage across the Atlantic. Columbus is believed to have taken Toscanelli's map with him on his first voyage. The map has been lost, but has been reconstructed, chiefly from materials furnished by the globe of Martin Behaim, which bears the date of 1492.[1] (For reproduction of Toscanelli's map, see Plate VI.)

Towards the end of the thirteenth century two Genoese galleys are said to have been fitted out with the view of rounding Africa from the west and opening up a route to India; this expedition was unfortunate.[2] In 1346 a sailor of the island of Majorca, Jacques Ferrer, also attempted to follow the west coast of Africa beyond the Canaries, but he was not more successful than the Genoese had been. The Portuguese expeditions of the fifteenth century along the African coasts were, however, the prelude to the grand maritime explorations which resulted in the discovery of America and the circumnavigation of the world. Not content with having expelled the Moors from their territories, the Portuguese followed them across the sea into the continent of Africa. These armed voyages originated a long series of discoveries in the Atlantic.

PORTUGUESE EXPEDITIONS IN THE FIFTEENTH CENTURY

HENRY THE NAVIGATOR.

When, in 1420, Prince Henry the Navigator established his maritime observatory at Sagres, employed the best Italian map-makers and pilots, and commenced to give an impulse to the navigators of Portugal, these were so incompetent that they dared not venture more than six miles from the coast.[3] All the expeditions sent to round Cape Bojador, even up till the year 1433, returned unsuccessful, because a reef extended six miles seawards and barred the passage.[4]

[1] See H. Wagner, Die Rekonstruktion der Toscanelli-Karte v. J. 1474 und die Pseudo-Facsimilia des Behaim-Globus v. J. 1492, *Nachr. d. K. Gesellsch. d. Wiss. z. Göttingen*, Philol.-hist. Kl., 1894, No. 3, p. 208.

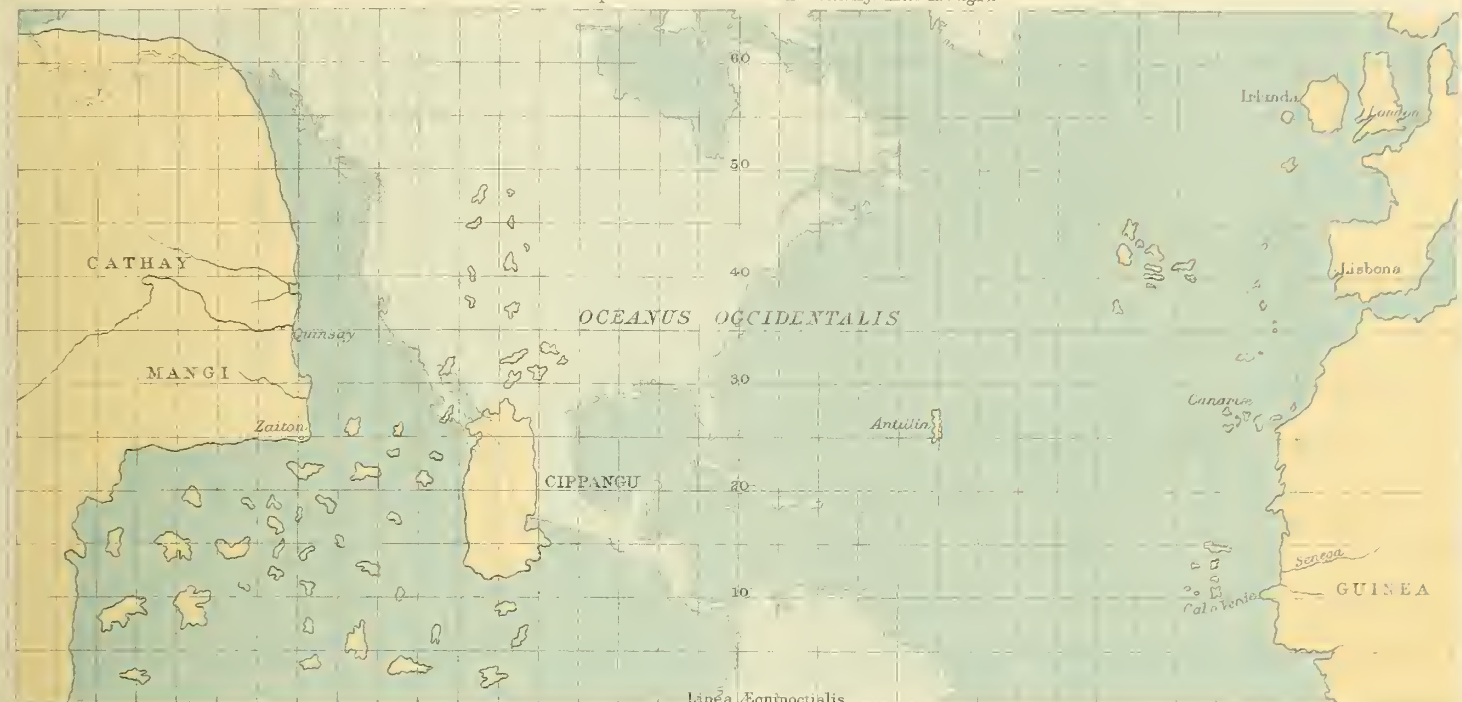
[2] The evidence for this expedition of the brothers Vivaldi (in 1291) is considered insufficient by R. H. Major.

[3] See Peschel (*op. cit.*, p. 237) concerning the instruments and methods employed by the Portuguese to determine latitudes at sea.

[4] See R. H. Major, The Discoveries of Prince Henry the Navigator, and their Results, ed. 2, p. 68, London, 1877.

ATLANTIC OCEAN
according to
TOSCANELLI A.D. 1474

The western part is reconstructed from M. Behaim's Globe.
the eastern part from charts of the XV Century. After H. Wagner.



Note. The Correct outline of North America is shown in light dotted line

TYPUS ORBIS TERRARUM

THE WORLD
according to
ORTELIUS
A.D. 1570

After many attempts this cape was cleared in 1433 or 1434 by Gil Eannes. Up to the time of Prince Henry's death, in 1460, the Portuguese had reconnoitred the African coast for about 1700 geographical miles, or about one-third of the distance to the Cape of Good Hope, which was finally doubled by Bartholomew Diaz in an expedition which set sail at the end of August 1486; thus for the first time was the true form of the African continent, as well as the communication between the Atlantic and Indian Oceans discovered. Diaz.

Columbus, while traversing the African and British seas, drawing charts and reading philosophical works, conceived the idea of those voyages of discovery which are always associated with his illustrious name. The successful expedition of Diaz made Columbus all the more impatient to start on his daring voyage across the Atlantic.[1] He calculated that there was an interval of not more than 90° between the Canary Islands and the eastern shores of Asia, and he estimated these 90°, on the parallel of the Canaries, at 1100 Spanish leagues, equivalent to five weeks of direct navigation; he thus erred in his calculations by 110° or about 2000 leagues. The doctrine of the Antipodes was far from being currently accepted; an instinctive terror was awakened at the idea of an immense unknown sea, at a time when the most daring navigators barely lost sight of the coasts. Yet Columbus successfully surmounted all the prejudices which prevailed in his day. It is not necessary to describe his embarkation at Palos, his rest at the Canaries, his passage across the Sargasso Sea, his struggles with his crew, his arrival in October 1492 at Guanahani. The examination of a part of the Greater Antilles was the fruit of this first voyage; the later ones do not relate directly to our subject. The Atlantic had been crossed, but the celebrated Genoese had no suspicion as yet of a still greater ocean beyond[2]; America was for him only the continent of Asia. In the newly-discovered land Columbus was further from the riches of Cathay than when he left Spain. He spent years in searching, on the opposite side of the world from its true position, for the kingdom of Kublai Khan, a hundred years after the Grand Khan's race had been driven from the throne of China. Columbus.

Bartholomew Diaz, as we have seen, not only reached the Cape of Good Hope in 1486, but passed to the east of it more than 140 leagues. A short distance further and he would have united the Portuguese discoveries to those parts of Eastern Africa known from an early date to the Arabs. At the same time that Diaz was sent towards the Cape, the Portuguese sent Pedro de Covilham by way of Egypt to Aden, and thence to Hindustan, Madagascar, and Sofala. It remained for the Portuguese merely to unite these voyages by a continuous one around the Cape and as far as India. This was accomplished by Vasco da Gama in November 1497; his fleet passed the Cape of Good Vasco da Gama

[1] Columbus' own brother, Bartholomew, is believed to have taken part in the voyage of Bartholomew Diaz around the Cape of Good Hope.

[2] In October 1502 Columbus, while in the neighbourhood of the Chirigui Archipelago, learnt from a native that at nine days' journey to the west there was another ocean. This was the first hint of the Pacific which reached Europeans.

Hope, and in May 1498 arrived at Calicut. Before twenty years had passed away the Portuguese pilots had mapped out the hydrography of the Indian and Chinese seas sufficiently for the first requirements of navigation. The circumnavigation of Eastern Africa was completed; the Red Sea as well as the Persian Gulf were recognised; the peninsula of India was drawn in its true form, as well as the transgangetic peninsula; and lastly, a great part of the archipelagoes extending from Sumatra to the Moluccas and New Guinea were visited. If it be remembered that these seas and shores were, we might say, absolutely unknown in Europe at the time Gama passed the south of Africa, and if we recall the incorrect representations given on Ptolemy's map and the maps of the fifteenth century, we shall appreciate the immense additions that the Portuguese made in so short a time to the map of the world, more particularly to the oceanic charts.

Portuguese in Eastern Seas.

Capture of Malacca.

When in 1511 Albuquerque carried Malacca by storm, a new centre of operations was created in the extreme east. Portuguese vessels radiated from thence in all directions through the archipelagoes of Oceania and towards the coasts of China. The coasts of Sumatra and Java were surveyed; the Sunda and Philippine Islands, Japan, Borneo, Celebes, and the north-west of New Guinea were explored.

Spanish Explorations.

The voyage of Columbus in 1492 was only the first step towards the discovery of the New World; it took many years and many voyages to complete the discovery of America. Other expeditions, official and clandestine, crossed the Atlantic in rapid succession.

The Cabots.

While the Cabots and the Cortereals explored the coasts of North America from Labrador to Florida, Columbus visited many of the West Indian Islands and the north coast of South America. Pinzon and Solis with Vespucci landed at Honduras, and coasted around the Gulf of Mexico;[1] Pinzon explored the coast of South America to 8° south; and Cabral was accidentally driven on the coast of Brazil in 1500, and explored from 12° to 16° south. This landfall of Cabral is interesting as showing that, even without Columbus, the discovery of America could not have been long delayed.

It has generally been held that Columbus lived and died in the belief that he had reached the Asiatic continent. We know that during his second voyage he made his crew affirm before a notary that Cuba was a part of Asia, and that as late as 1503 he wrote to the Spanish sovereigns that he had reached the province of Mango, near Cathay. In going west he believed he was approaching the mysterious realms of Prester John. Harrisse has, however, produced documentary evidence that some of Columbus's companions and contemporaries, nay even Columbus himself, had clearly recognised, as early as 1501, that the coasts of the New World were not the coasts of

[1] Varnhagen and Fiske appear to have satisfactorily explained the mystery about the first voyage of Vespucci; he sailed with Pinzon and Solis as pilot and cosmographer in 1497, explored the coasts of Honduras and Florida, and returned in October 1498 by way of Bermudas with 222 slaves on board (Varnhagen, Amerigo Vespucci: son caractère, ses écrits (même les moins authentiques), sa vie et ses navigations, Lima, 1865, and Le premier voyage de Amerigo Vespucci définitivement expliqué dans ses détails, Vienna, 1869; Fiske, The Discovery of America, chap. vii., London, 1892).

Asia represented on the chart of Toscanelli.[1] The absence of all domestic animals among the natives, as well as of all the civilisation, wealth, and display of the fabulous East, must have forced this conclusion on the mind of Columbus, although he may have felt that to acknowledge this to the Spanish sovereigns would have proved fatal to further discovery in the West. We know he prevented some of his companions who held these views from returning to Spain, fearing the result should such opinions be made known at the Spanish court. Indeed, as early as the second year of the sixteenth century, the eastern coast lines of the American continent had been more or less carefully examined from Labrador to the mouth of the Rio de la Plata, and every endeavour was being made to find a strait leading towards the Indies.

Pacific Discovered by Balbao.

On the 25th September 1513, from the summit of the Sierra Quarequa, Vasco Nuñez de Balbao beheld a boundless ocean extending towards the setting sun—the Pacific was discovered. During many years a passage into this further ocean was in vain sought for in all directions, towards the north as well as towards the south; this was finally discovered by Magellan.

Magellan.

Ferdinand Magellan, after a sojourn in the far east in the service of Portugal, returned home and devoted himself to serious cosmographical studies. He became convinced that the Spice Islands lay so far to the east as to be situated in the hemisphere reserved for the Spaniards by the decision of the Pope.[2] He consequently offered his services to the King of Spain, and proposed to reach these islands by a new and shorter route than that taken by the Portuguese. He embarked on the 20th September 1519; in the following year, on the 21st October, he entered the mouth of a passage in 52° south latitude, henceforth to be known as the Strait of Magellan. On the 28th November, on leaving the Strait, he beheld the mighty ocean. For ninety-nine days the vessels of Magellan ploughed the Pacific; on the 6th March 1521 the Mariana Isles rose before them, and ten days later the flotilla was in sight of the archipelago which was to bear the name of Philippines. Here Magellan lost his life in a fight with the natives of Mactan, but one of his vessels,—the "Victoria," in command of Sebastian del Cano—ultimately reached Spain in 1522.

First Attempt at Deep-Sea Sounding.

A memorable fact connected with this great expedition is the attempt of Magellan to determine the depth of the ocean. At that period the sounding lines carried by explorers measured from one to two hundred fathoms, and it was with the assistance of these that Magellan tried to sound the ocean in 1521 between the two coral islands, St Paul and Los Tiburones; he was, of course, unable to reach the bottom, and somewhat naively concluded from this that he had reached the deepest part of the ocean. Great historical interest attaches to this attempt, for it is the first authentic sounding ever

[1] Harrisse, The Discovery of North America, London and Paris, 1892, pp. 97, &c.

[2] This papal line was at first placed at 100 leagues to the west of the Cape Verdes, but by a later treaty at 370 leagues to the west (see August Baum, Die Demarkationslinie Papst Alexanders VI. und ihre Folgen, p. 54, 1890).

made in the open sea.[1] During his voyage Magellan also measured distances with the log.[2]

The voyage of Magellan was the greatest event in the most remarkable period of the world's history; it far surpassed all others in its effect on oceanographical conceptions. The memorable discoveries in the thirty years from 1492 to 1522 doubled at a single bound all that was previously known of the surface of the earth, and added a hemisphere to the chart of the world. The fiery zone of the ancients had been crossed, a death blow was dealt to Ptolemy's view that the Indian Ocean was an enclosed sea, the southern temperate zone of Aristotle and Mela had been reached. The sphericity of the earth, the existence of Antipodes, were no longer scientific theories but demonstrated facts. The impression produced on men's minds by these great events is without parallel, and their influence can be traced throughout all those great intellectual and moral changes which characterised the transitional period known as the Renaissance. Columbus, Gama, Magellan, America, the route to India, the circumnavigation of the globe; three men and three facts opened gloriously a new era of history, of geography, and especially of oceanography. By creating new relations, by enlarging the field of research, observation, and study, these men and these discoveries contributed more than anything else to the marvellous progress during the last three hundred years in all branches of human knowledge and to the rapid development of modern civilisation. (For voyages down to the time of Magellan, see Plate VII.)

D.—PROGRESS OF OCEANOGRAPHICAL KNOWLEDGE, FROM THE VOYAGE OF MAGELLAN TO THE VOYAGES OF COOK.

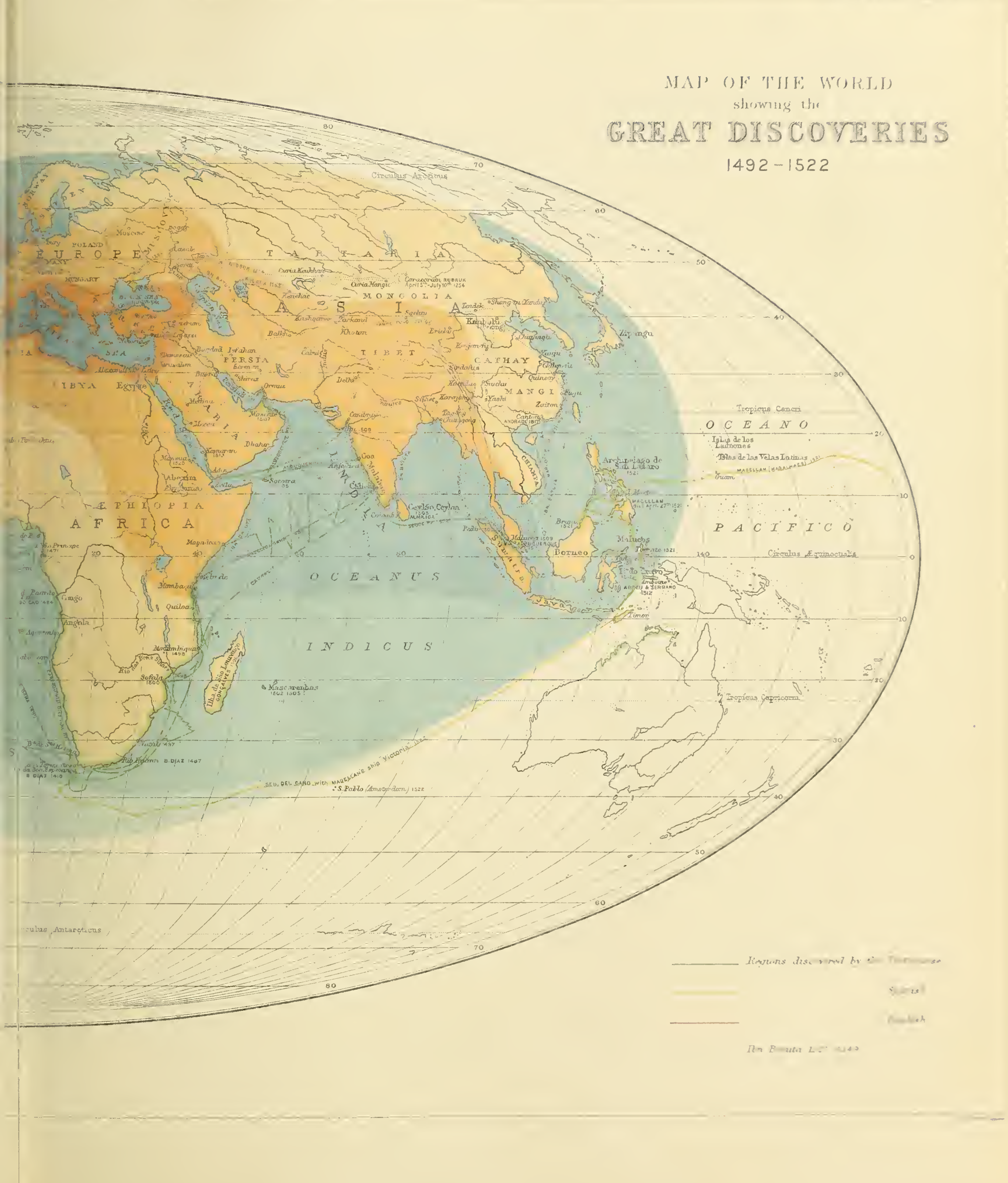
DRAKE.

While Columbus and Gama had within a few years many imitators in the Atlantic and Indian Oceans, fifty-seven years elapsed before Drake accomplished the second circumnavigation of the globe. Drake was the first to see the extreme promontory of South America, later on called Cape Horn. "At length the vessel (of the Admiral) found itself near the extremity of the country extending towards the South Pole, which extreme cape, or most advanced point of all these islands (Tierra del Fuego), is situated near the 56th degree. Beyond this, towards the south, we found neither islands nor

[1] Krümmel, Der Ocean, p. 35; Pigafetta (Premier voyage autour du Monde, p. 52, Paris, l'an ix) says:—"For three months and twenty days we sailed about 4000 leagues on that sea which we called the *Pacific*, because during all the time of our navigation we did not experience a single storm, neither did we discover any land, with the exception of two desert islands, in which we found nothing but birds and trees, and for this reason we named them the Unfortunate Islands. *We were unable to find any bottom along their coasts*, and saw only a number of sharks. These islands are 200 leagues apart, the first in 15° south latitude, the second in 9°."

[2] Pigafetta says:—"According to the reckoning we made with the chain astern, we ran each day fifty or sixty leagues" (First Voyage Round the World, Hakluyt Society, p. 65; Guillemard, Life of Ferdinand Magellan, London, 1890, p. [illegible]). The oldest description of the log, or logge, dates from the time of Bourne, 1577 (see Breusing, *Zeitschr. f. Erdkunde*, Bd. iv. pp. 111 *et seq.*); Bourne wrote the "Rules of Navigation." In the Encyclopædia Britannica (art. Log) we read that the log line was used in navigation as early as 1570, and alluded to by Bourne in 1578.


DISCOVERIES OF THE NORSEMEN
OCEANO PACIFICO
MAR DEL SUR
MUNDUS NOVUS
AMERICA
(since 1507)
OCEANUS
OCCIDENTALIS
MAR DEL NORTE
MERIDIONA
Tropicus Cancri
MAGELLAN (MAGALHAES) 1521
Nueva España
Mexico
Terra firma
Rio de Janeiro
Tierra del Fuego
Greenland
Martin Behaim A.D. 1492
A.D. 1507


MAP OF THE WORLD
showing the
GREAT DISCOVERIES
1492–1522
EUROPE
ASIA
TARTARIA
MONGOLIA
TIBET
CATHAY
MANGI
PERSIA
ARABIA
INDIA
LIBYA
ÆTHIOPIA
AFRICA
OCEANUS
INDICUS
OCEANO
PACIFICO
Borneo
Malucos
Circulus Arcticus
Tropicus Cancri
Circulus Æquinoctialis
Tropicus Capricorni
Regions discovered by the

continents, but only the meeting of the Atlantic and the South Sea, in a vast and free space."[1] In North America Drake reconnoitred a country, till then unexplored, on the western coast, from Cape Mendocino (in lat. 41½° N.) northwards to near lat. 48° N., not far from the Vancouver archipelago, now called the Oregon coast.

SEARCH FOR NORTH-EAST AND NORTH-WEST PASSAGES.

The search after a north-east passage from Europe to Asia must have been suggested by the form given to the northern part of the Asiatic continent in Ptolemy's map. Sebastian Cabot was one of the promoters of Willoughby's Expedition, which went in search of this passage in 1553. This expedition was a repetition of the periplus of Scandinavia formerly accomplished by Ohthere. One of the three vessels commanded by Chancellor reached the White Sea, and anchored in the harbour of Archangel, whence Chancellor proceeded to Moscow and concluded a commercial treaty with the Russians. In 1556 Stephen Burrough continued the discoveries of the preceding expedition, and reached the Strait of Kara, but proceeded no further. The attempts of the Dutch to pass around Asia by the north-east were not more successful. The fruitless expeditions of the Dutch have, however, left their trace on the history of navigation. To them we owe the discovery of the two largest islands in the boreal seas—Nova Zembla and Spitzbergen; on reaching the northern extremity of Spitzbergen, in 1596, in latitude 80° 11′ N., Barents had penetrated further north than any former navigator.

The idea of a north-west passage was revived twelve or fifteen years after Chancellor's voyage, but we need not follow the endeavours made in that direction by Frobisher, John Davis and Hudson, between the years 1576 and 1610, although their voyages furnished much information on the morphology of the northern seas.

At the time of Magellan the only coasts of America known were those laved by the Atlantic; of the western coasts only a very small part had as yet been seen, but on the coasts of Africa, Asia, and Oceania the work of discovery was continued and largely completed.

CHARTS OF THE SIXTEENTH CENTURY.

The maps drawn in the last quarter of the sixteenth century show at a glance the degree of knowledge arrived at regarding the New World. The general contour is as exact as could be expected from nautical surveys aided by the compass only, and based on determinations of latitude correct to within one-third of a degree, but without any astronomical longitudes. Two parts were still vague, viz., both extremities of the new continent. In the south the cartographers connected the unexplored lands about the Strait of Magellan with the vague conception of an austral continent of vast extent,[2] and this idea was long held. The nautical knowledge of the north did not extend beyond the latitude of 41° N. on the north-west coast and 65° N. on the north-east. The voyages of Mendaña, Queiros, and Torres added much to our knowledge of the Pacific Ocean. Many of the islands situated in the great Asiatic archipelago, as far as New Guinea, were

[1] Drake's World Encompassed, Hakluyt Society, p. 87.

[2] See Dalrymple, An Historical Collection of Voyages in the South Pacific Ocean, London, 1770; Major, Early Voyages to Terra Australis; Rainaud, Le Continent Austral, 1893.

visited during the sixteenth century; isolated points of the island-continent which was soon to receive the name of New Holland or Australia were seen, but out of the immense number of scattered Polynesian islands very few had been discovered, and their identification was most uncertain.

Geographical Discoveries of the Seventeenth and Eighteenth Centuries.

The geographical work of the sixteenth century was continued, but with less vigour, during the seventeenth century. The only considerable result of the investigations made in the Great Ocean during the seventeenth century was the discovery by the Dutch navy of the western half of New Holland, from the Gulf of Carpentaria in the north to about the middle of the south coast. Abel Tasman in 1642 showed that Australia and Van Diemans Land were surrounded by the ocean to the south, but the west coast of New Zealand, which he visited, was believed to be a part of the Great Southern Continent.

In the north, hydrographic explorations were continued, always with a view of discovering a shorter route to India. Hudson, in his last voyage in 1610, found near the 60th parallel the strait now bearing his name; the current coming from the west made him suspect the existence of a great inner sea, which was explored by himself, and in the following years (1612–1613) by Thomas Button. William Baffin (1616) hugged the western coast of Greenland as far as lat. 74° N., about $1\frac{1}{2}$ degrees higher than the spot reached by Davis, and, continuing to sail northwards in an open sea, he reached the strait which he named Smith's Sound, in lat. 78° N. He was unable to proceed further in this direction. Turning south-west, he discovered on the coast, in lat. 74° to 76° N., two wide openings, Jones' Sound and Lancaster Sound, the latter of which has played an important part in modern explorations. The name of Baffin's Bay has deservedly been retained for the enclosed sea to which Davis' Strait leads, and into which open important passages to the Polar Sea.

In the middle of the seventeenth century the relations of land and water had been observed directly on two-thirds of the earth's surface. In the Pacific, the Sandwich Islands, the Society Islands, the principal islands of the Navigator Archipelago, and the Viti Islands had been discovered, while the Marquesas, Santa Cruz Islands, and the New Hebrides had been discovered but lost sight of. The explorations in southern latitudes were less numerous, and many people still believed in the existence of a vast continent surrounding the South Pole, and extending into low latitudes. Half of the south-eastern coast of Australia was not yet known.

Absence of Voyages of Discovery from 1642 to 1764.

When, in 1728, the Russian expedition under Bering passed through the straits which bear his name, the discovery of the continent of America may be said to have been completed, and the new world stood revealed in its broad and general outlines. Bering made further explorations in the same direction, but after the numerous voyages in the preceding centuries the absence of discoveries for over a century before Cook is surprising. Every incentive seemed to be wanting among maritime nations at that time. All the regions offering immediate profit to the explorer had been discovered, commercial relations had been established, colonies had been founded, countries rich in precious metals had been conquered, and people rested in the enjoyment of wealth. The time had not yet come when civilised and educated nations would thirst for knowledge, and would send their vessels to investigate what still remained unknown regarding the sea. The expedition of Edmund Halley, in 1699, to improve our knowledge concerning longitude and the variation of the compass, was a purely scientific voyage; still scientific voyages were really initiated at the time of James Cook, in the latter half of the eighteenth century.

In the foregoing short account the important additions made to the knowledge of the distribution of land and water during the period under consideration have been indicated. Let us now turn to some other aspects of the science of Oceanography. After Magellan's voyage of circumnavigation the nomenclature of the sea assumed a modern character. Sebastian Münster, in the first general map in his Cosmography,[1] introduces the following denominations:—*Mare Pacificum, Mare Indicum, Mare Septentrionale* applied to the Arctic Ocean, *Oceanus Occidentalis* applied to the basin of the Atlantic north of the equator, and *Mare Aethiopicum* to the southern part of the Atlantic. Gerard Mercator, in his famous universal map, replaces the *Oceanus Occidentalis* of Münster's maps by *Oceanus Atlanticus*, corresponding to the North Atlantic, the southern part of the Atlantic is called *Oceanus Aethiopicus*, and at the western opening of the Strait of Magellan we read *El Mar Pacifico*.[2] NOMENCLATURE OF THE OCEANS. MÜNSTER.

According to Krümmel,[3] in the second half of the sixteenth century and beginning of the seventeenth, the term *Atlantic* was applied:—(1) to the sea lying to the west of Morocco (Münster); (2) to the sea to the south west of Liberia (Münster later); (3) to the north-west portion of that ocean (Michael Mercator); (4) to the whole of the North Atlantic (Gerard Mercator); (5) to the whole Atlantic (Varenius); and (6) to the Universal Ocean (Ortelius).

Varenius was the first to undertake a critical examination of this nomenclature, and he arranged it as follows:[4]—(1) The *Atlantic Ocean*, often called *Mare del Nort;* this is the sea enclosed between the western coasts of the Old World and the eastern coasts of the New. He divides the Atlantic into two parts, one north and one south of the equator; in the north this ocean joins the Hyperborean Sea, and in the south the Austral Ocean. (2) The *Pacific Ocean* (*Mare Pacificum*), often given the name of *Mare del Zur;* it is situated between America and Asia, and extends its immense VARENIUS.

[1] Münster, Cosmographia Universalis, Basel, 1544.

[2] This Spanish nomenclature, as observed by Krümmel (Versuch einer vergleichenden Morphologie der Meeresräume, Leipzig, 1879, p. 3), often used at that period, did not simplify matters. Thus we find a *Mar del Nort*, sometimes applied to the North Atlantic and sometimes to the whole Atlantic; a *Mar di India*, or even a *Mar del Zur*, standing for the Pacific. Traces of this singular nomenclature still exist in the names of two parts of the Nicaragua Republic, *San Juan del Norte* (or Greytown), being situated twenty miles south of *San Juan del Sur*.

[3] Krümmel, *op. cit.*, p. 6.

[4] Varenius, Geographia generalis in qua affectiones generales telluris explicantur, p. 82, Cambridge, 1672.

surface as far as the Indian Isles, the Philippines, and China. (3) The *Hyperborean Ocean* (*Oceanus Hyperboræus*), the north ocean stretching around the Arctic lands. (4) *Oceanus Australis* surrounding the Austral continent, of which the Indian Ocean is only a part. Other geographers, adds Varenius, divide the ocean into four parts, and adopt the following subdivisions:—(1) The Atlantic, to the north of the equator; (2) the Aethiopian Ocean, to the south of the equator; (3) the Pacific Ocean; and (4) the Indian Ocean. But he does not seem to attach great importance to this nomenclature; he says:—"Res non est magni momenti; sequatur quilibet quod ipsi optimum videtur. Magis enim a nostra fictione quam a natura dependet hæc divisio." It is important to note that this is the first time we find the Atlantic subdivided into two parts, as practised in our day. According to Krümmel, Guillaume Delisle adopted the following designations:—(1) The *North Sea* for the whole of the Atlantic with the name generally written north of the equator, although in certain maps it appears south of the equator; (2) the *Indian Ocean;* (3) the *South Sea,* occasionally called the *South Sea or Pacific*, sometimes the *Great South Sea*, but these names always apply to the whole Pacific.

Isobathic Curves—Buache.

The first attempt to represent the bottom of the sea by isobathic curves is to be found in a map by Philippe Buache in 1737. These isobathic curves are intended to show that certain elevations of the sea-bottom correspond with the orography of the neighbouring land. In his Essay on Physical Geography,[1] published in 1752, he develops these ideas, which may be summarised as follows:—

After the deluge the summits of the highest mountains formed a small number of islands; the waters falling, other islands of less altitude soon appeared, but still separated from the first. The waters continuing to recede, the higher ridges uniting these islands began to show themselves, then the table-lands formed by masses of mountains became visible, and finally the lower plains appeared. Had the water still continued to recede other lands would have appeared in succession, and the bottom of the sea would be a vast valley; it might then have been seen how the basins of the sea are diversified, and how the continents are united by submarine chains now hidden from view by the waters covering them. The directions of certain chains of islands, of rocks, of shallows, which cross the sea, seem to unite the chains of terrestrial mountains. The soundings of navigators, the observations on the currents and their directions, are almost incontestible proofs that the bottom of the sea differs from the land only in that it happens to be below the line at which the waters ceased to recede.

[1] Buache, Essai de géographie physique, où l'on propose des vues générales sur l'espèce de charpente du globe, composée des chaînes de montagnes qui traversent les mers comme les terres; avec quelques considérations particulières sur les différents bassins de la mer et sur sa configuration intérieure (*Hist. de l'Acad. des Sciences,* 1752, pp. 399 et seq.).

This arrangement of the bottom of the sea is the subject of Buache's work, and he arrives at the following conclusions:—The globe is sustained by several chains of mountains, which cross the sea as well as the land, and serve probably to increase the solidity of the globe; the chains of mountains are the framework of the globe, repeating an idea already expressed by Father Athanasius Kircher, who considered these chains as the "squeletæ ossatura globi." These mountains divide the sea into different basins, which appear to be united merely because the mountains enclosing them are, for the most part, covered with water.

CONTOURS OF SEA BOTTOM COMPARED WITH THOSE OF DRY LAND.

The marine valleys are not all equally deep. If the water of the channel separating France from England were withdrawn, a ridge of mountains uniting Dover and Calais would be left uncovered. Were the sea to subside still further, the Scilly Isles and the Isle of Wight would become mountains separated from England by valleys left dry. Were the waters to fall 60 fathoms, England itself would become a huge mountain separated by a valley from Normandy, and the bottom of the channel at its opening, which would then extend from the Isle of Ushant to the Scilly Isles, would become the sea border. Supported by these examples, drawn from a part of the ocean which he had carefully studied, Buache concludes that islands are but the summits of the highest mountains, and that they are frequently united by other mountains of less altitude, the existence of which has been proved by the sounding-lead. These submarine chains, according to the author, determine the division of the seas, and they are almost invariably the continuation of those we find on land.

Buache distinguishes three great seas. He calls the Atlantic *the Ocean,* and retains the appellation *Indian Sea* with the meaning attached to it by his predecessors; he calls the Pacific Ocean the *Great Sea;* lastly, he mentions two small frozen seas in the north and south. He divides the three great oceans by means of his submarine mountains into subordinate basins; thus *the Ocean* (the Atlantic) includes a sea of the *North of the Ocean,* a sea of the *North-West,* and an *Atlantic Sea of the Ocean.* The Gulf of Mexico is an annex in the west, as the Mediterranean and Baltic are in the east. All these subdivisions refer to what we now call the North Atlantic. He did not subdivide the South Atlantic, but gives the whole of that part of the Atlantic the name of *Southern Ocean of the Ocean.*

The *Indian Sea* comprises the *Gulf of Arabia,* embracing the Red Sea and the Persian and Arabian Gulfs, the *Gulf of Bengal,* and the *Archipelago of India,* limited in the west by the submarine chain uniting the coast mountains of Burmah with the north-west cape of Sumatra, to which belong as a ridge-line the Andaman and Nicobar Islands.

He subdivides the *Great Ocean* into *Northern Sea of the Great Ocean, South Sea* between the two tropics, and *Southern Sea of the Great Ocean.* These subdivisions, as shown by Buache's map, rest on his supposed submarine chains. This nomenclature did not find favour with scientific or seafaring men, with the exception of the name of "Great Ocean," which he gave to the Pacific.

The simplest manner of studying the relief of the globe is by dividing the land into drainage basins, separated by ridges whose infinite ramifications cover the continents with a natural network. Upon this primitive fact the French geographer bases all his theories of general geography. Doubtless Buache's ideas are fundamentally true, but they have one fault: like all theories which precede observation, they strain the facts and exaggerate the deductions. They are, nevertheless, a first step in the right direction towards a scientific method, founding geography no longer on an abstract line, but on the real form and relief of each region.

Buache's oceanic nomenclature was soon abandoned, but his conception of submarine mountains found more or less favour with Alex. von Humboldt, Bergman, Kant, Gatterer, Ritter, and Leopold von Buch. Börsch, in his work on Orography,[1] opposes these ideas, saying:—"The mountains which reach the shore should not be considered as being united with those running in the same direction in islands or in other continents." Hickisch,[2] on the other hand, thinks that although this proposition may be correct, it must not be taken in too absolute a sense, for the chain of mountains in the island of Nova Zembla should be considered as a prolongation of the Ural Mountains. Deep-sea soundings have proved that it is only in the vicinity of continental coasts and islands that the floor of the sea may be considered as a prolongation of the neighbouring land; these soundings have taught us to form a more correct idea of the orography of the sea, and have reduced hypothetical conceptions to their real value.

With the discovery of America and the circumnavigation of Africa a new era opened for navigation. Endeavours were immediately made to find more accurate methods of ascertaining the position of vessels in the open sea, and more care was bestowed on the construction of charts and the errors of the compass. The voyage of the Astronomer-Royal, Halley, in 1699, was undertaken solely with these objects in view, and was followed by the construction of a variation chart, and proposals for finding longitudes from occultations of fixed stars.

Progress of Cartography in the Sixteenth, Seventeenth, and Eighteenth Centuries.

We have seen that the art of drawing up maps was cultivated in the fourteenth and fifteenth centuries by the seafaring nations of the Mediterranean, and marine charts improved more rapidly than maps of the land. In the sixteenth century this art passed into the hands of the Spaniards and Portuguese; about the middle of that century the German draughtsmen took the lead; towards the end of the sixteenth and during the seventeenth centuries the Dutch and Flemish map-makers flourished, and were afterwards superseded by the French.

[1] Börsch, Von den Unebenheiten des festen Landes, insbesondere von Gebirge, Marburg, 1817, p. 16.
[2] Hickisch, Das System des Urals, Dorpat, 1882, p. 229.

The Governments of Spain and Portugal endeavoured to have charts drawn up with the greatest possible accuracy. King John II. of Portugal created a commission for the further development of these sciences; Martin Behaim was one of its members. In Spain Amerigo Vespucci was appointed Chief Pilot in 1508, and soon became the head of a hydrographic bureau, superintending the execution of charts. These charts were prepared with scrupulous care, and became the types from which others were drawn. It was ordered at the same time "that henceforth all navigators sailing towards known or unknown parts of India, who should discover new regions, islands, harbours, or bays affording some interest for the general chart, should, on their return to Europe, report the same to the Chief Pilot, so that all these indications might be noted on the large chart." This was a formal order issued to all sea-captains, and must have led to the acquisition of much information respecting the ocean; but the information did not spread abroad for some time. The Portuguese forbade, under pain of death, the exhibition of the charts showing the route to Calicut. Some idea may be formed of the importance which they attached to the proper construction of these charts, when we remember that in Spain they sent for foreigners to correct or complete these documents. It was for this purpose that, in 1512, the celebrated English navigator Sebastian Cabot, and, in 1515, the Roman Antonio Maurino, repaired to Spain.

The Universal Chart, executed at Seville in 1527, which is now in the Library of Weimar, and a second similar chart, of 1529, bear the first hydrographic signs—crosses and dots for reefs and other dangerous spots; these are also to be seen in the first printed portulano published in Venice in 1528 under the title of "Portulano delli Lochi maritimi ed Isole del mar di Pietro Cappo." Ortelius (1527–1598) published the first atlas under the title *Theatrum Orbis Terrarum* (1570).

THE FIRST HYDROGRAPHIC SIGNS.

Cabot observed with great care the changes in the variation of the compass, and he first made allowance for magnetic changes; after the first thirty years of the sixteenth century navigators were careful not to neglect this datum when drawing charts. Charts were further improved by a more accurate outline of the sea-coast, and by more precise indications of the position of each of the points; the progress made in this direction was in direct relation to the improvement in the methods used for determining latitude and longitude, and the improvements made in nautical instruments. There was, however, a certain slowness in attaining these improvements. At the commencement of the period under consideration the charts in use were still drawn up with the mariners' compass. P. Nuñez, a Portuguese, was one of the first to draw attention to the defects of these charts. It was reserved for the Germans, the Dutch, and the Flemish to introduce, towards the middle of the sixteenth century, scientific modifications in cartography.

The astronomers Stabius and Johann Werner, and after them Varenius and Hase, developed the stereographic projection, and applied it to the representation of terrestrial surfaces. In 1514 Werner produced a stereographic projection of the globe, as far as the tenth degree south latitude, at the horizon of Nuremberg. But a more important modification was introduced by G. Mercator, who, towards the middle of the sixteenth century, invented his well-known method of representing the whole surface in true bearings, which was destined to render such signal services to navigation.[1] The researches of Ed. Wright, relating to the theory and construction of these charts,[2] and those of Henry Bond and Gregory (1668), added to the advantages this method offered to navigators. This cartographic process was created at a time when marine charts were far from being complete. Henceforth it was no longer necessary to trouble about finding a system of projection, and attention could be devoted to improving the charts in all points useful to mariners.

MERCATOR'S CHARTS.

Although the science of geography made rapid advances, owing to the great voyages of discovery, still the progress of those branches of geodesy relating to map-making was slow. Distinct advances, however, are to be observed in the Cosmographia of Sebastian Münster as early as 1544, and in the triangulation of Snellius in 1615. The methods already known for determining longitudes were developed, while other methods were invented, and when the astrolabe was replaced by the sextant (octant), invented, it has been said, by Newton about 1700 and quite independently by Hadley in 1731, mariners possessed the means of establishing the position of places with tolerable accuracy.[3]

METHODS OF DETERMINING LONGITUDES.

The seventeenth century was a remarkable period for astronomical and mathematical studies, on which the exact knowledge of the globe rests, and by the end of that century sufficiently numerous astronomical observations had been made to determine the position of many points on the earth's surface, and hence to allow of the errors in the charts being rectified. The great French geographer, Guillaume Delisle, undertook this herculean task, and his work was continued by Bourguignon d'Anville, who was 29 years of age when Delisle died in 1726. D'Anville was superior to his predecessor, especially as regards workmanship.

HYDROGRAPHIC SIGNS IMPROVED.

Progress was soon manifest in the indication of depths, hydrographic signs, the first meridian, the scale, the orthography, the type, &c. As to hydrographic signs, crosses were used to show reefs and rocky bottoms; sandbanks and shallows were marked with dotted lines or masses of dots; other hydrographic signs were introduced at a later period. Marine charts, as compared with land maps, present some differences. In marine charts the sea is left white, the coasts alone are distinctly marked, and the mountains inland are only represented when of service to the mariner for finding out his bearings; on the sea area are shown the soundings, the shallows, the currents, the tides, the compass, &c. Even at an early period note was taken of the nature and the colour of the bottom of the sea, for these characteristics might be of service to seamen in a fog as denoting the approach to land.

[1] Mercator's map on this increasing cylindrical projection was first published in 1569.
[2] Certain Errors in Navigation, London, 1610.
[3] The sextant was also invented independently by Godfrey of Philadelphia in 1730.

The soundings which could be ascertained with the appliances then in existence were noted in the charts, but only on some points of important coasts. The oldest bathymetrical charts of the North Sea, the English Channel, and the British coasts, show such soundings at points near the coasts, for instance, in the chart of G. Mercator, representing the "Hollandt Comitatus" (completed in 1585), and in the charts of Lucas Janszoon, Waghenaer of Enkhuyzen (1586) who, by his Spieghel der Seevaerdt, became the founder of nautical map collections.[1] These authors were imitated by William Blaeu and Jan Janszoon.

As the soundings multiplied, it became more difficult to place them on marine charts without detriment to their clearness. It was then sought to represent them by a method, the first application of which to charts is due to Philippe Buache. This geographer, whose ideas on the classification of the oceans have already been mentioned, was led by his researches to study the bottom of the sea, and he endeavoured to find the means of representing its inequalities. With this view he introduced curves of equal level, and, from what has been stated of his views, it will be seen that he was indeed a man to whose mind this improvement would naturally suggest itself. This important innovation in the tracing of charts, now even more generally employed in the representation of land surfaces, was applied to the sea for the first time in a chart of the English Channel drawn by Buache in 1737, in which he traced, according to soundings made every ten fathoms, isobathic curves, or curves of equal level.[2]

Use of Isobathic Contour Lines on Charts.

The bathymetrical indications shown on certain marine charts of the time, and the labours of Buache just referred to, lead us to speak of the knowledge possessed during the seventeenth century as to the depths of the sea. The requirements of navigation undoubtedly led to the earliest bathymetrical observations, at first confined to the vicinity of the shores and comparatively shallow waters. But when the scientific movement began in earnest, there were minds prepared to investigate everything regarding the sea, knowing that, in order to have an accurate notion of the form of our planet, it is important not only to measure the elevation of the surface above water, but also to sound the hidden depths of the ocean. Notwithstanding, very little progress was made in the bathymetry of the sea, on account of the difficulties which beset such investigations. If in our day, when so many able instrument-makers have taxed their ingenuity to devise new appliances for deep soundings, there still remain many improvements to be made before accuracy is secured, it is not astonishing that the first attempts proved unsuc-

Progress of Knowledge regarding the Depths of the Sea.

[1] In 1588 a reproduction of this atlas appeared in London as the first "waggoner."

[2] According to Licka (Zur Geschichte der Isohypsen, *Zeitschr. f. Vermessungswesen*, Bd. ix. p. 40), the French engineer Millet de Mureau was the first, in 1748, to place on plans of forts numbers indicating the altitude near each point levelled. He did not, however, succeed as yet in uniting points of equal altitude by a contour line, an idea which the Dutchman Cruquius had put in practice twenty years before when sounding the river Merwede. Buache, as we have said in the text, is nevertheless considered as the first to make use of isobaths for the sea (see Günther, Lehrbuch der Geophysik, Bd. i. p. 289, Stuttgart, 1884).

cessful. These rude attempts are not devoid of interest, since they showed progress in the knowledge of the physico-chemical and biological phenomena of the sea.

From the most remote ages soundings have been made by hand with a plummet.[1] Varenius pointed out, during the seventeenth century, the difficulties that beset deep-sea soundings.[2] But, long before the time of this famous geographer, endeavours were made to surmount the difficulties attending direct sounding by substituting for the sounding-line and lead an apparatus, the original idea of which is due to Cardinal Nicolaus Cusanus.[3]

Cusanus' Sounding Apparatus.

Generally speaking, this apparatus consisted of two bodies, one lighter than water the other heavier, so connected that when the heavier body touched the bottom the lighter one became self-detached and rose to the surface alone, the depth being calculated from the time required for the apparatus to sink to the bottom and the float to rise again to the surface. Such is the principle on which the first bathometers with self-acting floats were constructed. According to Poggendorf,[4] the bathometer of Cusanus consisted of a hollow sphere, having a weight attached by means of a hook, which became detached on the weight touching the ground; the weight was intended to carry down the sphere with a certain degree of velocity.[5]

Puehler's Apparatus.

About a century later Puehler[6] took up Cusanus' idea, and devoted the 44th chapter

[1] Herodotus says : " On approaching Egypt by sea, when you are still a day's sail from the land, if you let down a sounding line you will bring up mud, and find yourself in eleven fathoms of water, which shows that the soil washed down by the stream extends to that distance " (Herod. ii. 5).

[2] In 1671 he wrote:—"Nautæ profunditatem explorant bolide, cujus materia est plumbea, figura pyramidalis, pondus duodecim circiter librarum, si funis sit trium vel plurium librarum, qualis sufficit ad ducentas perticas, etsi alii requirant bolidem plurium librarum, possunt tamen in hac observatione decipi, si funus ab aquæ vorticibus et undis abreptus non perpendiculariter sed oblique descendat" (Varenius, *op. cit.*, lib. i. prop. vi. p. 144).

[3] 1401–1464.

[4] Poggendorf, Geschichte der Physik, p. 116, Leipzig, 1879.

[5] In Cusanus' work : De Staticis experimentis fragmentum, which is added to Vitruvius' edition of Bâle, 1543, a mechanician speaking to a philosopher says:—"Cum plumbo fieret formato ad instar lunæ octodicrum, ita tamen quod cornu unum sit ponderosius et aliud levius, et in leviori pomum aut aliud leve tali instrumento appendatur quod plumbo in fundum pomum trahente et primum cum ponderosiore parte terram tangente et se sic successive, inclinante pomum de cornu liberatum sursum revertatur."

[6] See Gunther, Lehrbuch der Geophysik, Bd. ii. p. 329. We give here the original text of Puehler relating to this apparatus :—"Erstlich solt du ein rund hole Kugel von Metall, als von Zyn oder kupffer, auff das allerdinnest geschlagen unnd dermassen gantz gemacht machen, dass kein tröpflin Wasser darein gehe, wann die Kugel, als du hören wirst, in das Wasser gesenkt wirdt unnd soll ein örlein von einem runden messenen Drat darauff gelötet sein. Darnach nimm ein vierecket ebengeschlagen Plech, auch von Metall gemacht, welches lenger, dann es breit ist, soll sein : unnd an dem ort der lenge breiter denn an dem andern : und soll auff der einen lengen seitten bey den breitten ort des plechs einen runden angel für sich geschossen, und zuruck gebogen haben : an dem andern ort diser seitten, soll es einen für gehenden fuss haben, der sich auch von dem plech zuruck dermassen herablasse : damit das plech, wenn es mit der hohlen Kugel gesenckt wirdt, und der fuss den boden oder den grund in dem wasser erraichet, für sich sinck, unnd sich mit dem Angel aus dem orlein der Kugel ziech, unnd die Kugel also künne von dem plech müssig und ledig werden. Gestalt und form des plechs und der Kugel hastu in nachfolgender Figur. Das plech aber soll an dem fuss also schwär sein, wenn der fuss an dem plech nicht wäre, dass er allein die Kugel rincklich gen boden kan ziehen. Darnach soltu Dir ein erdenes fass lassen machen, das mit hoch, sunder breit, wie ein erden handbeck, wol gebrennet, und glasürt sey : und mitten an dem Boden, ein kleines lochlein hab: dises Instrument solt Du zuvor also zubereiten und probieren, an dem ort des meers oder wassers, dass du das Instrument widerumb waist auss dem wasser zu gewinnen, und die tieffe des wassers mit einer mass, als einem pleysenckel etlicher klafter lang kanst abmessen, thu das plech mit seinem angel in das orlein der Kugel und halt die Kugel in der hand, und das plech an die Kugel hange, und lasse daz plech in daz wasser

of his Geodesy to the study of the question: "Wie die Tieffe einers Weihers, Graben, See und anderer stillstehender Wasser, sollen künstlich abgemessen und ergründet werden?" He takes a hollow tin or copper sphere, hermetically closed, and provided with an eye by which a metal plate is attached. The top of the plate is furnished with a hook fitting into the eye of the sphere, the under part being fitted with a heavy foot. Whenever the apparatus touches the bottom the sphere is freed from the hook, and returns to the surface. This is exactly the idea of Cusanus, but Puehler added an apparatus to act as a clepsydra, measuring the time the sphere takes to re-appear. For this purpose he advises the use of a clay vase with a small hole at the bottom. The moment the bathometer is dropped, the vase is applied to the surface of the water, which filters through the small orifice at the bottom. He had noted the quantity of water entering the vase in a former experiment with his bathometer in water of which he knew the depth.

Cusanus' idea was again taken up by a Neapolitan architect named Alberti, of whom Blancanus[1] speaks in a work on architecture. Alberti describes an apparatus consisting of a heavy sphere (a) and a light bent metal tube (b), which is released on touching the bottom, and acts as a float. He says:—"Given water of known depth (p), b requires t (time measured by the clepsydra) to return to the surface, then you have for an unknown depth $t_1 : t = p_1 : p$, $p = \frac{tp_1}{t_1}$. ALBERTI'S APPARATUS.

Cusanus, Puehler, Alberti, and all their successors who have endeavoured to solve the problem of the depth of the sea by means of apparatus with self-detaching floats, take it for granted that the descent of a heavy body through a resisting medium, such as water, is always uniform. This is only approximately the case. One might, indeed, admit that, when the appliance goes down, the velocity is very nearly uniform, for resistance here paralyses acceleration; but we must also admit that there will be acceleration of motion when the float, detached from the weight, returns to the surface.

More than a century later Robert Hooke continued these bathymetrical experiments. He had a sphere made of wood, well varnished, and provided with a steel spring, to which a piece of metal was suspended; this became detached on coming in contact with the bottom, and allowed the float to ascend.[2] Soon after this Rochon made experiments in the Indian Ocean with a modified apparatus of this celebrated English physicist. But HOOKE'S APPARATUS.

sinken: und wenn du das erden gefäss auf daz wasser setzest und das wasser berürt, lasse die Kugel auss der hand: darnach sihe wenn die Kugel uber daz wasser auffart: in dem selben augenblick verhalt das löchlein das an dem boden des erden gefäss ist: als dann weg das wasser das in den erden gefässe gefunden auf das aller fleyssigest, merck das gewicht, wie schwär es gewogen hat: dergleichen süchte oder messe auch die tieffe des wassers, an dem ort da du das instrument gesenkt hast: und was für eine Proportion der Zal der Schwäre des gewichts des wassers zu der Zal der klaffter und tieffe des wassers hat: solche Proportion wird auch haben die zal oder schwäre des wassers in dem erden gefässe gefunden, wie jetz gesagt, zu der zal der Klaffter, die die tieffe des wassers ist" (Ein kurtze und grundliche anlaytung zu dem rechten Verstand Geometriæ, Dillingen 1563, p. 652).

[1] Blancanus, Sphæra mundi seu Cosmographia, Mutinæ, 1635, pp. 1470 *et seq.*

[2] See *Phil. Trans.*, vol. ii. pp. 439 *et seq.*, 1667 (reproduced in the tail-piece to this Introduction).

it was almost impossible to determine exactly the moment when the float returned to the surface, and Hooke endeavoured to obviate this defect by a new apparatus, which he presented to the Royal Society in 1671. This improved "Explorator profunditatis, distantiæ, abyssi," had a sphere with a hole through the diameter, in the orifice of which he placed an axis with inclined blades. During the descent of the bathometer a hand connected with clockwork was set going by an endless screw, and acted as a marker. As soon as the weight was detached at the bottom, a spring closed the orifice with a valve and stopped the clockwork during the ascent. Lastly, a third improvement was introduced by Hooke. A vertical rod bore the wooden sphere intended to return to the surface, having on the upper part a float or buoy to show more distinctly the moment of emersion. The apparatus was provided, moreover, with two odometers—the one to register the descent, the other the ascent. The weight of the bathometer was held by a spring-hook; Bacciali replaced this by clutches, the arms of which held the sphere during the descent and opened to let it go on touching the ground.

These methods and bathymetrical apparatus increased but little the bathymetrical knowledge of the sea, and rendered insignificant services as regards soundings. The soundings taken during the period under consideration were made in the usual manner with lead and line, and were confined to spots near the coasts and in comparatively shallow waters. We have noted the fruitless efforts of Magellan to sound the Pacific; apart from this detail, which has only historical interest, there is little progress to record.

Kircher's View as to the Depth of the Ocean.

Father Athanasius Kircher, in his encyclopædic work Mundus Subterraneus, devotes a chapter to oceanographical questions.[1] After having given the nomenclature of the oceans, and indicated the subterranean rivers supposed to feed the Caspian, so often mentioned by the ancients, he examines the opinions accepted in his time as to the depths of the sea. His doctrine that the deepest seas were to be found opposite the loftiest mountains was adopted by many. Kircher sums up his opinion on the subject thus:[2] "In the same manner as the highest mountains are grouped in the centre of the land, so also should the greatest depths be found in the middle of the largest oceans; near the coasts with slight elevations, the depth will gradually diminish towards the shore. I say coasts with slight elevations, for if the shores are surrounded by high rocks, then greater depths are there found; this is proved by experience on the shores of Norway, Iceland, and the Îles de Flandres." He imagines the bottom of the ocean, over its whole extent, to be very uneven. The marine plains must be found in those places not thronged with islands, where the declivities of the oceanic mountains are not pronounced. He brings forward scanty proofs in support of his theory, his experiments being mostly made on the sea-shore. He concludes by saying: "Ex his adductis patet, quam hallucinentur, qui putant, maris profunditatem ubique aut æqualem esse, aut determinari posse certam ejus profunditatem; tam enim

[1] Kircher, Mundus Subterraneus, Amst., 1664, p. 85. [2] *Ibid.*, p. 97.

id difficile est, quam difficile montium per universam telluris superficiem diffusorum altitudines certa ratione inquirere; ut proinde illud huc quadrare videatur: altitudinem cœli, latitudinem Terræ, profunditatem maris quis mensus est?"[1]

Varenius[2] states that the depth of the sea may reach one German mile; at certain points the depth varies from $\frac{1}{80}$, $\frac{1}{20}$, $\frac{1}{10}$, $\frac{1}{4}$, to $\frac{1}{2}$ a mile. But, as in the case of Kircher, this opinion is not founded, with regard to great depths, on actual soundings. Varenius explains why the sea becomes shallower as the shore is approached, by saying that it is due to the concave form of the ocean basins. We have given Kircher's arguments against those who maintained that the bottom of the sea was a plain with few elevations, and those who professed that it was possible for man to determine the depth of the ocean. Varenius tries to show that the sea is not infinitely deep; the earth being a sphere, the radius cannot be infinite, nor, therefore, the depth of the sea. And, besides, the sea has a bottom; it does not extend from one point on the earth's surface to any other opposite point, for if the land were to be thus divided by the sea, it would, owing to its weight, immediately come together again. The observations made in the Mediterranean led Varenius to believe that some relation does exist between the height of the coast and the depth of that sea.

Varenius' Views on the Depth of the Sea.

Similar ideas as to the depth of the ocean were developed a century later by Marsilli in his Histoire physique de la Mer. Marsilli argues that the bottom of the Mediterranean in the Gulf of Lions is not only united with the shores, but forms a continuation of them; he rejects the opinion of the coral-fishers that those parts of the sea situated further from the shores, and called abysses, have no bottom. He says:[3]—"The fishermen, working on that slope where they are in the habit of finding coral at 150 and 200 fathoms, and their lines not allowing soundings in greater depths, imagine that the bottom cannot be found, and call it, in their exaggerated jargon, a bottomless abyss, impossible to be sounded. This idea, entertained by people of experience in marine matters, as well as by the simple fishers, appears to me absurd, and founded merely on the fact that nobody has yet cared to undertake the trouble and expense required for such soundings, which, according to all appearances, will never be made unless some prince orders for that purpose special vessels with suitable instruments. With regard to seamen, they never seek the bottom in deep waters. . . . . . My various observations on the highest mountains of Europe, which I took with the barometer, induced me to seek the greatest depths of the sea, deeming that under the water, abysses of corresponding

Marsilli's Notions on the Abysses of the Ocean.

[1] *Ibid*, p. 97. In the following chapter (cap. xv., De inæqualitate fundi maris cui jungitur Historia memorabilis supradicta confirmans, fol. 98, 99), Kircher confirms what he has just said on the irregularity of the sea-bottom by the history of the famous diver Pescecola, an authentic account of which was given him by the Secretary of the Royal Archives of Sicily. This account is almost as fabulous as that which we quoted from Mas'ūdī, on the foundation of Alexandria, and represents tolerably well the ideas then prevalent regarding the animals peopling the bottom of the sea, regarding the lower currents, and the form of the bottom.

[2] Varenius, *op. cit.*, p. 143.

[3] Histoire physique de la Mer, par L. F. Comte de Marsilli, traduit par H. Boerhaave, Amsterdam, 1725, p. 10.

depth must be found. The St. Gothard in Switzerland is the highest mountain I have as yet visited, but as I have not its exact altitude, I will take the one nearest to our shores, viz., Mount Canigou, which Mr Cassini, while tracing the Meridian of the Royal Observatory of Paris, which is carried through the entire length of France, found to be 1400 fathoms above the level of the sea. I have applied this rule to the depth where the bottom begins to descend rapidly, and also to a spot where Mount Canigou begins to rise, to form a section, wherein one may see at a glance the connection between these two points, equally distant from the greatest height of the mountain and the greatest depth of the sea.[1] This demonstration sufficiently proves, I think, that the unknown depth of the sea corresponds with the greatest height of the mountains on land, for it is easy to see that both are formed of superposed strata, lying at a certain ascending or descending angle."

Marsilli allowed himself to be carried away by his love of symmetry; he does not adduce one fact in support of his theory on the depths of the sea. But his work, which is interesting in more than one respect, deserves to be quoted, because it reflects the ideas of the time in which it was written, and also because the section he gives is the first attempt to graphically represent the relief of the globe. Marsilli held, along with the most able seamen whom he had consulted, that the greatest depth of the Mediterranean was abreast of the island of Malta. The seamen had also observed that when the shores are high and vertical the sea is very deep.

Marsilli on Marine Deposits.

Marsilli makes a few observations on the knowledge then possessed concerning the nature of the bottom of the sea. He believes that the basin of the sea was excavated "at the time of the creation, out of the same stone which we see in the strata of the earth, with the same interstices of clay to bind them together."[2] He adds that we should not judge of the nature of the bottom by the materials which seamen bring up in their soundings. They dredge almost always on a muddy bottom, and very rarely on a rocky one, because the latter is covered with slime, sand, sandy, earthy, and calcareous concretions, and organic matter. These substances, he says, conceal the real bottom of the sea, and have been brought there by the action of the water; they always cover stony masses. "Lastly," he adds, "to explain myself briefly, I may compare the bed of the sea to a cask, which, having long held wine, seems from the inside to be made of dregs of tartar, though it is really of wood." In the profiles accompanying his work, he has marked with dotted lines the stony parts of the bottom; he distinguishes those which are covered with fine sand or with a sandy conglutination; the part covered with fine sand is always that exposed to the flow of rivers.

[1] The figure (Marsilli, *op. cit.*, pl. iii. p. 4, profiles or sections of the basin of the sea) shows the profile of Mount Canigou, the highest mountain in the Pyrenees, the height of which is 1400 fathoms, down to Cape Rose in Catalonia. It extends into the sea for a distance of 54 miles south-east, and at that point lies the abyss, which is as much below the surface of the sea as the mountain is above it.

[2] Marsilli, *op. cit.*, p. 14.

The rise, during the fifteenth century, of Geology, which includes the oceanographical changes of past ages, gave an impetus to many questions relative to the distribution of land and water in past times, and led to an investigation of many phenomena in existing oceans. Leonardo da Vinci, in the fifteenth century, wrote that the sea changes the equilibrium of the earth, that the shells accumulated in various layers have necessarily lived on a spot previously occupied by the sea; that the great rivers carry into the ocean the waste of the land, and the deposits thus formed have been successively covered by others of varying thickness, and finally that the bottom of the sea has become the tops of mountains. RISE OF GEOLOGICAL KNOWLEDGE. VINCI.

Ever since that period researches have constantly been made by naturalists to discover the relationship between the marine animals of our own time and those discovered in a fossil state. The name of Steno, a Dane, is associated with the evolution of general ideas as to the formation of the earth. In his famous work: De solido intra solidum naturaliter contento dissertationis prodromus (1669), he endeavours to show that the carapaces of Crustacea are formed of matter secreted by the animal's body; he establishes the connection existing between fossils and the sedimentary layers containing them, and the true origin of both. He was the first to distinguish the layers formed in the sea from those deposited in fresh water, and to notice the character of the shells in both instances. He concludes, from his observations on the nature of these deposits, that the layers now found perpendicular or inclined were horizontal at the time of their formation. These changes in the position of land strata, considered as the primary cause of the earth's inequalities, constitute the fundamental idea of Steno, and are now universally adopted. STENO.

Geology received another great stimulus in Italy towards the middle of the eighteenth century, through the theoretical ideas of Ant. Lazzaro Moro, and still more through the observations of Arduino. In 1740 Moro developed a system in which he attributes to frequently recurring submarine explosions the formation of mountains, plains, and islands. The apparition of the small islands Mikra Kaŭmena and Nea Kaŭmena in the volcanic group of Santorin, and the phenomena which accompanied the formation of Monte Nuovo, seem to have given rise to this theory. According to Moro, the globe was primitively covered with water; on the third day of creation the crust which formed the bottom of the sea was raised, the mountains resulting from this upheaval being the primitive rocks devoid of fossils. At a later period lava and other substances arose from the interior of the earth, and accumulated on the bottom of the sea, being upheaved in their turn through the same agency. With the rocks of this second upheaval diverse substances, such as salt, sulphur, and bitumen, were associated, and as a natural consequence the water became salt; animals were developed in the sea; the earth became peopled about the same time, and, the eruptions continuing, an alternation of sedimentary and eruptive deposits was produced. MORO.

ARDUINO.

The ideas of Arduino were less theoretical than Moro's; he divided the Paduan, the Vicentin, and the Veronese mountains into primary, secondary, and tertiary. The secondary mountains are for the most part formed of compact limestone in continuous strata, containing petrified organic bodies; these strata vary in hardness, fineness of grain, composition, colour, and in the species of marine organisms they contain, since, according to the author, there is but one kind in each stratum.

BALDASSARI.

Whilst Donati explored the Adriatic in order to investigate the habitats of living beings, Baldassari made researches on the fossils of the Siennese territory. He recognised, as had Marsilli in the territory of Parma, Spada near Verona, and Schiavo in Sicily, that the remains were not mixed confusedly, but, on the contrary, distributed in families in such a manner that in certain spots *Arca* abounded, while in others the comb-shell, *Venus*, *Murex*, &c., were more plentiful, according to the nature of the rock. He noticed the regular arrangement of fossils in the various strata, the natural position of the corals, the perforation of the rocks by lithophagous shells, but he gave no opinion on the theoretical bearings of these facts, *i.e.*, whether the sea had been withdrawn suddenly or gradually, whether the animal or vegetable productions supposed to belong to the torrid zone had been brought thence to the north, or whether the temperature of the country was higher then than it is now. In the great works of Wolfgang Knorr and Walet (1755–1773) a distinction is drawn between the pelagic fossils and those found on the sea-coast, and they express the opinion that those whose analogues have not been found must exist in the deep seas as yet unexplored.

In Italy during the eighteenth century the microscope was applied to the examination of marine deposits, and had much influence on the study both of living animals and of fossils,[1] for the sand of the Adriatic, near Rimini, was found to be almost exclusively composed of microscopic shells, and the Tertiary marls of the sub-Apennine hills were

BECCARI.

also found to contain a prodigious quantity of them. Beccari, towards 1729, created a new branch of conchology by the discovery of a small kind of polythalamous shell of nautiloid shape (*Nautilus Beccarii*, Linné). The coils of the helix and its transverse divisions give it a great resemblance to the ammonite, a comparison which was long adopted for all the other analogous forms so plentiful in the marls of North Italy.

BIANCHI.

Ten years later G. Bianchi, better known by the name of J. Plancus, announced that he had found on the shore at Rimini the living analogue of the small fossil ammonite, and that its dimensions were such that it required 130 of them to equal the weight of a grain of wheat. He found a great many other species, which he still classed along with the nautili and ammonites, on account of their internal divisions. His work[2] contributed much to increase our knowledge on this subject, and at a later period he pointed out that,

[1] See d'Archiac, Cours de Paléontologie Stratigraphique, tom. i. p. 26, Paris, 1862.

[2] De conchis minus notis in littore Ariminensi, Venice, 1739 (cited by d'Archiac).

within a mile of Sienna, there existed a bed of microscopic shells analogous to those found on the shores of Rimini.

SOLDANI.

Later on, Soldani examined with a magnifying glass the clay of the tufa and sands of North Italy, and produced his essay on the nautiloid layers of Tuscany,[1] and thus enriched science with descriptions and drawings of a multitude of shells belonging to minute marine animals, always looked upon as nautili and ammonites, an error perpetuated till 1835. As he assigned no particular names to these diversified forms, which he described and represented with care, and even grouped according to certain analogies, Soldani did not contribute to advance the knowledge of them as much as he might have done had he applied to them the then well-known nomenclature of Linnæus. From 1789 to 1797 he published another very considerable work[2] on the microscopic shells found on the shores of Giglio, Elba, and other islands. He observes in this work that these small bodies are not young specimens, which grow with age, but perfect adults; the various species occupy various depths, and this explains, he adds, why those in a fossil state are not found mixed indifferently in all the strata.

PROGRESS OF KNOWLEDGE RESPECTING THE TIDES.

The hypothetical ideas of some Arab writers, and the observations of Pytheas and Posidonius on the causes of tides have been already noticed.[3] In the sixteenth century there was marked progress in the knowledge of these phenomena; men began to study the local peculiarities of the tides, as shown by the instructions given by Cabot for the Polar explorations (1553), according to which the time when a particular tide set in was to be noted down for each port. It was owing to observations of this nature that a body of facts was gradually grouped together on which to establish the theory of tidal phenomena. Galileo connected them with the rotation of the earth on its axis; Francis Bacon found their explanation in the configuration of the terrestrial masses of the Old and New Worlds. Simon Stevin is nearer the truth, for he can already foretell for each port the hour of the tide by means of lunar phases. Kepler, in the Introduction to his Astronomia Nova, recognises the dependence of the tides on the attraction of all the heavenly bodies. Descartes came next with his theory of the eddies of ether, which Varenius accepts as being the best explanation of the phenomena of flux and re-flux. Lastly, the publication of Newton's Principia produced a complete modification in this branch of science, and the works of MacLaurin, Euler, and Bernouilli, competing for the prize offered by the Academy of Sciences of Paris in 1740, added new mathematical elements to the theoretical ideas of the time.

Observations on marine currents increased as people began to abandon coasting,

[1] Saggio orittografico ovvero osservazioni sopra le terre nautilitiche ed ammonitiche della Toscana, Siena, 1780.

[2] Testaceographia et zoophytographia parva et microscopica [4to, with 179 plates], Siena, 1789–1797 (cited by d'Archiac).

[3] See pp. 15, 21, 37.

Observations on Marine Currents.

which was almost the only navigation known to the ancients and up to the middle ages. As early as the fifteenth century the Portuguese discovered the Guinea current; Vasco da Gama must have noticed the Mozambique current. In 1513 Antonio d'Alemanos observed the current of the Gulf Stream near Florida, and Varenius, as far back as 1650, places the source of this current in the Caribbean Sea.[1] From Sir Richard Hawkins' observations it is evident that the Gulf Stream had already been observed in the northern parts of the Atlantic between Newfoundland and Europe. It is probable that, as early as 1497, Sebastian Cabot observed the Labrador current, while the first navigators who ventured into the Pacific had to grapple with the cold current of Peru, as shown by their log-books.

Leonardo da Vinci, in explaining the currents running from the equator to the poles, said they were produced by an elevation of temperature, which expands the water, and would make an equatorial swelling were the waters unable to flow away by the currents, and thus re-establish the equilibrium of the surface of the sea. The cold currents from the poles to the equator had been explained in the seventeenth century by the great evaporation of the water in the tropical zones, which had to be balanced by water brought from higher latitudes. We may add that, even at that period, the salinity of the tropical waters was attributed to the same cause, viz., evaporation. The current towards the west, which had already been observed by Columbus, was interpreted as being in accordance with the rotation of the earth, not, however, in the sense of Copernicus, but by supposing the liquid envelope of our planet to be drawn from east to west by the movement of the "primum mobile" of the Ptolemaic system of astronomy.

In 1665 Athanasius Kircher traced on a map all that was then known of marine currents. J. Vossius discussed this important question, and collected together all the information extant in his time. He points to a "motus perpetuus" in the torrid zone, which follows exactly the course of the sun, and becomes more pronounced between the coast of Peru and the Moluccas; he also mentions a second similar motion running in a southern direction, dependent on the sun's movement, but modified sensibly in its course by the configuration of the African coast; and, lastly, he speaks of a "motus tertius priori semper contrarius," of which the Gulf Stream forms part.[2] Fournier, in his great work on hydrography, had, it is true, twenty years before Vossius given a careful list of all the localities, to the number of twenty, where currents had been noticed,[3] but he had formed no theory to explain these phenomena. We know of no really important addition to this subject during the eighteenth century.

[1] "In sinum Mexicanum impetuose inter Cubam et Jucatan illabitur mare, affluitque inter Cubam et Floridam" (Varenius, Geographia generalis, Camb., 1672, p. 119).

[2] Vossius, De motu marium et ventorum liber, Hagæ Comitum, 1663, pp. 1, 4, 8.

[3] Fournier, Hydrographie contenant la théorie et la pratique de toutes les parties de la navigation, Paris, 1643, p. 479.

Throughout the period now under consideration, many accurate observations were made in all latitudes on the temperature of the surface waters of the ocean, and about the middle of the eighteenth century the subject of deep-sea temperature first began to attract attention.[1] Count Marsilli was one of the first to test the temperature of the sea at various depths. He made his experiments between Cassis and Riou in the Mediterranean. The table giving all his experiments shows that they were made in depths ranging from 10 to 20 fathoms.[2] His experiments extended only from January to June; he was unable to continue them during the other months. He concludes that, were the experiments continued and found to concur with his own, they would prove the temperature of the sea to be the same in all seasons. Marsilli's observations were made with the assistance of a common thermometer. The only merit of his observations is to show that scientific men were actively engaged investigating this question in the eighteenth century. According to Thoulet,[3] Aristotle affirmed that the surface waters were warmer than the deeper ones, an opinion supported by Buffon in 1750, from the fact that a lead drawn up rapidly from deep water communicated a marked sensation of cold to the hand.

OBSERVATIONS ON DEEP-SEA TEMPERATURES.

In 1749 Captain Ellis, during a voyage to the north-west coast of Africa, made two experiments at depths of 3900 and 5346 feet (650 and 891 fathoms), in latitude 25° 13′ N.,[4] with an instrument devised by Dr Hales, and described by him in a paper read before the Royal Society.[5] It consisted of a bucket about the size of a household pail, with valves at top and bottom, which remained open as the apparatus descended, and closed when drawn up. He obtained in both cases, with the thermometer enclosed in this vessel, readings of 53°, and rightly attributed this uniformity to the greater depth of water through which the instrument had to be hauled causing a rise in the temperature. Similar devices to ascertain the temperature of deep water were made use of by Foster, Cook, and Lord Mulgrave.[6]

OPINIONS AS TO WHY THE SEA IS SALT. VARENIUS

Varenius, in his Universal Geography, examines the origin of the salt taste of the ocean waters, which he attributes to the presence of the particles of salt it contains; he then inquires into the origin of that salt. Rejecting the opinions current in his time, he offers two hypotheses: first, the saline particles being co-eternal with the ocean, that question cannot be treated without reference to the origin of the ocean itself, and second, the fact that water carries along with it in solution the saline matters contained in the earth. He admits that the waters grow salter on approaching the equator, and less so on nearing the poles. Among the various theories which he brings forward to explain these phenomena are the following:—The difference of

[1] See Prestwich: On Submarine Temperatures, *Phil. Trans.*, vol. clxv. p. 590, 1875.
[2] Marsilli, *op. cit.*, pl. vi. p. 16.
[3] Thoulet, Océanographie (Statique), Paris, 1890, p. 281.
[4] *Phil. Trans.*, vol. xlvii. p. 214, 1752.
[5] *Ibid.*, p. 213.
[6] In the "Race-horse," 1773, between Norway and Spitzbergen.

evaporation in different latitudes, the amount of rainfall and snow, and the quantity of water brought down by the rivers. He observes the difference between the specific gravity of fresh-water and that of sea-water, and the difference in their freezing points. This latter difference, he says, is owing to the salt of sea-water, which contains a something (spiritus) opposed to congelation.

Marsilli

Marsilli was also one of the first to study the saltness of the sea, and the bitter taste of its water.[1] He believes that both are due to the solvent effect of water on the substances forming the bed of the ocean. He made experiments with the hydrometer,[2] and found that the deepest waters were heavier than the surface water. He states that he drew the water from various depths, but does not describe in what manner. He avers that the salt in the surface water of the Mediterranean, at those points where rivers and torrents do not mix with it, and where coral is freely developed, is equal to $\frac{1}{32}$ of the weight, and $\frac{1}{29}$ of the volume, of the water. He attributes the bitter taste of the water to the presence of bitumen.[3]

Boyle

In his paper: Of the Saltness of the Sea, Robert Boyle describes a great number of experiments. He personally made a series of observations on the water of the English Channel, collecting it from various depths, and observing its specific gravity. The samples from beneath the surface were probably procured by means of Hooke's water-bottle, an extremely ingenious valved box, which is fully described and figured in one of the early numbers of the *Philosophical Transactions*.[4] Boyle investigated the saltness of the water by a number of processes: he tried the estimation of total solids by direct evaporation and ignition, but not being satisfied with the result he ultimately took the density as an index of the saltness, and determined this either by means of a glass hydrometer, by weighing in a phial which was afterwards weighed when full of distilled water, or by weighing a piece of sulphur in distilled water and sea-water consecutively.

"As for the different degrees of the saltness of the sea," says Boyle, "I shall deliver what I have been informed of as briefly as I can. And first, it hath been observed, by one to whom I gave a glass conveniently shaped to try the specific gravity of the water, that it grew heavier and heavier as he came nearer the line, till within about 30° latitude;

[1] Marsilli, *op. cit.*, p. 21.

[2] Marsilli, *op. cit.*, p. 220. This important apparatus for ascertaining the specific gravity of sea-water was discovered about the fourth century of our era. It was made according to the principle of Archimedes. As mentioned by Günther (*op. cit.*, Bd. ii. p. 366), the invention of this apparatus was discussed by E. A. Gerland (Zur Geschichte der Erfindung des Aräometers, *Ann. d. Physik u. Chemie*, ser. 2, Bd. ii. pp. 150 *et seq.*) and M. Schmidt (Report in *Philol. Wochenschrift*, Jahrg. iii. p. 1224). The first clear description of this instrument is to be found in the fifteenth letter of Bishop Synesius to Hypatia; nothing in the letter, however, suggests that Synesius was the inventor of the apparatus. One Rhemnius, in a poem in hexameters, attributes the invention to Archimedes; others attribute it to Priscianus. It is quite possible that neither of them invented it, but the inventor, whose name is unknown, may have lived between 200 and 400 of our era.

[3] Marsilli, *op. cit.*, p. 13.

[4] *Phil. Trans.*, vol. ii. p. 439, 1667 (reproduced in the tail-piece to this Introduction).

from whence to Jamaica he observed no alteration in the specific gravity in the least. And in confirmation of this I am likewise informed by one, who for his own satisfaction weighed the water, both under the Aequinoctial and at Cape of Good Hope, and found that the weight of both was the same. To which may be added that it is commonly observed at Mozambique, one of the hottest places in the world, that the sea is so salt there, that it bears up the ships a considerable height out of the water, more than in other places; and that the water may be much salter in one place than another, by having more salt dissolved in it, does not only appear from what hath been said, but also from what is frequently observed in the different strengths of brine-pits."[1]

Halley was of opinion that the saltness of the sea was due to the substances carried down in solution by the rivers. HALLEY.

OBSERVATIONS ON THE TRANSPARENCY OF SEA-WATER.

The colour and transparency of sea-water were also the subjects of observation. Bouguer, who made experiments on the transparency of the water at Croisic and in the torrid zone, supposes that a depth of 10 feet of water weakens light at most in the proportion of 5 to 3, or perhaps 5 to $3\frac{1}{2}$.[2] He says that the depth at which sea-water loses the whole of its transparency will be found to be about 656 feet.[3] It was recognised even then, however, that the transparency varied at the same depth in different seas. Muncke[4] reports the following experiments made last century on board the ship "Coquille":—"To judge of the transparency of sea-water, we used to tie a string to a board painted white, and would let it down till we could see it no longer. We found that near the island of Waïgion it disappeared from sight at a depth of 59 feet, and with a very bright sky at 75·3 feet; near Port Jackson, 38·3 feet; near New Zealand, 35 feet; and near Ascension between 28 and 36 feet." There is a very wide divergence in the different statements, for Wood, in 1676, observed mussel shells on the bottom at 80 fathoms, near Nova Zembla, and Admiral Milne records having seen the bottom in the Caribbean Sea at 25 fathoms.

COLOUR OF THE SEA.

The celebrated experiment of Halley with the diving-bell seems to have led to the study of the coloration of the sea. Newton said the colour of the sea was green; Marsilli thought it was blue, and explained it by the presence of salt in sea-water. This writer maintained at the same time that the colour varied in the upper and lower strata of the sea.

MARINE ORGANISMS

As regards the knowledge of marine organisms, Gesner in 1558 published the fourth book of his work,[5] which is devoted to the description of fishes and marine animals; and John Johnston, who studied at St. Andrews in 1619, published a treatise on aquatic

[1] Boyle's works, epitomised by Boulton, vol. i. p. 282, London, 1699.
[2] Bouguer, Traité d'Optique, p. 64, Paris, 1760.
[3] J. H. Lambert, Photometria, &c., Augsburg 1760.
[4] In Gehler's Physik. Wörterbuch, Aufl. 2, Bd. vi. Abth. iii., p. 1708, Leipzig, 1837.
[5] Gesner, Historiæ Animalium, Liber iv., Tiguri 1558.

animals in 1649;[1] while Buffon and other authors of less note contributed to the slowly increasing knowledge of littoral and pelagic animals and plants during the fifteenth, sixteenth, and seventeenth centuries. The honour of first employing the dredge as a means of scientific investigation is claimed for two Italians, Marsili and Donati, who about 1750 used an ordinary oyster dredge for obtaining specimens in shallow water. During the nineteenth century the knowledge of marine fauna and flora made, as we shall see, great advances by an extension of this method.

The following account, as told by Boyle, of Sir John Hawkins' observations, is interesting as indicating the views regarding marine life at this period:—

A Sixteenth Century Description of Pelagic Life.

"Were it not for the Moving of the Sea, by the Force of Winds, Tides and Currents, it would corrupt all the World. The Experience of which I saw *Anno* 1590, lying with a Fleet about the Islands of *Azores*, almost Six Months, the greatest Part of the time we were becalmed, with which all the Sea became so replenished with several sorts of Gellies and Forms of Serpents, Adders and Snakes, as seem'd Wonderful; some green, some black, some yellow, some white, some of divers Colours, and many of them had Life, and some there were a Yard and a-half, and some two Yards long; which had I not seen, I could hardly have believed; and hereof are witnesses all the Company of the Ships, which were then present, so that hardly a Man could draw a Bucket of Water clear of some Corruption."[2]

Imperfect Knowledge respecting Sea-Weeds.

The first notable account of marine algæ is Sir Hans Sloane's in his *Natural History of Jamaica*. His sea-weeds, however, especially the corallines and calcareous Siphoneæ, get mixed up with corals and zoophytes. Other pre-Linnæan botanists enumerate forms similarly confused. Linnæus made no considerable reformation in limiting the organisms described as "Fuci," "Ulva," "Spongia," &c.; and the earliest serious attempt to deal with algæ is the *Historia Fucorum* of Samuel Gottlieb Gmelin in 1768. This book was followed by Esper's *Abbildungen der Tange*, or Icones Fucorum (1797), and, most important of all, Dawson Turner's *Fuci* (1808–1819). However, so late as Lamouroux's *Histoire des Polypiers Coralligenes flexibles vulgairement nommés Zoophytes* (1816), we find the calcareous algæ and zoophytes intermingled. With the gradual shedding out of the zoophytes in the process of producing a natural classification—the work of C. Agardh, Greville, and others—the marine algæ became finally a consolidated natural group.

E.—THE PROGRESS OF OCEANOGRAPHY FROM THE TIME OF COOK TO THE CHALLENGER EXPEDITION.

Voyages of James Cook.

The period which opens with the voyages of James Cook, in the second half of the eighteenth century, may be considered as the beginning of the scientific exploration of

[1] Johnston, Historiæ naturalis de Piscibus et Cetis, Libri v., de Exanguibus aquaticis, Libri iv., Francf. 1649, Amst. 1657.

[2] Boyle's Works, epitomised by Boulton, vol. i. p. 281, London, 1699.

the sea. The transit of Venus across the sun's disk was to take place on June 3, 1769. At the request of the Royal Society, the Government granted the "Endeavour" to convey an astronomer to one of the islands of the Pacific Ocean. Cook, with Green, an astronomer from the Royal Observatory, and Banks, the naturalist, started from Plymouth on August 26, 1768, and reached Tahiti on April 12 following. After the observations had been taken during the transit, Cook completed the map of Tahiti (Otaheite), and within the subsequent twelvemonth the navigator had explored with every hydrographic detail the great archipelago of the Society Islands, surveyed the two islands of New Zealand, traced the whole eastern coast-line of New Holland for a distance of more than 1600 miles, and discovered Torres Strait, thus showing that Australia was an island.

The great discoveries of Cook, by demonstrating beyond doubt that neither New Zealand nor New Holland formed part of an Austral continent, considerably discouraged the view of the existence of any southern continent. The Royal Society, wishing to solve once for all this important question, induced the Government to fit out a new expedition to the South Seas. Cook set sail again with the "Resolution" and "Adventure," accompanied by the naturalists Forster, father and son. In this voyage, commencing in 1772, Cook circumnavigated the South Sea in its highest latitudes, and crossed it in such a manner as to leave no room for the supposition of an Austral continent, unless at the pole.[1]

The great navigator in his last expedition, during which he was massacred by the savages of the Sandwich Islands, worthily crowned his career. During that expedition he surveyed and drew the general outlines of north-west America, from the point where the Spanish explorations and those of Drake and Bering stopped, thus showing exactly the region where the extremity of the American continent approaches the furthermost point of Asia, and pointing out the real direction in which a passage from the Atlantic to the Pacific was to be sought.

It has already been noted that Hipparchus thought Ceylon a part of a southern continent, and that Ptolemy enclosed by his Southern Ethiopia the Indian Sea, which thus became a mediterranean. In the sixteenth century, when the Ptolemaic geographical notions were revived, geographers thought they had discovered the southern continent in New Guinea. At the time of Cook's embarkation people still regarded New Zealand as part of this great Austral land. Up to that time many learned men could only conceive the equilibrium of the globe by supposing the existence of a polar continent in the south to counterbalance the accumulation of land in the northern hemisphere.[2]

The observations of Cook are very numerous and remarkably precise; they are a storehouse of data for geography, terrestrial physics, and the natural sciences. The most important fact to be noticed, however, is that after these voyages of the famous English explorer the chart of the Pacific, until then almost a blank, differed but little from that

[1] See Rainaud, Le Continent Austral, Paris 1893, p. 437.

[2] See Dalrymple, An Historical Collection of Voyages in the South Pacific, London, 1770.

of the present day, and the same may be said of the general superficial outlines of the other oceans.

Voyages Subsequent to Cook

Among the more important marine Expeditions which added to our knowledge of the ocean between the time of Cook and the Challenger Expedition may be mentioned [1]—The "Boussole" (French), La Perouse (1785–1788); the "Recherche" and "L'Espérance" (French), D'Entrecasteaux, in search of La Perouse (1791–1793); the "Neva" (Russian), Captain Krusenstern accompanied by Horner and Kotzebue (1803–1806); the "Rurik" (Russian), Captain Kotzebue accompanied by Chamisso (1815–1818); the "Coquille" (French), Captain Duperrey (1822); the "Jane" and "Beaufoy" (British), Captain Weddell (1822–1824); the "Predprijätje" (Russian), Captain Kotzebue accompanied by Lenz and Eschscholz (1823–1826); the "Blossom" (British), Captain Beechey (1825–1828); the "Ssenjavin" (Russian), Captain Lütke accompanied by Erman (1826–1828); the polar voyages of Parry, John Ross, and Scoresby (British, 1806–1827); the "Astrolabe" (French), Captain Dumont d'Urville (1826–1829); the "Adventure" and "Beagle" (British), Captain Fitzroy accompanied by Darwin (1831–1836); the "Princess Louise" (German), Captain Wendt accompanied by Meyen (1830–1832); the "Bonite" (French), Captain Vaillant (1836); the "Venus" (French), Captain Dupetit-Thouars (1836–1839); the "Astrolabe" (French), Captain Dumont d'Urville, and the "Zélée," Captain Jacquinot (1837–1840); the "Porpoise" (American), Captain Wilkes accompanied by Dana (1839–1842); the "Erebus" and "Terror" (British), Captain Sir James Clark Ross accompanied by Hooker (1839–1843); the "Sulphur" and "Samarang" (British), Captain Belcher (1837–1846); the "Herald" (British), Captain Kellet (1845–1851); the "Rattlesnake" (British), Captain Stanley and Lieutenant Dayman accompanied by Huxley (1846–1850); the "Novara" (Austrian), Admiral von Wüllerstorf-Urbair (1857–1860); the "Bull-dog" (British), Captain M'Clintock accompanied by Wallich (1860). (For subsequent Expeditions see page 101 *et seq.*, and for tracks of voyages, see Plates VIII. and IX.)

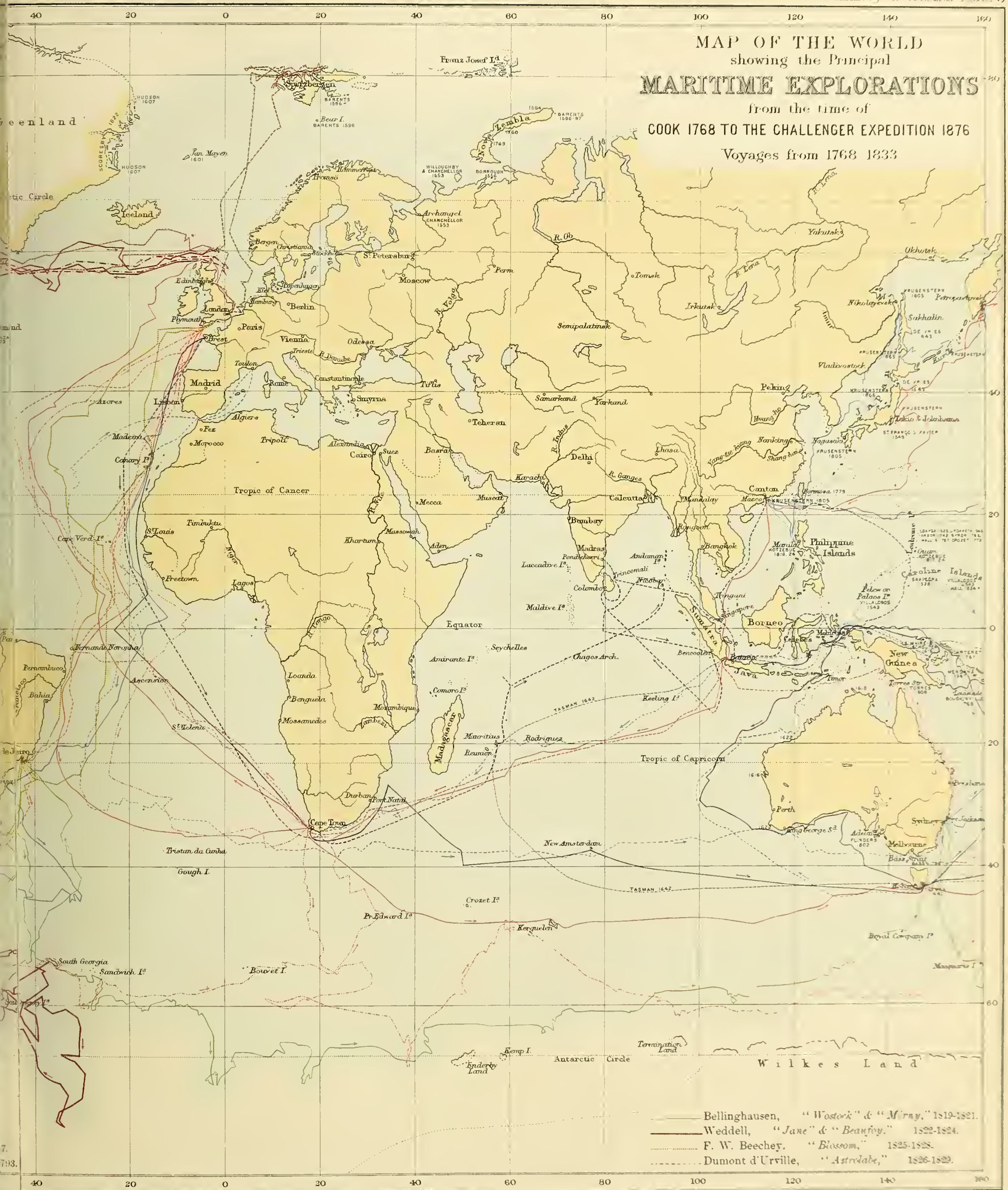
Cook left little to be done by his successors in regard to the discovery of new lands, but in the records of the splendid set of sea-voyages above enumerated, there are inexhaustible materials dealing with the science of the earth and of man. Investigators gradually directed their attention to the physical and biological conditions of the sea, and to the study of the causes of oceanic phenomena, so that all these voyages added much to our knowledge of terrestrial physics, hydrography, zoology, and botany. We shall now endeavour to indicate the views held by navigators and scientific men on these subjects, from the time of Cook down to the Challenger Expedition.

Buffon in his Histoire Naturelle [2] distinguishes oceans, mediterraneans, and gulfs. Oceans are those seas surrounding continents, which occasionally penetrate into the land

[1] For a more complete enumeration of the scientific cruises in the oceans and various seas, the reader is referred to Boguslawski, Handbuch der Oceanographie, Bd. i. pp. 390–400, Stuttgart 1884.

[2] Buffon, Histoire naturelle, générale et particulière, tom. ii. p. 101, Paris 1769.


Lord Mulgrave, "Racehorse" & "Carcass," 1773.
John Ross, "Isabella" & "Alexander," 1818.
W. E. Parry, "Hecla" & "Griper," 1819-1820.
W. E. Parry, "Fury" & "Hecla" 1821-1823.
W. E. Parry, "Hecla" & "Griper," 1824-1825.
W. E. Parry, "Hecla," 1827.
John Ross, "Victory," 1829-1833.
James Cook, "Endeavour," 1768-1771.
James Cook, "Resolution," 1772-1775.
James Cook, "Resolution," 1776-1780.
La Pérouse, "Boussole," 1785-1788.
D'Entrecasteaux, "Résolution" & "Subtile,"
D'Entrecasteaux, "Recherche" & "L'Espérance,"
New Siberia Is
Parry Islands
Baffin Bay
Baffin Land
Aleutian Islands
Sandwich Is
Philippine Islands
Caroline Islands
Marshall Is
Gilbert Is
New Guinea
Samoa Is
Society Is
Cook Is
Tonga
Fiji Is
Marquesas Is
New Zealand
Chatham Is
Wilkes Land
Victoria Land
Valparaiso
Buenos Ayres
Galapagos Is
Easter I.
Sydney
Brisbane
Borneo
Canton
Peking
Tahiti
Kermadec
Auckland Is
Antipodes I
Campbell I
Macquarie I
Bermudas
Bahama Is
Jamaica
Lima
Panama
Mexico
Havana
Boston
Quebec
New York
Chicago
St Francisco
New Orleans
Charleston
Winnipeg
Denver
St Louis
Vancouver I.
Kadiak I.
Amukta Str
Melville Sd
Banks Ld
Juan Fernandez Is
Falklands
South Shetland
Graham
Alexander I Land
Strait of Magellan
Pitcairn
Mangareva
Paumotu Is
Rapa
Tubuai Is
Rarotonga
Palmyra
Washington I.
Fanning
Christmas
Malden
Phoenix Is
Ellice Is
New Caledonia
New Hebrides
Solomon Is
Torres Str
Bass Str
Melbourne
Pobl.
Galapagos


MAP OF THE WORLD
showing the Principal
MARITIME EXPLORATIONS
from the time of
COOK 1768 TO THE CHALLENGER EXPEDITION 1876
Voyages from 1768 1833
Bellinghausen, "Wostok" & "Mirny," 1819-1821.
Weddell, "Jane" & "Beaufoy," 1822-1824.
F. W. Beechey, "Blossom," 1825-1828.
Dumont d'Urville, "Astrolabe," 1826-1829.

masses by rather large openings, or by narrow passages thus forming inland seas or mediterraneans; gulfs, on the other hand, open widely towards the sea. These subdivisions were accepted by several hydrographers of his time.

The famous French hydrographer, C. F. Claret de Fleurieu,[1] in 1769, made, at the request of the Académie des Sciences, a voyage for the trial of the chronometers of Berthoud and Leroy. This voyage, and the one undertaken with the same object in 1771–1772 by Borda, de Verdun, and Pingré, are not only of importance from having improved the methods of determining longitudes at sea, but also from the considerable improvement effected in the charts of the Atlantic Ocean and North Sea, which till then were very imperfect. The construction of the quadrant by Hadley, of the sextant by Dollond, the measurement of an arc of the meridian in South America, the appointment of a board of longitude, the conception of the nautical almanac, and the formation of a surveying branch of the naval service, all belong to the same period.

IMPROVEMENT IN METHODS OF DETERMINING POSITIONS AT SEA.

Fleurieu wrote the introduction to Marchand's voyage,[2] and drew up along with Louis XVI. the instructions for La Perouse's voyage. The cruise of Marchand in 1791 along the north-west coast of America, though undertaken in a purely commercial spirit, added a few new facts to the knowledge of the archipelagoes in the Pacific Ocean, and materially improved the map of the Marquesas Islands; but the greatest interest of the narrative lies in Fleurieu's introduction, containing his views on hydrography. Fleurieu had two objects:—"My first aim," he says, "has been to bring back hydrographic divisions of the seas to natural principles, and to reform the erroneous qualifications and denominations given to them. My second object will be to rectify the hydrographic nomenclature, and to give each portion of the sea-border, in both continents, such names as are best suited to them." The earth is considered by the French hydrographer as formed of two continental masses and a universal sea. "The Ocean is one, it is infinite, its waters surround our planet from one pole to the other, and are equalised over the whole surface of the ocean." The two terrestrial continental masses advance into the ocean so as to divide the latter into two vast regions of unequal surface: the Atlantic Ocean between the western coasts of the Old World and the eastern coast of America, and the second ocean considerably larger, extending between the west coast of the New World and the east coast of the Old. He looks upon the Malay Archipelago and the great Australian lands as the remains of a terrestrial mass, once united to the south of Asia, which the mighty ocean ruptured. The Indian Ocean is included in his Great Ocean. He recognises besides a frozen Arctic Sea and an Antarctic Sea limited, as in most modern maps, by the polar circles. He placed the limits

NOMENCLATURE OF THE OCEANS BY FLEURIEU.

[1] Fleurieu, Voyage fait par ordre du Roi pour éprouver en mer les horloges, Paris 1783.

[2] Voyage autour du Monde par E. Marchand, précédé par les observations sur la division hydrographique du globe, et changements proposés dans la nomenclature générale et particulière de l'hydrographie, par Cl. Fleurieu, tom. iv. pp. 1–74, Paris l'an viii.

between the Atlantic and the Great Ocean at the meridians of Cape Horn and the Cape of Good Hope. He then subdivides the oceans by imaginary lines, making use of the equinoctial circles: thus he distinguishes, between the north polar circle and the northern equinox, a North Atlantic Ocean; between the two equinoctial circles an Equinoctial Atlantic Ocean; and from the southern equinox to the south polar circle a South Atlantic Ocean. He adopts similar subdivisions for the Pacific, where he has a Great Boreal Ocean, a Great Equinoctial Ocean, and a Great Austral Ocean. He looks upon the Indian Ocean as a large gulf. "How can one consider as a separate sea," he asks, "a gulf which measures at its opening more than 1500 marine leagues, an opening almost equal to one-quarter of the earth's circumference?"

MALTE BRUN

Malte-Brun[1] also divides the ocean into two basins: the "Great Oriental Austral basin, occupying the greater part of the aquatic hemisphere of the globe," which comprises our South Polar Sea, the Pacific, and the Indian Ocean, communicating with the "Occidental basin" at Cape Horn and the Cape of Good Hope.

BALBI

Adriano Balbi's subdivision of the seas is very similar to Fleurieu's, but he names four oceans: the Northern Ocean, the Southern Ocean, the Atlantic Ocean, and the Great Ocean.[2] The Indian Ocean is but a portion of the last.

The nomenclature of the seas was finally settled, it is said, by a committee of the Royal Geographical Society of London in 1845,[3] and is the one generally adopted at present; the only objections to which it has given rise refer to the artificial divisions of the oceans in the southern hemisphere.

PROGRESS OF CARTOGRAPHY

If the charts of the present day be compared with those in existence before Cook's time, the perfection attained will easily be noticed. This important branch of oceanography has been very greatly developed through the extension of geographical and geodetic knowledge under the impulse of commerce and inter-oceanic relations. Nearly all regions of the ocean are accurately represented in our charts, even the polar regions so far as explored being laid down with precision. Certain points are detailed with minute care; others rather less so. This is because the scientific element is not the only one at work. Those parts of the coasts most frequented by traders are those most accurately surveyed. Here, as in many things, the immediate requirements of man are the main-spring, and scientific investigation is but a secondary consideration.

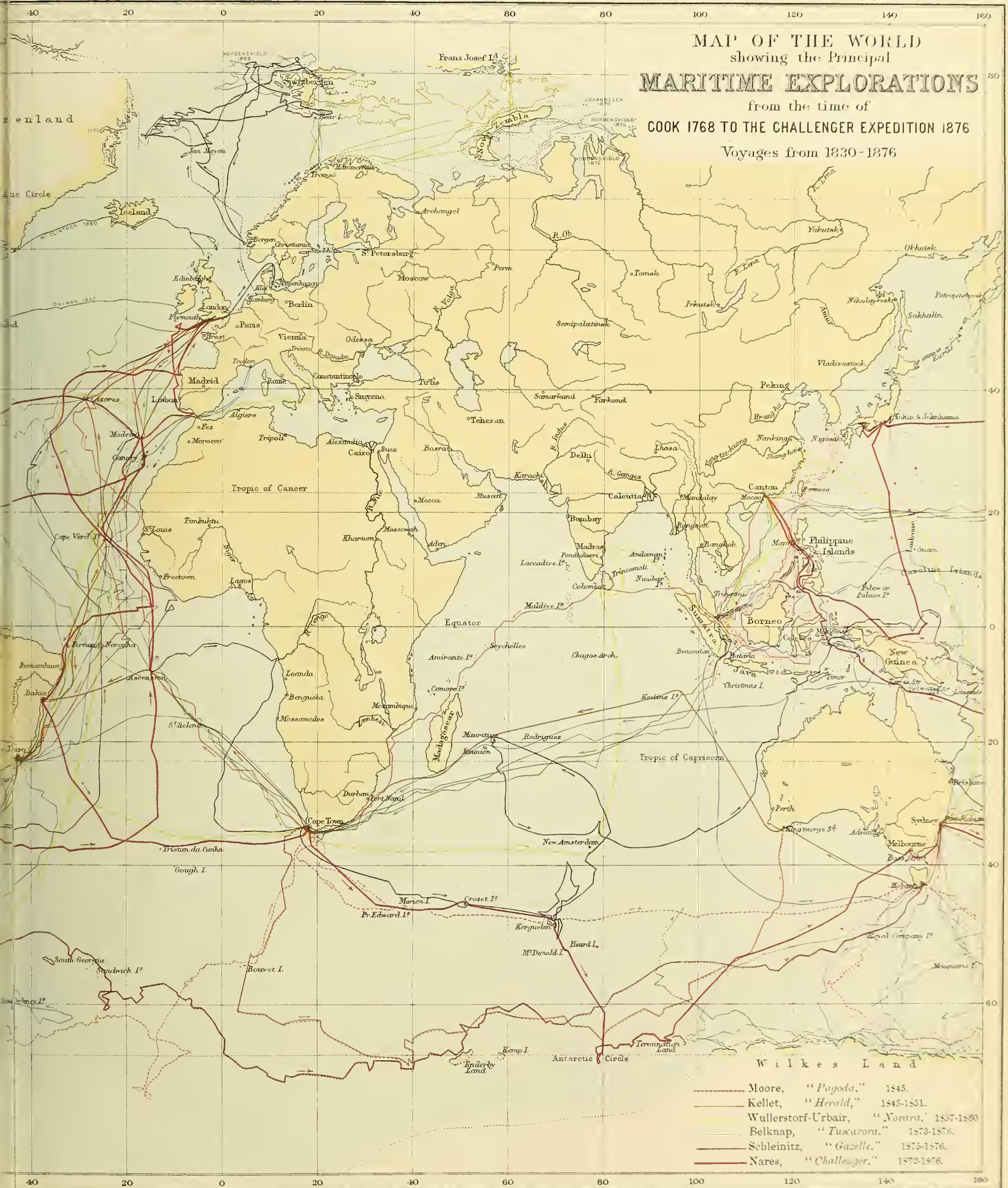
It must be remembered that much precise knowledge has been attained during the past centuries as to the form and dimensions of the earth. Mercator's projection has been generally adopted, as also the meridian of Greenwich. New details have been

[1] Malte-Brun, Précis de la géographie, ed. 2, tom. ii. pp. 162–166, Paris, 1812.

[2] Balbi, Compendio di Geographia Universale, ed. 2, Venezia, 1819.

[3] No reference, however, to the work or opinions of this committee are to be found in the publications of the Society, prior to June 1893, when the proceedings of the committee were published at my suggestion (see *Geogr. Journal*, vol. i. p. 53[illegible], 1893).


Koldewey, "Germania," 1868.
Koldewey & Hegeman, "Germania" & "Hansa," 1869.
Hall, "Polaris," 1871-1873.
Weyprecht & Payer, "Tegetthoff," 1871.
Weyprecht & Payer, "Tegetthoff," 1872-1874.
John Franklin, "Erebus" & "Terror," 1845-1847.
M'Clure, "Investigator," 1850-1854.
Collinson, "Entreprise," 1850-1854.
Kellet, "Resolute,"
M'Clintock, "Intrepid," 1852-1853.
M'Clintock, "Fox," 1857-1859.
Fitzroy, "Beagle," 1831-1836.
Dumont d'Urville, "Astrolabe" & "La Zelée," 1837-1840.
"Sulphur," 1837-1842.
"Sabrina," 1839.
C. Wilkes, "Porpoise," etc., 1839-1842.
J. C. Ross, "Erebus" & "Terror," 1839-
E. Belcher, "Samarang," 1843-1846.
Wilkes Land
Victoria Land
New Siberia Is
Parry Islands
Baffin Bay
Baffin Land
Davis Str.
Aleutian Islands
Sandwich Is
Philippine Islands
Borneo
New Guinea
Caroline Islands
Marshall Is
Gilbert Is
Samoa Is
Society Is
Paumotu Is
Marquesas Is
Fiji Is
Tonga Is
Cook Is
New Zealand
Sydney
Melbourne
Chatham Is
Valparaiso
Buenos Ayres
Galapagos Is
Callao
Lima
Panama
Mexico
San Francisco
New York
Boston
Halifax
Bermudas
Canton
Peking
Easter I.
Pitcairn
Graham L.
South Shetland
Falkland Is


MAP OF THE WORLD
showing the Principal
MARITIME EXPLORATIONS
from the time of
COOK 1768 TO THE CHALLENGER EXPEDITION 1876
Voyages from 1830-1876
Moore, "Pagoda," 1845.
Kellet, "Herald," 1845-1851.
Wullerstorf-Urbair, "Novara," 1857-1860
Belknap, "Tuscarora," 1873-1876.
Schleinitz, "Gazelle," 1875-1876.
Nares, 1872-1876.
Tropic of Cancer
Equator
Tropic of Capricorn
Antarctic Circle
Wilkes Land

introduced for determining position, and are based upon astronomical and geodetic observations. The survey of coast-lines is no longer made by the aid of the compass, but by accurate and really scientific methods. The meteorological element is introduced in the graphical representation of the seas, hydrographic signs guide the seaman, reliable soundings for every important point show the depth of water, the currents are indicated, and any peculiarities relating to local tides are marked with precision. The bathymetrical charts of Maury and Delesse, the wind and current charts of the Hydrographic Office, and the temperature charts of the Meteorological Office published previous to 1872, all show great progress in these branches of knowledge. The latest cartographic elements introduced are those relating to depth and the nature of the bottom, which were especially investigated by the Challenger Expedition. The study of deep-sea deposits has been brought about by the requirements of navigation and the more modern applications of electricity, and now constitutes an important branch of oceanography. Since the Challenger Expedition, charts show soundings and the nature of the bottom at all depths in nearly every region of the ocean, the reliefs of the ocean basins being indicated with much definiteness.

DEEP-SEA TEMPERATURES AND THERMOMETERS,—CAVENDISH, IRVINE.

The first self-registering thermometer was made by Cavendish about 1757,[1] who suggested that it might be applied to ascertaining "the temper of the sea at great depths." It was applied for this purpose by Dr. Irvine, who accompanied Lord Mulgrave to the Arctic in 1773; during this expedition one of the first attempts was made at deep-sea sounding, the deepest cast being 683 fathoms. Irvine seems also to have sent down a water bottle of his own construction, the water brought up having a temperature of 40° F., the surface being 55° F. De Saussure in 1780, by using padded and protected slow-action thermometers, was able to ascertain correctly the temperature of the Mediterranean at 300 and 600 fathoms.[2] Six's[3] combined maximum and minimum thermometer was invented in 1782, and was used by Krusenstern in 1803 and by Sir John Ross in 1818. Du Petit Thouars in 1832, in the Atlantic and Pacific, and Martins and Bravais in 1839, off Spitzbergen, made use of forms of protected thermometers in attempting to measure the temperature of deep water. During Sir James Clark Ross's Antarctic expedition the temperature of the water was observed very frequently at all depths down to 2000 fathoms, and its density at the surface and at various depths was determined almost daily. These observations were very valuable at the time, as giving the first real clue to the distribution of temperature at the bottom of the sea, but in this expedition, and in those of Wilkes and D'Urville, the thermometers were not properly protected

DE SAUSSURE.

ROSS.

[1] *Phil. Trans.*, vol. l. p. 308, 1757. Cavendish's maximum thermometer is constructed on the same principle as that known in France as Walferdin's *outflow* thermometer; his minimum thermometer is on the same principle, but has a U-formed stem instead of a straight one.

[2] H. B. de Saussure, Voyages dans les Alpes, Neuchatel, 1796. In the agenda (tome iv.) he gives a scheme for a complete study of the oceans; many lines of work there suggested have since been carried out.

[3] *Phil. Trans.*, vol. lxxii. p. 72, 1782.

against pressure, and consequently it came to be generally believed that in all open seas the water below a certain depth maintained a uniform temperature of 39° F. right down to the bottom. Ross lays special emphasis on the fact mentioned by earlier observers that the temperature of the surface water falls rapidly as the depth of the sea diminishes; he cites one instance when in a single day the temperature at the surface fell from 70° F. where the depth was 400 fathoms, to 51°·5 where it was only 48 fathoms,[1] a fact now known to be of local, but not universal, occurrence, being apparently limited to windward shores.

In 1843 Aimé introduced reversible outflow thermometers to ascertain the temperature in deep water, but, although ingenious, they were not simple enough nor sufficiently handy for ordinary observations. Maury about 1851 made some observations on the temperature of the deeper waters of the sea.[2] For this purpose he used cylinders made of non-conducting material, discarding the ordinary thermometer with an index, as the index might move during the ascent, or in great depths the thermometer might be broken by the pressure; neither did Maury approve of Sexton's metallic thermometer with silver or platinum spiral, which was very expensive; besides, he preferred simplicity in all instruments intended for this branch of research. Commander Rodgers, of the U.S.S. "Vincennes," made a few interesting observations on deep-sea temperature in the Arctic Ocean in 1855.

First use of Protected Bulb.

The first self-registering thermometer with bulb protected from pressure was made use of by Captain Pullen in 1857, on board H.M.S. "Cyclops." Shortly after this time protected thermometers of the Six pattern (Miller-Casella),[3] and Negretti and Zambra's protected inverting thermometers, were introduced and improved in various ways. These thermometers were employed during the "Porcupine" and Challenger expeditions, and are now universally used in deep-sea investigations with excellent results.

Miller-Casella, Negretti and Zambra.

Views as to Temperature of Deep Sea and Ocean Circulation.

Péron, a French naturalist, who went round the world about 1805, and made many temperature observations, held that the bottom of the sea was covered with eternal ice, consequently life was there impossible. Sir James Clark Ross, as we have said, believed the temperature of the deeper water of the ocean to be 39° F., a belief shared by many of his successors, apparently because it was thought that this was the temperature of maximum density, as in fresh water, although Despretz and others had previously shown that the maximum density point of sea-water and of salt solutions might be below zero Centigrade. This view as to the temperature of deep water was supported by Leonardo da Vinci, Lenz, Arago, and Humboldt, who maintained that circulation was produced in the ocean by the heated and lighter water of the equator flowing to the poles over the surface, while the colder and denser waters of the poles sank and flowed along the bed of

[1] J. C. Ross, A Voyage of Discovery and Research in the Southern and Antarctic Regions during the years 1839–43, London, 1847.

[2] See Lee, Cruise of the Dolphin, Washington 1854.

[3] See Thomson, Depths of the Sea, p. 289, London, 1874.

the ocean. Franklin appears to have been the first to make a scientific exploration of the Gulf Stream, by means of an extensive series of observations of the temperature of the surface waters of the Atlantic; he attributed the origin of the Gulf Stream to the action of the trade winds.[1]

Bergman in 1779 and Marcet in 1822 recognised that the variations in the quantitative and qualitative composition of sea-water from different regions of the ocean were exceedingly slight. In 1818 Dr John Murray of Edinburgh published an extremely valuable research on the water of the Firth of Forth;[2] he showed that by treating portions of the same sample of water in different ways, widely different quantities of the various salts might be obtained, and that the only satisfactory method of proceeding was to determine each base and each acid separately. The attempt to discover whether the composition of sea-water differed at separate places was frequently made, but the conditions of observation were unsatisfactory. The samples could not be relied upon as properly collected or preserved, and much uncertainty remained on the subject.

COMPOSITION OF SEA-WATER.

JOHN MURRAY.

In 1865 a paper by Professor Forchhammer of Copenhagen, on the Composition of Ocean Water, was published in the Philosophical Transactions,[3] recording the result of twenty years of patient work, and its publication marks an era in the history of ocean chemistry. Forchhammer worked under great disadvantages; his samples of water were brought home by seafaring men from different parts of the world in corked bottles, and they were necessarily all taken from the surface or immediately beneath it. Forchhammer did not attempt to determine quantitatively all the elements that occur in sea-water, but confined himself to the very accurate estimation of the principal components, viz., chlorine, sulphuric acid, magnesia, lime, potash, and (by difference) soda. Although his methods have since been improved on, all the analyses were models of care and accuracy, and all his results have been confirmed and extended by Professor Dittmar's elaborate research, carried on under conditions immensely more favourable, on the water samples carefully collected on board the Challenger. Forchhammer's grand conclusion was that although the salinity of sea-water may and does vary within certain limits, yet if samples be taken in all parts of the open sea, avoiding the vicinity of land and the mouths of large rivers, the proportion of each constituent to the total salts will be found to be the same everywhere, the differences in surface water being merely differences due to dilution and concentration.

FORCHHAMMER.

In the works of Müller, Duperrey, Freycinet, Jacquinot, Péron, Quoy, Gaimard, Lesson, Gaudichaud, Eydoux, Souleyet, Reynaud, and Scoresby, are to be found many interesting accounts of marine organisms found on the coast or in surface waters, which

FIRST INVESTIGATIONS CONCERNING DEEP-SEA ORGANISMS.

[1] Franklin, American Phil. Soc., vol. ii. pp. 315 *et seq.*, Philadelphia, 1790; for further details on the Gulf Stream see J. E. Pillsbury, "The Gulf Stream and its Investigation," Rep. U.S. Coast and Geodetic Survey for 1890, App. 10, p. 488, Washington, 1891.

[2] *Trans. Roy. Soc. Edin.*, vol. viii. p. 205, 1818.

[3] *Phil Trans.*, vol. clv., p. 203, 1865.

show an increasing knowledge of marine zoology. Up to the end of last century the little that was known about the inhabitants of the lower zones of the sea seems to have been derived from a few specimens collected on the shore after tempests, or to captures made by chance on sounding or fishing lines, or brought up by dredges and nets while fishing for oysters and mussels. In 1799, Otto Friedrich Muller introduced the naturalist's dredge, a modification of that used by Marsili and Donati in 1750,[1] for investigating the fauna of the bottom of the sea.[2]

Sir John Ross.

Sir John Ross, in his voyage to Baffin's Bay[3] in 1817–1818, mentions four deep-sea soundings which may be considered historical. The first sounding was made 2 miles from the coast to a depth of 2700 feet, and brought up gravel and two small living Crustaceans (*Gammarus*); the second, in 3900 feet of water and 18 miles from the coast, brought up pebbles and brown clay with *Serpulæ*, Corallines, and Crustaceans; the third, in 6000 feet and 6 miles from the coast, brought up black mud with a few worms; and in the fourth sounding, in 6300 feet, he obtained a starfish attached to the line below the depth of 2400 feet. Not only are these results worthy of attention, but also the method employed in obtaining them. Ross used an apparatus of his own invention, manufactured by the blacksmith on board his vessel, which he called a "deep-sea clamm."[4] By means of this ingenious instrument he succeeded not only in taking deep soundings, but he brought up a much larger quantity of the deposit from the bottom of the sea than he could have done with the sounding lead; thus in Baffin's Bay, lat. 72° 23′ N., long. 73° 07′ W., he brought up from a depth of 1050 fathoms several pounds of greenish mud.[5]

These observations of Ross opened a new era in submarine soundings, and proved for the first time that organisms existed at great depths. The truth was not recognised at once, and the observations of the celebrated navigator had not at that time sufficient influence to overcome the opinion generally current that the sea was uninhabited at depths approaching 1000 fathoms; this was the first example of animals brought up from such depths. Dr. Carpenter has given the most precise details on this point, received from General Sir Edward Sabine, who was a member of Sir John Ross' expedition:—"The ship sounded in 1000 fathoms, mud, between 1 and 2 miles off shore (lat. 73° 37′ N., long. 75° 25′ W.), a magnificent *Asterias caput-medusæ* was entangled by the line and brought up with very little damage. The mud was soft and greenish, and contained specimens of *Lumbricus tubicola*. So far my written journal, but I can add, from a very distinct recollection, that the heavy deep-sea weight had sunk, drawing the line with it, *several feet* into the very soft greenish mud, which still adhered to the line when brought

[1] See *ante*, page 68.
[2] See Narr. Chall. Exp., vol. i. p. xxxv.; and Thomson, Depths of the Sea, p. 237, London, 1874.
[3] Ross, A Voyage of Discovery for the Purpose of Exploring Baffin's Bay, vol. i. p. 178, and App., p. lxxxv., London, 1819.
[4] Voyage of Discovery in His Majesty's Ships "Isabella" and "Alexander," App. p. cxxxv., London, 1819.
[5] See Wallich, North Atlantic Sea-bed, pp. 78, 79, London, 1862.

to the surface of the water. The starfish had been entangled in the line so little above the mud, that fragments of its arms, which had been broken off in the ascent of the line, were picked out from amongst the mud."[1]

In 1826 Henry Milne-Edwards and Audouin made zoological expeditions along the French coasts, afterwards continued on the Sicilian coasts with de Quatrefages; in 1828 the Russian Lütke explored the archipelago of the Caroline Islands, and from 1831 to 1836 the observations of Fitzroy and Darwin were conducted during the voyage of the "Beagle." These expeditions awakened much interest in marine zoology, and gave an impetus to many scientific questions connected with oceanography.

MILNE-EDWARDS, LÜTKE, DARWIN.

In 1836 Ehrenberg produced his first works. His name will ever remain inseparably connected with the discoveries relating to the microscopic organisms of the sea. It would be impossible to enumerate here the numerous memoirs and important publications of this micrographer, who devoted his whole life, with extraordinary activity, to the study of microscopic organisms, of atmospheric dust, of material brought up from deep soundings, and of numerous questions appertaining to the sea. One salient point may be dwelt on, viz., the connection he established between certain classes of living microscopic organisms and the part they played in geological times. As early as 1836 he showed that the siliceous strata known as "Tripoli," found in various parts of the globe, especially at Bilin in Bohemia, were but an accumulation of the skeletons of Diatoms, Sponges, and Radiolaria; he pointed out the presence of Diatoms in the subsoil of Berlin. In 1839 his observations at Cuxhaven revealed the presence of living Diatoms and Radiolarians on the surface of the Baltic, belonging to the same species as those found fossil in the Tertiary deposits of Sicily and Oran. He showed, moreover, that in the Diatom layers of Bilin the siliceous deposit had, under the influence of infiltrated water, been transformed into compact opaline masses. Starting from these facts, he concluded that rocks similar to those which play so important a part in the terrestrial crust are still being formed on the bottom of the sea by minute organisms. He recognised the association of greensand and Globigerina limestone. His observations exercised a great influence on the study of micro-organisms, whose rôle in nature is in an inverse ratio to their size.

EHRENBERG'S MICROGRAPHIC STUDIES.

The United States sent out their first purely scientific expedition in 1839 under the command of Captain Wilkes. This expedition returned in 1842; its work was chiefly geographical and astronomical, but during the first year a few dredgings were made in shallow water, and a number of deep soundings were obtained at intervals during the voyage. The sounding line employed was a copper wire, a great improvement on previous methods. The great American naturalist Dana, who accompanied this expedition, added much to our knowledge of several groups of shallow-water and pelagic animals, and the geology and mineralogy of many oceanic islands.

WILKES' EXPEDITION.

[1] See Carpenter, *Proc. Roy. Soc.*, vol. xvii. p. 177, 1868.

Sir James Clark Ross' Antarctic Expedition

A British Antarctic Expedition under Sir James Clark Ross sailed in the "Erebus" and "Terror" in 1839, and returned safely in 1843. Like Sir John Ross in the Arctic voyages, his nephew was determined to make the most of his opportunities in all directions, and was seconded in his efforts by the able co-operation of Dr., afterwards Sir, Joseph D. Hooker, who accompanied the expedition as assistant surgeon. Without neglecting his main purpose—the exploration of the ice-bound coasts of the southern hemisphere and the search for the South Magnetic Pole—he carried on astronomical, physical, and zoological work, and achieved important results.

A number of unsuccessful attempts were made to ascertain the depth of the water in mid-ocean, the failure being due to the want of a proper line. Sir James Ross accordingly had one made on board, 3600 fathoms long, fitted here and there with swivels to prevent it unlaying in its descent, and made strong enough to support a weight of 76 lbs. On the 3rd January 1840, when in lat. 27° 26′ S. and long. 17° 29′ W., the first abysmal sounding was satisfactorily taken with the new line, the depth marked being 2425 [1] fathoms. Sounding in such great depths could only be attempted in dead calm weather, and the line was allowed to run out from an enormous reel in one of the ship's boats, the time each 100 fathom mark left the reel being noted in the usual way. On the 3rd March 1840, a sounding of 2677 fathoms was taken in lat. 33° 21′ S. and long. 9° E., 450 miles west of the Cape of Good Hope. Water of equal depth was frequently sounded during the cruise, and on two occasions at least no bottom could be found with over 4000 fathoms of line.

Introduction of Time Intervals in Sounding.

Ross' Dredgings in Deep Water

The dredgings which were taken occasionally turned out to be one of the most valuable parts of the scientific work of the expedition. On the 21st April 1840, a haul of the dredge was taken in 95 fathoms of water, and it came up full of coral. On the 18th January 1841, when in lat. 72° 57′ S. and long. 176° 6′ E., a Crustacean (*Nymphon gracile*) was found attached to the lead, after a sounding in 20 fathoms. Next day, when the depth was 270 fathoms, a dredge was put over, and when hauled up was found to be nearly full; it contained a block of granite, a number of small stones, some beautiful specimens of living corals, and, to quote Captain Ross's own words:—"Corallines, Flustræ, and a variety of marine invertebrate animals, also came up in the net, showing an abundance and great variety of animal life. Amongst them I detected two species of *Pycnogonum*, *Idotea baffini*, hitherto considered peculiar to the Arctic Seas, a Chiton, seven or eight bivalves and univalves, an unknown species of *Gammarus*, and two kinds of *Serpula* adhering to the pebbles and shells." [2] On 20th January 1841, the deep-sea clamm brought up stiff green mud containing corals and fragments of starfish from a depth of 320 fathoms. Two days later the dredge was kept out for several hours in 300 fathoms, and its contents included "many animals, some

[1] Antarctic Voyage, vol. i. p. 46.

[2] *Ibid.*, p. 203.

Corallines, and a quantity of sand, mud, and small stones."[1] Ross's deepest dredging was made at 10 A.M. on the 11th August 1841, in lat. 33° 32′ S., long. 167° 40′ E., when the dredge was let go in 400 fathoms; after being dragged along the ground for half an hour, it was hauled on deck, and found to contain "some beautiful specimens of Coral, Corallines, Flustræ, and a few Crustaceous animals." The reflections of the accomplished leader of the expedition are extremely significant, but so completely had Ross's researches faded from memory, that twenty years after they were made, the fact of living creatures being found under 400 fathoms of water was hailed as a great discovery. Yet Ross, referring to his dredgings in 1841, says:—"It was interesting amongst these creatures to recognise several that I had been in the habit of taking in equally high northern latitudes; and, although contrary to the general belief of naturalists, I have no doubt that from however great a depth we may be able to bring up the mud and stones of the bed of the ocean, we shall find them teeming with animal life; the extreme pressure at the greatest depth does not appear to affect these creatures; hitherto we have not been able to determine this point beyond a thousand fathoms, but from that depth several shell-fish have been brought up with the mud."[2]

MIGRATION OF MARINE ANIMALS FROM ONE POLAR REGION TO THE OTHER SUGGESTED.

From the fact that the same species were to be found towards both poles, and that these animals are very sensitive to a change of temperature, he suggested that it would be possible for them to pass from one frigid zone to another, provided the temperature of the intervening sea bottom had a range not exceeding 5° F. Ross's observations confirmed his idea that the temperature at the bottom of the open sea was uniform in all latitudes, and subsequent investigations prove this, generally speaking, to be correct.

Sir James Ross was an indefatigable zoological collector, but it is to be regretted that the large collections of deep-sea animals, which he retained in his own possession after the return of the expedition, were found to be totally destroyed at the time of his death. Had they been carefully described during the cruise or on the return of the expedition to England, the gain to science would have been immense, for not only would many new species and genera have been discovered, but the facts would have been recorded in journals usually consulted by zoologists, instead of being lost sight of as was the case. A large number of zoological drawings made by Hooker during the Antarctic cruise were recently handed to the various naturalists engaged in working up the Challenger collections, and show that some of the Challenger discoveries had been anticipated by Ross.

Humboldt addressed a letter to Lord Minto, First Lord of the Admiralty, with

[1] Antarctic Voyage, p. 207.

[2] *Ibid.*, vol. i. pp. 202, 203. The organisms dredged from 2400 feet by J. C. Ross were examined by Stokes and Forbes, who found small corals, fragments of shells, two articulations of a small fossil (?) *Pentacrinites*, a spine of *Cidaris*, fragments of *Echinus*, a small broken *Cerithium*, a fragment of *Cleodora*, and a few rock fragments. Besides these organic remains Foraminifera were very plentiful belonging to the genera *Textularia*, *Nodosaria*, &c. (see Wallich *op. cit.*, pp. 80, 81).

reference to Sir J. C. Ross's Antarctic Expedition, calling attention to the importance of observing the microscopic organisms, which Ehrenberg had shown played so important a rôle in the constitution of terrestrial strata. Hooker first made known some of the results of Ross's deep-sea dredgings and investigations in 1845,[1] and fuller details were given by Ross himself in the account of the voyage published in 1847. Hooker observed[2] that the water and ice of the Antarctic regions swarmed with Diatoms to such an extent that they gave the water a brown tint. Between lat. 50° and 70° S. prodigious quantities of them were found, and in lat. 80° S. all the surface ice, the sides of the icebergs, and the base of the great Victoria Barrier within the reach of the waves, were coloured brown by these organisms. He observes that the siliceous skeletons must, after the death of the organisms, form siliceous deposits of considerable extent around all coasts bordered with ice, at depths between 80 and 400 fathoms. Opposite Victoria Barrier the bottom was covered with a white or greenish mud, consisting principally of Diatom frustules. In very deep water, opposite Victoria and Graham's Land, the mud was very pure and fine grained, but in shallow water, near the coast, it was mixed with sandy and gravelly particles. Hooker considered that these microscopic plants were intended to maintain in the south Polar regions the balance between the animal and vegetable kingdoms, and also to purify the vitiated atmosphere, performing in Antarctic latitudes the part of plants in other regions. He states that Diatoms exist in every latitude from Spitzbergen to Victoria Land, Iceland, Great Britain, the Mediterranean, North and South America, and the islands of the South Sea, and that the frustules of species living in the Antarctic have contributed to the formation of various strata during geological periods. He estimates that the deposit formed principally of Diatom frustules extends continuously for more than 400 miles off Victoria Land, at depths of about 300 fathoms. The existence of remains of Diatoms, including a few Antarctic species, in volcanic ashes, pumice, and scoriæ, led him to suppose that organic substances covering the bases of active volcanoes, like Mount Erebus and Vesuvius, might be ejected from the craters along with volcanic products.

Hooker's Observations on Antarctic Diatoms.

The researches of Ross and even those of Ehrenberg cannot be said to have established any important generalisation. The advantages to be derived from a knowledge of the horizontal and vertical distribution of the organisms living under the waters of the sea at greater or less distances from the shore do not appear to have been at first understood. However, as far back as 1838, H. T. de la Bèche inserted, in his Recherches sur le partie théorique de la géologie, a map by Brodrip indicating the localities and the depths at which living specimens of shellfish had been found in the sea and at the mouths of rivers.

The Horizontal and Vertical Distribution of Organisms initiated.

Risso, whose observations were made in the Gulf of Genoa, was the first to distinguish

[1] *Ann. and Mag. Nat. Hist.*, ser. i., vol. xvi. p. 238, 1845.
[2] *Brit. Ass. Report* for 1847, Trans. of Sections, p. 83; see also Flora Antarctica, London, 1847.

a bathybial fish-fauna, assigning to it certain fishes and stating the depths at which they habitually live.[1] R. T. Lowe paid special attention to the wonderful variety of the fishes of the sea surrounding Madeira. His History of the Fishes of Madeira appeared in five parts at irregular intervals between the years 1843 and 1860, and he gives precise depths at which many fishes occur. The discovery that some fishes live at an early period of their existence at or near the surface, and at a later stage descend into the depths of the ocean, is due to Lowe. J. Y. Johnson, between the years 1862 and 1866, made some most interesting additions to ichthyology; he discovered important bathybial types, but treated them like any other rare surface fishes, without taking note of their pertinence to a distinct fauna.[2] Between 1860 and 1870 Günther published several papers on deep-sea fish, and formed the idea of a special adaptation of the ichthyic type to bathybial life. OBSERVATIONS ON DEEP SEA FISHES.

Early in the present century naturalists turned their attention to the study of the geographical distribution of marine animals, and some detailed researches appeared on the subject. Edward Gray studied the Molluscs in fresh, brackish, and salt waters, and pointed out the species having representatives in all the three areas. Valenciennes showed that not one fish was common to both the Red Sea and the Mediterranean. But it is only since the observations made in 1840 by Edward Forbes in the Ægean Sea that these studies have acquired a real importance, on account of the methodical manner in which they were conducted and followed up.

The great importance of dredging as a means of zoological research was recognised in 1839 by the British Association, which appointed a committee "for researches with the dredge, with a view to the investigation of the marine zoology of Great Britain, the illustration of the geographical distribution of marine animals, and the more accurate determination of the fossils of the Pliocene period, under the superintendence of Mr. Gray, Mr. Forbes, Mr. Goodsir, Mr. Patterson, Mr. Thompson of Belfast, Mr. Ball of Dublin, Dr. George Johnston, Mr. Smith of Jordan Hill, and Mr. A. Strickland."[3] From the number of eminent men on this committee valuable reports were looked for, and not in vain. One alone, Professor Edward Forbes, did more than any of his contemporaries to advance marine zoology. "Edward Forbes," says Thomson, "was the ruling spirit of this committee, and under the genial influence of his contagious enthusiasm great progress was made during the next decade in the knowledge of the fauna of the British seas."[4] BRITISH ASSOCIATION DREDGING COMMITTEE.

Forbes conducted long and patient investigations into the bathymetrical distribution of life in various seas, and by the fascination of his literary style he invested his reports EDWARD FORBES' INVESTIGATIONS IN DEEP WATER.

[1] Histoire naturelle des principales productions de l'Europe méridionale, tom. iii., Paris, 1826. Risso states that *Alepocephalus* lives at 350 fathoms, *Trachyrhynchus* and *Macrurus* at 250 or 300 fathoms, *Uraleptus* at 170 fathoms, and *Gadus* at 150 fathoms.

[2] See Günther, Zool. Chall. Exp., part lvii. p. xx., 1887.

[3] *Brit. Ass. Reports* for 1839, p. xxvi.; Memoir of Edward Forbes, by Wilson and Geikie, p. 246, 1861.

[4] Thomson, The Depths of the Sea, p. 265, London, 1874.

with an interest that carried the knowledge of his work far beyond the limits usually set to the labours of specialists. Forbes' ideas on many points are no longer entertained; had he lived longer he himself would doubtless have been the first to discover and proclaim the error of many of them. "To Forbes is due the credit of having been the first to treat these questions in a broad philosophical sense, and to point out that the only means of acquiring a true knowledge of the *rationale* of the distribution of our present fauna is to make ourselves acquainted with its history, to connect the present with the past. This is the direction which must be taken by future inquiry. Forbes, as a pioneer in this line of research, was scarcely in a position to appreciate the full value of his work. Every year adds enormously to our stock of data, and every new fact indicates more clearly the brilliant results which are to be obtained by following his methods, and by emulating his enthusiasm and his indefatigable industry."[1]

Before Forbes' time the bathymetrical distribution of marine animals had been investigated to a certain extent, but the works of Audouin and Milne-Edwards (1830), Sars (1835), and Oersted (1844), applied only to the more superficial waters of the sea.

In 1840 Forbes joined as naturalist the surveying ship "Beacon" while in the Mediterranean, and for eighteen months he studied the Ægean Sea and its shores, taking more than one hundred dredgings at different depths down to 130 fathoms. In 1843 he read to the British Association at Cork his Report on the Molluscs and Echinoderms of the Ægean Sea, and their distribution as connected with geology,[2] and in 1844 Forbes published his memoir On the Light thrown on Geology by Submarine Researches.[3] He maintains that the dredgings show the existence of distinct regions at successive depths, having each a special association of species. He remarks that the species found at the greatest depths are also found on the coasts of England, and he concludes, therefore, that such species have a wider geographical distribution.[4] Forbes divided the area occupied by marine animals into eight zones of depth, in which animal life gradually diminished with increase of depth, until a zero was reached at about 300 fathoms. He showed that in Cretaceous and Tertiary layers similar zones may be distinguished, and that depth must have been in former times, as it is now, one of the factors in the distribution of marine organisms. He found fewer species in the deep zones than in the shallow ones, and supposes that plants, like animals, disappeared at a certain depth, the zero of vegetable life being at a less depth than that of animal life. Forbes concluded that, as nearly all marine basins are over 300 fathoms in depth, most of the sedimentary beds must be devoid of organic remains, and the absence of organisms in some strata convinced him that they had been formed at great depths, or deposited prior to the existence of organisms. He observed that the number of organisms found in colder regions increased with

VERTICAL DISTRIBUTION OF MARINE

GEOLOGICAL PHENOMENA

[1] Thomson, The Depths of the Sea, p. 6, London, 1874.

[2] *Brit. Ass. Report* for 1843, p. 130. [3] *Edinburgh New Phil. Journ.*, vol. xxxvi. p. 318.

[4] This generalisation, though correct for certain areas, cannot be applied to the great oceans; it is applicable only to a part of the Mediterranean.

the depth of water, and in the deeper zones of warm latitudes species are noticed which are inhabitants of the littoral zones of the highest latitudes. Forbes also showed that all sea-bottoms are not equally fit for the development of life, for in all the zones he found areas less peopled than others, these barren areas being mostly formed of sand, and inhabited only by creatures whose remains were not likely to be met with in a fossil condition. Thus might be explained the rarity of fossils in certain sandy beds. On the other hand, beds or banks of marine animals are of definite thickness, each species being best developed at a certain depth. A species may die out through the accumulations produced by its own organic remains reaching a height at which the animal cannot exist; other species may then come and settle on the top, but were the bottom of the sea to sink the first species might return, and in the space intervening between such *dying out* and *return* sand and ooze might have been deposited. This might explain, in certain cases, the alternation of layers with and without fossils, and these facts show how a change in the level may exert a great influence on the structure of the layers.

Forbes and Lovén on Bathymetrical Distribution.

The general conclusion arrived at by Forbes, and shared by Lovén, may be expressed thus:—The greater the number of bathymetrical zones in which a species exists in the same region, that is, the more frequently it is found at varying depths along the same coast, the wider the area over which it will be found to exist. This proposition was a necessary consequence of the conclusion arrived at in 1842 by de Verneuil and d'Archiac from their study of transition beds; they say—"If we consider the development of organisms in those ancient periods, horizontally, geographically, or in space, it will be seen that those species found at a great many spots and in countries lying far apart, are almost invariably those which lived during the formation of several successive systems."[1] This quotation shows that the mode of distribution of marine Mollusca, both vertically and horizontally, had been recognised from the study of the fossil fauna of the globe.

In 1846 Forbes published an important work on the connections between the present flora and fauna of the British Isles, and the changes which have modified the extent of ground occupied by them in former times, particularly during the glacial period.[2] These labours had considerable influence on geological studies. The facts as then understood indicated that the greater number of marine animals, especially Polyps, Echinoderms, and Mollusca, live or are best developed at a certain depth, and led to the following conclusions:—Supposing a marine basin on which sedimentary layers are deposited; in the centre the layers are perhaps thousands of feet below the surface, while near the shore, the bottom gradually rising, the layers will be found nearer and nearer the surface. Under these circumstances it was thought impossible that the same species of animals should be found in equal numbers over the whole extent of the layers; it was naturally supposed that animal life would disappear in the layers formed in the centre of the basin, or that different

[1] *Bull. Soc. géol. France*, sér. i. tom. xiii. p. 260, 1842.

[2] Mem. Geol. Survey, vol. i. p. 336, 1846.

species would be found there. These rational conclusions received some support from Forbes' brilliant researches, and have been partially confirmed by recent investigations.[1]

Forbes' name is inseparably associated with the bathymetrical distribution of marine life, and his clearly-defined zones—the Littoral, Laminarian, Coralline, and the Region of the Deep-Sea Corals—enormously facilitated the work of descriptive naturalists. The region of deep-sea corals extended from 50 fathoms to an unknown depth, and Forbes points out that vegetable life is entirely absent from it, and "as we descend deeper and deeper in this region, the inhabitants become more and more modified, and fewer and fewer, indicating our approach towards an abyss where life is either extinguished, or exhibits but a few sparks to mark its lingering presence. Its confines are yet undetermined, and it is in the exploration of this vast deep-sea region that the finest field for submarine discovery yet remains."[2]

The Faroe Channel.

In his Report[3] to the British Association in 1850, Forbes says: "A more difficult task, and one which can be hardly hoped for fulfilment without the help of a steam vessel and continued calm weather, is the dredging of the deeps off the Hebrides in the open ocean. Much of the deep sea area around the Zetlands is sure to reward the explorer. . . . . . And lastly, though I fear the consummation, however devoutly wished for, is not likely soon to be effected, a series of dredgings between the Zetland and Faroe Isles, where the greatest depth is under 700 fathoms, would throw more light on the natural history of the North Atlantic, and on marine zoology generally, than any investigation that has yet been undertaken." He saw with a prophetic eye that field of exploration which, twenty years later, became the scene of the investigations of Carpenter, Thomson, and Gwyn Jeffreys, and still more recently of Murray and Tizard.

Zero of Life in the Ocean.

The disciples of great men tend to assert dogmatically what their master suggested hypothetically, and it was so with the followers of Edward Forbes. They viewed the life-zero, not as a probability, but as a certainty, building their belief more on the *à priori* absurdity of creatures being able to live in the absence of light and air, and under the great pressure which must prevail in the depths of the sea, than on any direct evidence. The impulse had now been fairly given to the study of the marine zoology of the deep

[1] Wilhelm Fuchs (Die Venetianer Alpen, p. 43, 1844) remarked that fossils had been looked upon as representing the organic forms of geological periods, but he could not accept that view as correct, for it was not at all impossible that, as on the earth certain organisms live at various heights above the sea, so in the ocean animals and plants might live at different levels; each species is not so much the representative of the period as of the level at which the layer was deposited. When the layers approached the surface the creatures which could live only at great depths disappeared, but continued to live in the deeper parts of the basin. Were any rapid and considerable action (as that of an earthquake) to affect the bottom of the sea, there might be found abnormal mixtures of organisms; thus he explains the mixture of fossils in the Alpine sediments. It will be seen from this that the facts observed by Forbes were destined to give a considerable impulse to marine investigation.

[2] Natural History of European Seas, p. 26; this classification was given as early as 1839 (see Memoir of Edward Forbes, p. 255).

[3] Report on the Investigation of British Marine Zoology by means of the Dredge, Part I., (*Brit. Ass. Report* for 1850, pp. 192–263)

sea; the Natural History Societies of Northumberland, Durham, and Dublin vied with each other in their ardour to promote fresh discoveries, and the knowledge of the marine fauna soon made great progress.

Lovén's Researches in Scandinavia.

The researches made in 1844 by Professor Lovén are directly connected with those of Forbes. In his Report to the British Association on the bathymetrical distribution of submarine life on the northern shores of Scandinavia, he says: "The region of the deep-sea coral is with us characterized in the south by *Oculina ramea* and Terebratula, and in the north by Astrophyton, Cidaris, *Spatangus purpureus* of an immense size, all living, besides Gorgoniæ and the gigantic *Alcyonium arboreum*, which continues as far down as any fisherman's line can be sunk. As to the point where animal life ceases, it must be somewhere, but with us it is unknown."[1] Lovén established the constancy of the laminarian zone, but in the regions he explored he found that the deep zones could no longer be compared with those in other areas, as they varied according to latitude, nature of the bottom, &c. He mentions a very interesting fact, viz., that the species found between Göttenburg and Norway at a depth of 80 fathoms live on the coast of Finmark at a depth of 20 fathoms only, thus showing the direct influence of temperature on the bathymetrical distribution of marine organisms.

Franklin's Expedition, Goodsir.

When Sir John Franklin's ill-fated Polar expedition set out in 1845, Mr. Harry Goodsir, a young zoologist of great promise, sailed on board the "Erebus" as assistant surgeon and naturalist. The expedition never returned, and only fragmentary records are preserved of the valuable work which Goodsir had already accomplished. "On the 28th June a dredge was sunk to the enormous depth of 300 fathoms, and produced many highly interesting species of Mollusca, Crustacea, Asteriadæ, Spatangi, and Corallines; such as *Fusus*, *Turritella*, *Venus*, *Dentalium*, &c., and also some large forms of Isopoda. As bearing upon the geographical distribution of species, Mr. Goodsir considers the occurrence of *Brissus lyrifer* (Forbes) and *Alauna rostrata* (Goodsir) as of the greatest interest, both of them being natives of the Scottish seas. The remarkable depth also appears to us to give peculiar interest to these researches, as we believe that the deepest dredgings ever previously obtained were those of Professor E. Forbes in the Levant, the deepest of which was 230 fathoms, itself far beyond any made by other naturalists."[2]

Observations in the Mediterranean. Williamson.

In 1845 Professor W. C. Williamson described some Foraminifera, Diatoms, and Sponge spicules from some Mediterranean muds, and, in discussing the origin of limestone strata in shallow and deep waters, he suggests that the whole of the calcareous organisms may be removed by carbonated waters.

Spratt.

In 1846 Captain Spratt, R.N., dredged in 310 fathoms, 40 miles to the east of Malta,

[1] *Brit. Ass. Report* for 1854, Trans. of Sections, p. 50.

[2] *Ann. and Mag. Nat. Hist.*, ser. i., vol. xvi. p. 164, 1845. Sir John Ross in the Arctic in 1818, and Sir J. C. Ross in the Antarctic, had, however, dredged in depths greater than 400 fathoms (see *ante*, pp. 76 and 78).

bringing up eight species of Mollusca, including *Pleurotoma maritima*, a species belonging to the coralline crag, which was supposed to be extinct. They were examined by Gwyn Jeffreys, who found them to be identical with species dredged subsequently at considerable depths in the North Atlantic by the "Porcupine." Spratt was of opinion that life existed at much greater depths, though the general character of the Ægean Sea tended to limit the depth to 300 fathoms.[1] In his survey of the Mediterranean between Malta and Crete, he afterwards procured fragments of shells, &c., from a depth of 1620 fathoms.[2] Like Lovén, Spratt proved that temperature influenced the distribution of marine organisms. He found in the six upper zones of Forbes summer temperatures of 30°, 23°, 20°, 16°·6, and 13°·3 C.; thus it might be said that different depths corresponded to different latitudes.

Michael Sars.

Before 1850 the attention of the Norwegian naturalist, Michael Sars, had been directed to the bathymetrical distribution of life on his native coasts, and he published in that year a list of nineteen species which lived at depths greater than 300 fathoms. His son, G. O. Sars, afterwards assisted him in the work of deep-water dredging, and the result was, in 1864, a list of ninety-two species, which lived between the depths of 200 and 300 fathoms. A few years later these untiring investigators found abundance of life at the bottom under 450 fathoms of water.

MacAndrew's Observations.

In his Report to the British Association on the marine testaceous Mollusca of the north-east Atlantic and neighbouring seas,[3] MacAndrew refers to the distribution of Mollusca along the coasts of Europe and Africa from the North Cape to the Canary Islands, showing of what the fauna consists over this extent of ground, how it becomes modified towards the south, and pointing out the species found also on the coasts of North America. He gives a table of 750 species obtained in his dredgings, which extended over 43 degrees of latitude, showing the horizontal and vertical distribution of each, the locality of their greatest development, the nature of the bottom, &c. A second table shows the geographical distribution of these species, among which are recorded 275 Acephalæ, 14 Pteropoda, and 460 Gasteropoda. He asserts that the Acephalæ have a greater bathymetrical and horizontal extension than the Gasteropoda, several species being found at all depths down to 100 fathoms and even more. As a general rule, the deeper species are smaller, their colours less bright, and the test less robust than the shallower species. MacAndrew's work proves that the exact distribution of marine Mollusca into provinces or faunæ is far from being so precise as was at one time imagined.

Woodward.

In his well-known book, Manual of the Mollusca (1851–56), S. P. Woodward gives much interesting information on the distribution of the Mollusca, valuable alike to the palæontologist and zoologist.

The influence of the work carried out by the United States Coast Survey on oceano-

[1] *Brit. Assoc. Report* for 1848, Trans. of Sections, p. 81.
[2] Spratt, Travels and Researches in Crete, vol. ii. p. 329.
[3] *Brit. Assoc. Report* for 1856, pp. 101–158.

graphical researches was soon felt. When appointed Director in 1844, Professor A. D. Bache gave orders for the collection and preservation of the samples brought up by the sounding machine while the officers were making hydrographic observations, with the double object of showing the relief of the sea-bottom and of forming a collection of the substances spread over the bed of the ocean. Deep-Sea Work of the U.S. Coast Survey.

Professor J. W. Bailey applied himself to the microscopic study of the soundings collected by the U.S. Coast Survey,[1] and in 1851 he showed the important part played by Foraminifera in the deposits off the coast of New Jersey. Owing to the abundance of these calcareous organisms, the deeper deposits differed considerably from the shore deposits, in which mineral particles, especially quartz, predominated. He observes that the quartz grains are angular in the deep soundings, and rounded and polished in shallower water. Bailey.

Lieutenant M. F. Maury, of the United States Navy, was for a long period associated with investigations relating to navigation. He approached the problems connected with the phenomena of the ocean from a scientific standpoint, and has in a sense popularised the science of the sea. The last edition of his Sailing Directions[2] furnishes an abstract of his views and of the progress made up to that time. The Brussels Maritime conference of 1853 was brought about principally through Maury's influence. The recommendations of this conference led to the adoption of a uniform method of making nautical and meteorological observations at sea among maritime nations, and have largely contributed to the rapid development of ocean meteorology in recent years. Maury.

The errors arising from the old methods of sounding with a heavy weight attached to a silk or hempen cord induced navigators and others to seek some improved apparatus, by means of which more accurate soundings could be obtained. They had recourse to a detonating apparatus, which exploded on touching the bottom, but this was abandoned on account of the difficulty in hearing the detonation. Ericsson and others constructed sounding machines containing a column of air, the compression of which indicated the pressure and thereby the depth, but all these attempts failed in very deep water.[3] Maury then applied to Baur, a New York mechanician, to construct from his plans a sounding machine with a screw propellor connected with clockwork, showing on a dial the number of revolutions made by the screw; each revolution represented a fathom. This apparatus worked well in comparatively shallow water, but was difficult to manage in very deep water. Lieutenant Walsh, of the United States Navy, sounded with a wire rope more than eleven miles long, and saw his rope run out to 34,000 feet without Ericsson's Sounding Machine. Walsh's Wire-Rope Soundings.

[1] Microscopical examination of soundings made by the U.S. Coast Survey, off the Atlantic coast of the United States, *Smithsonian Contributions to Knowledge*, vol. ii. article iii. pp. 1–15, 1851.

[2] Maury, Explanations and Sailing Directions to accompany the wind and current charts, 8th ed., Washington, 1858 and 1859.

[3] See Nautical Magazine, 1836, p. 390. Ericsson's principle was subsequently adopted by Sir William Thomson in his Navigational Sounding Machine.

reaching the bottom. Lieutenant Parker, U.S.N., of the sloop "Congress," ran out 50,000 feet of line without touching the bottom.

Walsh's experiments on board the "Janey" convinced Maury that wire was less suitable than cord. He then had recourse to a line with a 32-lb. bullet attached, which was allowed to descend, and when it touched bottom the twine was cut near the surface, the depth being calculated by measuring what was left of the twine on board. The experiments of Lieutenant Rogers Taylor on board the "Albany" showed that it was necessary to use something stronger than twine. Maury demonstrated the influence of submarine currents by sounding on the same spot with one and with two 32-lb. bullets, for he found invariably that the depth indicated was less when the two bullets were used; the double weight descends faster, and is therefore not so long exposed to the action of the currents. From this it was considered advisable to use stronger lines, reckoning the time each 100 fathoms took to run out, but still the moment of touching bottom, if bottom were reached, remained doubtful. Lieutenant S. P. Lee of the "Dolphin" obtained, however, some good results, and afterwards every American ship, the officers of which would undertake deep soundings, was supplied with a sufficient quantity of prepared line and 32-lb. bullets. Every opportunity of sounding in deep water was to be taken advantage of, still one important particular was wanting,—there was no positive proof that Lee and his predecessors had touched bottom, and up till that time it had been deemed impossible to bring up samples of the deposit.

Brooke's Sounding Apparatus.

It was then that Midshipman J. W. Brooke, a young and distinguished officer attached to the Observatory, proposed to Maury that the well-known apparatus, which now bears Brooke's name, should be adopted. This consisted of a detaching apparatus affixed to the lead of the sounding line, on a principle similar to that employed by Cusanus, Puehler, and Alberti without a line.[1] With this apparatus Brooke collected in the Pacific samples from depths down to 3500 fathoms; Midshipman J. G. Mitchell of the "Dolphin" and his men acquired such dexterity in the use of the apparatus that they seldom failed to bring up a sample of the bottom. The samples thus obtained were carefully labelled and sent to the head of the Hydrographic Office. Brooke made use of his apparatus on board the "Vincennes" in the North Pacific,[2] but he confesses that the motion of the boat interfered with the precision of the observations. After several trials in the Indian Ocean and Coral Sea, however, he came to the conclusion that it was possible to take soundings down to any depth. He mentions a sounding taken in the Indian Ocean at a depth of 7040 fathoms, but the line broke; this failure he attributed to the currents. In the Coral Sea some excellent results were obtained; from a depth of 2150 fathoms, in lat. 13° S., long. 162° E., the tube came up full of clayey calcareous matter so compact that it retained the marks made by the bullet in slipping along the tube.

[1] See *ante*, pp. 56 and 57.

[2] Maury, *op. cit.*, vol. i. p. 169.

In 1856 Professor J. W. Bailey made known the nature of the soundings collected by Brooke in the Sea of Kamchatka in depths of 900 to 2700 fathoms.[1] He remarks that in all the samples mineral matters diminished with increase of depth, and that while the mineral particles decreased the organic remains increased. Of organic remains Diatoms predominated, Sponge spicules and Radiolarians being also present, while the calcareous tests of Foraminifera were absent. These deposits of microscopic organisms, in their richness, extent, and high latitude, resemble the siliceous deposits of the Antarctic already noticed by Hooker. Bailey's researches proved that localised deposits were formed in the high seas, in which not calcareous, but siliceous, remains predominated. The excellent state of preservation of these siliceous organisms, and the fact that many of them still retained the soft parts, led him to conclude that they must have been living up to a very recent period, not necessarily at the great depths where they were found, but probably drifted from shallower deposits. He always maintained this opinion, convinced of its importance from a zoological point of view. He extolled the good example set by Brooke, saying that "soundings from any part of the ocean are sure to yield something of interest to microscopic analysis, and it is as yet impossible to tell what important results may flow from this study." BAILEY ON DEEP-SEA DEPOSITS.

About the same time Bailey published his work on the origin of greensand and its formation on the bottom of modern seas.[2] Ehrenberg had long before observed a pseudomorphism of the calcareous shells of Foraminifera in the Chalk into silica. As early as 1845 Bailey had called attention to the casts of Foraminifera in the Eocene marls of Fort Washington.[3] Dr. G. A. Mantell[4] stated in 1846 that casts of Foraminifera and their soft parts were preserved in flint and limestone, and that the chambers of the Foraminifera were often filled with calcite, silica, or silicate of iron. But Ehrenberg was the first to show the connection between greensand and the Foraminifera, and to throw light on a point which had long puzzled geologists. In 1855 he said that, judging from all the examples he had examined up to that time, greensand must be considered as due to the filling up of organic cells of Foraminifera, like a lithoid mould.[5] Bailey verified Ehrenberg's results from the examination of a number of Cretaceous and Tertiary rocks of North America. GREENSAND DEPOSITS. BAILEY. EHRENBERG.

L. F. de Pourtalès in 1853[6] announced that he had obtained from a depth of 150 fathoms, in lat. 31° N., long. 79° W., a deposit formed of almost equal parts of *Globigerinæ* and black sand, probably greensand. Bache showed these, and similar samples taken in the region of the Gulf Stream, to Bailey, who found in them casts of organisms, some of which were "well-defined greensand, others reddish, brownish, or almost POURTALÈS.

[1] *Amer. Journ. Sci.*, ser. 2, vol. xxi. pp. 284-285, 1856.
[2] *Proc. Boston Soc. Nat. Hist.*, vol. v. pp. 364-368, 1856.
[3] *Amer. Journ. Sci.*, ser. 1, vol. xlviii. p. 341, 1845.
[4] *Phil. Trans.*, p. 466, 1846.
[5] *Monatsb. d. k. Akad. Wiss. Berlin*, 1855, p. 172.
[6] Report U.S. Coast Survey for 1853, App. p. 83.

white."[1] He concludes that these glauconitic casts have not been transported from ancient formations, but have been formed where they were found in the same manner as in geological formations. He states that his own and Ehrenberg's researches prove that other organisms, besides Foraminifera, may serve as moulds for the greensand, and he notices that with the well-defined casts are associated green grains less regular in form, "having merely a rounded, cracked, lobed, or even coprolitic appearance."[2] The phenomena accompanying the decomposition of organic substances, he says, are closely connected with the formation of this mineral—a green or red silicate of iron or almost pure silica.

Maury's Tables of Soundings in the Deep Sea.

Maury gives tables of soundings obtained up to 1857, showing those of the "Albany" (1850–51), the "Dolphin" (1851–52, Captain Lee), "Dolphin" (1852–53, Lieutenant Berryman), "Jamestown" (1851), "Plymouth" (1851), "Janey" (1849), "Saratoga" (1850), "Congress" (1851), "John Adams" (1851), "Susquehanna" (1851), "St. Louis" (1852), and "Saranat" (1853). He notes the rate of descent for each 100 fathoms, as observed in each of the principal expeditions, discussing the results of the soundings and making use of them in the construction of his bathymetrical map.[3]

Telegraph Plateau of the Atlantic.

In 1856 Lieutenant Berryman, in the steamer "Arctic," sounded across the North Atlantic, the principal object being to verify the discovery of a long submarine ridge between Newfoundland and the British Islands, to which the name of Telegraph Plateau had been given, and along which a company was preparing to lay a cable. He obtained samples of the deposit from thirty-four points between St. John's, Newfoundland, and Valentia. These deposits were described by Bailey,[4] who, from the fact that the mineral particles were angular, concluded that there is little movement at the bottom in deep water, otherwise the mineral fragments would be rounded. This confirmed what was already known as to the relative immobility of very deep water, and was of considerable importance with reference to the cable about to be laid, as it showed the small chance of displacement through bottom currents. He observed the abundance of calcareous matter due to the accumulation of microscopic shells, which fall to the bottom after the death of the organisms. Bailey also observed the presence of volcanic ashes in the deposits, and remarked that the Gulf Stream had spread these "plutonic tallies" over thousands of miles; this most important discovery was to receive further confirmation and generalisation from the subsequent observations of Maury. Some doubt having arisen as to whether these ashes might not have been thrown overboard from passing steamers, Bailey compared the two, and arrived at the conclusion that the substances found on the bottom of the Atlantic were really of volcanic origin. Maury supposed that this dust might have been carried by the wind from volcanoes in Central America or from extinct volcanoes in the Western Islands, though admitting the difficulties in the way of account-

Absence of Currents in Deep Water.

Volcanic Ashes.

[1] *Proc. Boston Soc. Nat. Hist.*, vol. v. p. 367.
[2] *Ibid.*, p. 368.
[3] Maury, *op. cit.*, pl. xi.
[4] *Amer. Journ. Sci.*, ser. 2, vol. xxi. pp. 284–285, 1856.

ing for the ashes being carried such enormous distances through the air ; these difficulties were solved by Murray in another direction during the Challenger Expedition by the discovery of floating pumice[1] stones in all parts of the ocean. By treating the deposits with acid, Bailey showed that there is always a small quantity of mineral particles in organic calcareous sediments, though veiled by the preponderance of the calcareous element, and that the calcareous organisms increase in abundance as the Gulf Stream is approached. He found only imperfect casts of Foraminifera in the deposits off the northern coasts, the green casts being generally met with in the more southerly soundings.

Maury represents the bathymetry of the Atlantic on a chart,[2] indicating by four shades of colour the depths within 1000, 2000, 3000, and 4000 fathoms. He says that the mineral particles found in the deep sea are not rolled, any more than the small shells associated with them, and concludes that the dynamic action of the sea is not felt at great depths, where the currents are too slow to move anything. This was an argument in favour of the cherished plan of binding the new and old worlds together by means of a telegraph cable, to which he often refers. He was of opinion that the mechanical actions which modify continental surfaces : the various effects of temperature, rain, wind, running water, and force of gravity, produce no effect on the bed of the sea. "We have," he says, "in imagination been disposed to regard the waters of the sea as a great cushion placed between the air and the bottom of the ocean to defend and protect it from the abrading agencies of the atmosphere." The deeps and shallows of the ocean would remain unchanged were it not for the microscopic organisms incessantly drawing from the sea-water the elements in solution to construct their solid envelopes, and these being showered upon the bottom and accumulating there. He estimated the part taken by calcareous and siliceous microscopic organisms in pelagic deposits, based upon Bailey's observations. He agrees with Bailey that the animalculæ, whose remains are found at the bottom of the sea, lived in the surface waters ; but he carries the idea too far when he asserts that the absence of light, low temperature, and pressure, preclude the possibility of life in very deep water. Ehrenberg held the opposite opinion regarding the habitat of these microscopic organisms, pointing out the presence of organic substances in the shells dredged from the bottom of the sea, and that some forms in the deposits were to be found nowhere else. Murray's tow-net observations have since proved that the most abundant of these shells from the bottom live in the surface waters.

MAURY'S BATHYMETRICAL CHART.

DO MICROSCOPIC ORGANISMS OF DEEP-SEA DEPOSITS LIVE IN SURFACE WATERS OR AT THE BOTTOM OF THE OCEAN?

In 1857 Captain Dayman sounded across the North Atlantic in H.M.S. "Cyclops," along the great circle between Valentia and Trinity Bay, Newfoundland, a little to the

DAYMAN'S SOUNDINGS ON THE TELEGRAPH PLATEAU.

[1] See Murray, *Proc. Roy. Soc. Edin.*, vol. ix. p. 247, 1877 ; Murray and Renard, Deep-Sea Deposits Chall. Exp., pp. 294 *et seq.*, 1891.

[2] Maury, *op. cit.*, pl. xi.

north of Berryman's line of soundings.[1] He used a modified form of Brooke's machine, elongated instead of spherical, the weights suspended by wire instead of cord, the valve for collecting the sediment being also different. Besides 18,000 fathoms of sounding line, he had 4000 fathoms of whale line, and 5000 fathoms of silk cord $\frac{1}{10}$ inch in diameter. He carefully noted the intervals of time in the descent of each 100 fathoms of line paid out. From the Irish coast as far as long. 11° 15′ W., the bottom was sandy, falling gradually to 90 fathoms. The deepest part on his line was between long. 15° and 45° W., where the deposit consisted of a plastic floury substance or ooze, which stuck to the line when drawn up. He thought this bed of ooze could not be very thick, for he occasionally found in it small pebbles, from which he concluded that they must have come upon a hard rock. From long. 45° W. to the coast of Newfoundland, he found a diversified bottom covered with stones and gravel; in Trinity Bay the water is deep and the deposit a thick mud.

Huxley on Globigerina Ooze.

Dayman's soundings were examined and reported on by Professor Huxley,[2] who found the samples obtained between 1700 and 2400 fathoms to be remarkable for their uniformity; in the bottles containing them Huxley observed a viscous substance, and small round corpuscles soluble in acid, which he called Coccoliths, and

Bathybius.

which he regarded as the skeletal parts of a gigantic Moneron—*Bathybius*[3]—widespread over the sea-bottom. When dry the deposit looked like chalk, and he observed that the calcareous organisms formed the principal part, *Globigerina* shells making up 85 per cent. of the mass; siliceous organisms were also present, including *Coscinodiscus* and other Diatoms. He considered the Globigerina Ooze to be of high scientific interest on account of its extent, depth, and resemblance to the Chalk, and discussed the question of the habitat of the Foraminiferous shells constituting the major part of the deposit.

According to the first hypothesis these shells must have been carried from comparatively shallow water to the spot whence they were procured; he refutes this idea by referring to the special characters of the deep-sea fauna, remarking that if the shells had been thus transported they would have been associated with shallow-water organisms, which must incontestably have been carried along with them, especially as the large *Globigerina*, so abundant in the deep sea, are, in proportion to their size, heavier and more massive than the majority of Foraminifera. According to the second hypothesis these Rhizopods live in the surface waters and fall to the bottom after death; Huxley

[1] Dayman, Deep Sea Soundings in the North Atlantic made in H.M.S. "Cyclops," in June and July 1857, London, published by the Admiralty, 1858.

[2] Appendix to Dayman's Report.

[3] See *Proc. Roy. Geogr. Soc.*, vol. xiii. p. 110, 1869. *Bathybius* has now only an historical interest, for during the Challenger Expedition it was shown that what was supposed to be a gigantic Moneron (*Bathybius*) consisted of the gelatinous sulphate of lime thrown down, from the sea-water associated with the specimens of the ooze, by the alcohol used in the preservation of the samples of deep-sea deposits (see Narr. Chall. Exp., vol. i. p. 939). The *Bathybius* error arose from a desire to ascertain the true condition of the ooze on the sea-bed, and with this view instructions were given which led to the use of too much alcohol in the preservation of the samples of the ooze for detailed examination.

considers this interpretation much more probable, supported as it is by the fact that many Radiolarians and Diatoms live at the surface. M'Donald of H.M.S. "Herald" had recently found some of these forms in the stomachs of pelagic Mollusca, but Huxley doubts very much whether these heavy *Globigerinæ* could maintain themselves in the surface water. The third hypothesis supposes these organisms to live in deep water, and, while not expressing a decided opinion on the matter, Huxley seems to prefer the last hypothesis, concluding by saying: "I abstain at present from drawing any positive conclusion, preferring rather to await the result of more extended observations."

"NOVARA."

During the years 1857 to 1859 the Austrian ship "Novara," under the command of B. von Wüllerstorf-Urbair, completed a circumnavigation of the world. The expedition was accompanied by Hochstetter as geologist, and by zoologists and botanists, who made large collections and many important observations. Although the expedition engaged in no special deep-sea investigations, the meteorological and physical observations were most important. The results of the expedition have been published in a splendid series of volumes by the Austrian Government.[1]

WALLICH'S OBSERVATIONS IN THE NORTH ATLANTIC.

In 1860, H.M.S. "Bulldog" was despatched by the British Government for the preparatory survey of the route for the telegraph cable between England and America; Dr. G. C. Wallich, who accompanied the expedition, gives an interesting account of his observations.[2] He shows how little foundation there is for the objections urged against deep water being habitable; after weighing the facts connected with the chemical composition of sea-water, he devotes some space to the study of carbonic acid in the ocean, its origin, use, and distribution. He deduces from his various observations on Radiolarians, Diatoms, and Foraminifera, that carbonate of lime and silica are always present in sea-water, that the quantity of carbonic acid increases with the depth, and that the solvent power of water on these two bodies is due to the presence of carbonic acid. He is of opinion that, while the carbonate of lime is present in such minute quantity on the surface or on the bed of the deep sea as to be inappreciable by chemical analysis, extensive calcareous deposits are nevertheless formed in a continuous manner. He believes that pressure, far from restricting the development of animal life to the upper zones of the sea, may be considered as one of the essential conditions of life in great depths.

PHYSIOLOGY OF DEEP-SEA LIFE.

Wallich examines the influence of light on the distribution of marine species, remarking that the want of light in very deep water produces the inverse phenomenon to that which fixes carbon in the plant and separates oxygen from carbonic acid. He concludes from his observations that organised beings living in the abysses of the ocean are descended from species living originally in shallow water; he believes that the Starfishes, &c., brought up from the greatest depths were caught alive in their natural

[1] Reise der Oesterreichischen Fregatte Novara um die Erde in den Jahren 1857, 1858, 1859, sixteen volumes, 4to. Wien, 1861 to 1875; see also R. v. Scherzer, Reise der Oesterreichischen Fregatte Novara um die Erde, Wien, 1866.

[2] Wallich, North Atlantic Sea-Bed, London, 1862.

habitat. Rhizopoda are more or less abundant in all seas, but the genus *Globigerina* may be regarded as essentially belonging to the deep sea, for it is found in all latitudes and at all depths; the point of its maximum development is in the greatest depths, where deposits made up of its dead remains stretch out for hundreds of square miles, forming probably deep beds. He endeavours to trace a connection between the Globigerina Ooze and the Gulf Stream, pointing out that the shells are abundant in the deposits between the Faroe Islands and the east coast of Greenland, and in a large portion of the direct line between Cape Farewell and Rockall, but are absent or rare in the deposits between Greenland and Labrador. In the southern hemisphere calcareous deposits had been found on the Agulhas Bank at a depth of 90 fathoms, in which the *Globigerina* shells made up 75 per cent. of the sediment; he suggested that the area covered by this deposit depended on the current flowing round the Cape from the east. The only difference between the deposit in this and in other parts of the Atlantic is that the shells are more delicate in form, perhaps because the water is not so deep. He was unable to find in a tow-net dragged through nearly 700 fathoms of water a single *Globigerina* shell, and therefore concludes that they live on the upper surface of the deposit at the bottom.

Discovery of Higher Organisms in Great Depths.

Wallich attaches great importance to the discovery of members of the higher groups living at a depth of 1260 fathoms, about half-way between Cape Farewell and the north-west coast of Ireland. On examining the visceral cavity in a specimen of *Ophiocoma*, he noticed a number of *Globigerinæ* more or less broken, amorphous particles, a few yellow oil globules, and several ova. In three deep soundings he found Annelid tubes composed almost entirely of small *Globigerina* shells, and in another case composed of minute calcareous debris and Sponge spicules in equal proportions. *Ophiocoma granulata*, found off the British and Scandinavian coasts in 10 to 50 fathoms, and off the coast of Greenland in 200 fathoms, was obtained from a depth of 1260 fathoms, without presenting any sensible modification, while the well-known littoral species, *Serpula vitrea* and *Spirorbis nautiloides*, were brought up from a depth of 680 fathoms. Wallich asks the questions: Whence did these creatures originate? are we to regard the localities in which they were found as their genetic centres, or only as isolated colonies tenanted by species whose genetic centres are to be looked for elsewhere? and in answering them he adopts the ideas of Forbes on the great changes which have taken place in the distribution of land and water during geological periods, supposing the submergence of a large tract in high latitudes of the North Atlantic. He says: "No proof of subsidence could be more complete, no proof of the truth of the doctrine of single specific centres more convincing, than the detection under such circumstances of a colony of acclimatized Star-fishes, belonging to a species typical of the Boreal province, well known to range from the confines of the Arctic circle to our own shores, and already shown to have accommodated themselves to a depth of 200 fathoms without variation; whilst the fact of subsidence being general throughout the whole area is rendered probable by the discovery of sessile Annelids, also belonging to known shallow-water species, at a depth of 680 fathoms, half-way between Iceland and the Faroe Islands."[1] He mentions that he met with no Algæ at depths greater than 200 fathoms, the only vegetable structures occurring at great depths being Diatomaceæ, and he sums up as follows :—" Basing my arguments on two facts which I venture to hope are unequivocally proved in the preceding pages, namely, that highly organized creatures have been captured in a living condition at depths vastly exceeding those to which animal life had previously been supposed to extend, and that their presence, where captured, cannot be regarded as an accidental or exceptional phenomenon, it has been my endeavour to establish the following important propositions :—

" I. The conditions prevailing at great depths, although differing materially from those which prevail near the surface of the ocean, are not incompatible with the maintenance of animal life.

WALLICH'S GENERAL VIEWS ON DEEP-SEA LIFE.

" II. Assuming the doctrine of single specific centres to be correct, the occurrence of the same species in shallow water and at great depths proves that it must have undergone the transition from one set of conditions to the other with impunity.

" III. There is nothing in the nature of the conditions prevailing at great depths to render it impossible that creatures originally, or through acclimatization, adapted to live under them, should become capable of living in shallow water, provided the transition be sufficiently gradual, and hence it is possible that species now inhabiting shallow water may, at some anterior period, have been inhabitants of great depths.

" IV. On the one hand, the conditions prevailing near the surface of the ocean render it possible for organisms to subside after death to the greatest depths, provided every portion of their structure is freely pervious to fluid : on the other hand, the conditions prevailing at great depths render it impossible for organisms still constituted to live under them to rise to the surface, or for the remains of these organisms after death to make their appearance in shallow water.

" V. The discovery of even a single species living normally at great depths warrants the inference that the deep sea has its own special fauna, and that it has always had it in ages past, and hence that many fossiliferous strata, heretofore regarded as having been deposited in comparatively shallow water, have been deposited at great depths."[2]

Many of Wallich's opinions have been confirmed by subsequent researches, and altogether he must be regarded as one of the most industrious pioneers in the investigation of the deep-sea.

The existence of a deep-sea fauna discovered by Wallich was soon established on conclusive proof. In 1860, the telegraph cable between Sardinia and Bone in the Mediter-

[1] Wallich, *op. cit.*, p. 151.

[2] Wallich, *op. cit.*, pp. 154–155. In addition to the North Atlantic Sea-bed, Wallich is the author of many papers in scientific journals between the years 1858 and 1873, describing marine organisms and treating of various aspects of deep-sea investigations and controversies.

Animals Attached to Submarine Cable Mediterranean.

ranean parted at a depth of 1200 fathoms, and was raised for repair under the direction of the electrical engineer, Fleeming Jenkin. Forty miles of cable were drawn up, bringing with it a quantity of Coral and other organisms, a few specimens of which were sent to Professor Allman, who made a list of fifteen varieties of animal life, including eggs of a Cephalopod, *Grantia*, *Plumularia*, *Gorgonia*, *Alcyonium*, *Cellepora*, *Retepora*, *Eschara*, *Salicornaria*, *Ascara*, *Lima*, and *Serpula*. Wyville Thomson says that, according to Jenkin's private journal which he was allowed to consult, a specimen of *Caryophyllia*, a true Coral, was found adhering to the cable at 1200 fathoms, the very point where it had snapped. Some portions of the cable were subsequently examined by A. Milne-Edwards,[1] who showed that the animals were living at the bottom, for their soft parts were preserved, and the bases of the Corals, &c., were moulded on the inequalities of the cable. Among the Mollusca were *Ostrea cochlear*, found in many parts of the Mediterranean; *Pecten opercularis*, common in the Mediterranean, which was found adhering to the cable at a depth of 1100 fathoms (?) and was highly coloured; *Pecten testæ;* a small somewhat rare comb-shell; and two Gasteropods. Corals were more numerous than Mollusca, including a species apparently identical with *Caryophyllia arcuata*, found fossil in the upper strata of Piedmont and at Messina, and another species of the same genus, *Caryophyllia electrica*, quite similar to a Pliocene fossil found by Deshayes at Donera, Algeria.[2] Besides these, two *Serpulæ*, some Bryozoa, and a few *Gorgoniæ* were observed. The result of these observations proved that forms till then known only as fossils existed at the bottom of modern seas. In directing the attention of geologists to these discoveries, Prestwich[3] shows the connection between some of the species collected and the geological strata :—

Ostrea cochlear, Coralline Crag.
Pecten opercularis, Coralline and Red Crag.
Pecten testæ, *Monodonta limbata*, *Fusus laminosus*, — Pliocene strata of Italy.

Previous to these observations the existence of living animals at considerable depths was still regarded by many naturalists as doubtful; it was held to be uncertain whether the creatures found adhering to the sounding line or caught in the sounding machine came really from the bottom or were captured in intermediate waters. The discovery by Fleeming Jenkin of members of the higher groups living attached to the cable

[1] Observations sur l'existence de divers Mollusques et Zoophytes à de très grandes profondeurs dans la mer Méditerranée, *Ann. Sci. Nat.*, Zool. sér. 4, tom. xv. pp. 149–157, 1861.

[2] Wyville Thomson (Depths of the Sea, p. 29) states that according to Jenkin's notes only one or two species, particularly *Caryophyllia borealis*, were found adhering to the cable at depths exceeding 1000 fathoms. From that depth Jenkin himself took off specimens of *Caryophyllia*. Thomson suspects that specimens from lesser depths were mixed with the deeper ones in the series examined by Milne-Edwards.

[3] Presidential Address, *Quart. Journ. Geol. Soc.*, vol. xxvii., 1871.

drawn up from a known depth furnished conclusive proof on this question, and some of them, like the Corals and Bryozoa, must have become attached to the cable as germs. It is to be noted, however, that although the pressure is the same, the temperature in the deep water of the Mediterranean is much higher than at corresponding depths in the open ocean, and this fact might have some influence on the bathymetrical range of species.

Otto Torell's Dredgings off Spitzbergen.

During Otto Torell's expedition to Spitzbergen in 1864, a great number of animals were taken at a depth of 1000 to 1400 fathoms. They included Rhizopoda, Bryozoa, Sponges, Annelids, Crustacea, and other forms. In subsequent expeditions to Spitzbergen, organisms were frequently secured from similar depths.[1]

Bocage's Observations and Wright's Dredgings off Setubal.

In 1864 M. Barboza du Bocage, director of the Natural History Museum of Lisbon, announced the occurrence on the coasts of Portugal of tufts of siliceous spicules similar to those of the *Hyalonema* of Japan,[2] which were taken by the shark-fishers of Setubal at a depth of 500 fathoms. Towards the end of 1868 Professor Perceval Wright proceeded to Portugal to investigate the question and procure specimens in a fresh condition. With a crew of eight men and an open boat he dredged at a depth of 480 fathoms for about the space of a mile, the dredge being filled with sticky yellowish ooze, in which glittered innumerable long spicules of *Hyalonema*, including some perfect specimens.[3] "This dredging," says Wyville Thomson, "is of special interest, for it shows that although difficult and laborious, and attended with a certain amount of risk, it is not impossible in an open boat, and with a crew of alien fishermen, to test the nature of the bottom, and the character of the fauna, even to the great depth of 500 fathoms."[4]

The considerable part taken by the United States Coast Survey in oceanographical researches has already been referred to. In 1867, the Superintendent, Professor B. Pierce, acting on the advice of Professor L. Agassiz, issued instructions that dredgings as well as soundings should be carried on off the Florida coasts under the direction of Count Pourtalès. Ordinary sounding leads with tallow were first used, but were afterwards replaced by Stellwagen's and Sands' sounding leads. Stellwagen's sounding cup is a conical iron cup screwed to the sounding lead, with a leather lid which firmly closes the cup when the apparatus is drawn up; Sands' sounding lead has a side opening with a spring door, which is forced open when the apparatus sinks into the deposit, and closes when drawn up. These machines were superior to the original form of Brooke's apparatus, as they brought up much larger samples of the deposit. Pourtalès states that in 1870 the number of samples of deposits collected by the Coast Survey amounted to 9000.[5] After the

Pourtalès on the Deposits off the Atlantic Coast of North America.

[1] *Zeitschr. f. wiss. Zool.*, Bd. xx. p. 457, 1870.

[2] *Proc. Zool. Soc.*, 1864, p. 265.

[3] Notes on deep-sea dredging, *Ann. and Mag. Nat. Hist.*, ser. 4, vol. ii. p. 423, 1868.

[4] Wyville Thomson, *op. cit.*, p. 277.

[5] See L. F. de Pourtalès, Der Boden des Golfstroms und der Atlantischen Küste Nord-Amerikas, *Petermann's Geogr. Mittheil.*, 1870, p. 393.

death of Professor Bailey the examination of the deposits devolved upon Pourtalès. In the deposits from off the American Coast from Cape Cod to Florida he found two well-marked varieties:[1] siliceous and calcareous. The siliceous deposits stretch along the coast as far as Cape Florida. The calcareous deposits are divided into Coral and Foraminiferous[2] formations, and are found at the greatest depths, at the southern point of Florida, and off Cuba and the Bahamas. Pourtalès remarked the coincidence between the limits of the siliceous deposits and the course of the cold current, and of the calcareous deposits and the warm current. He also distinguished a muddy deposit of much less extent, which he considered quite subordinate; it was observed off the eastern part of Long, Block, and Martha Islands. He considered this deposit as related to the Tertiary formations, some traces of which appear on Gay Head Reefs, Martha's Vineyard, and other localities in Massachusetts. The deposits in shallow water off the American coast are sandy, principally quartz grains, with a few grains of hornblende, felspar, and sometimes glauconitic, but the grains of glauconite may be derived from the disintegration of the geological strata.[3] In these sandy deposits he observes that the Foraminifera are distributed in zones, sometimes overlapping: thus the zone nearest the shore from 10 to 20 fathoms is relatively poor, containing only a few small *Polystomellæ*; then *Miliolina* is met with in small numbers at about 40 fathoms; *Truncatulina advena* is found from 25 to 70 fathoms; *Marginulina* and *Cristellaria* begin at about 35 fathoms and extend down to over 1000 fathoms. From a depth of 60 fathoms the sand becomes mixed with *Globigerinæ*, which increase to such an extent that at a depth of 100 fathoms the shells are as abundant as the sand grains, marking the commencement of the calcareous deposit.

LOUIS AGASSIZ ON THE POURTALÈS PLATEAU.

In connection with the laying of a telegraph cable between Cuba and Florida, explorations were begun in 1867, and continued for two years, occasionally under the personal supervision of L. Agassiz. The coral reef was found to be closely confined to the coast of Florida, for the large reef-building Corals only acquire their full development near the surface, not extending below 10 fathoms. The fauna inhabiting the reef consists of a large number of animals of all classes, and is totally different from that of the deep sea. From the reef the bottom is muddy down to 50 or 60 fathoms, and is covered with dead Mollusca and triturated fragments of Corals, with few living animals. Then follows a rocky plateau, which Agassiz calls the Pourtalès Plateau, down to 100 and occasionally 200 fathoms, the bottom being a calcareous conglomerate with Molluscs and Corals. The Foraminiferous deposit is found in the Florida Strait at moderate depths, at points where the rocky bottom is hidden. Pourtalès observes that this calcareous

[1] Report of Superintendent of U.S. Coast Survey for 1869, pp. 220–225, Washington, 1872.

[2] Pourtalès claims that this Globigerina Ooze, one of the most important of oceanic deposits, was first observed in 1853 by Lieutenants Craven and Maffitt during their investigation of the Gulf Stream in connection with the U.S. Coast Survey; it was subsequently noticed during the preliminary survey of the route for the Transatlantic cable.

[3] From the Greensand of New Jersey (Pourtales in Rep. U.S. Coast Survey for 1869).

formation occurs without interruption along the bed of the Gulf Stream, in the sinuosities of the Gulf of Mexico, and in the deep channels through the Bahama Bank, and again along the Atlantic coast from a depth of 100 fathoms, or, what comes to much the same thing, from the internal edge of the Gulf Stream, whence it stretches over a vast extent of the Atlantic. He says the whole bottom is an immense bed of chalk in process of formation, while the littoral fauna, with its numerous Corals and Molluscs, will furnish material for oolitic calcareous beds of shells, corals, conglomerate, &c.

Pourtalès on Stages in the Formation of Greensand.

Pourtalès also gives a description of the different stages in the formation of glauconite. He says :—" We find, side by side, the tests perfectly fresh, others still entire, but filled with a rusty-coloured mass, which permeates the finest canals of the shells like an injection. In others, again, the shell is partly broken away, and the filling is turning greenish; and finally we find the cast without trace of shell, sometimes perfectly reproducing the internal form of the chambers; sometimes, particularly in the larger ones, cracks of the surface or conglomeration with other grains obliterates all the characters. They even coalesce into pebbles, in which the casts can only be recognised after grinding and polishing." [1] Pourtalès observes that these glauconitic grains are deposited in depths of 50 to 100 fathoms near the coasts of Georgia and South Carolina. Greensand may also be found in the bed of the Gulf Stream, but in such cases it is sporadic. Dredgings were taken down to a depth of about 700 fathoms, the zoological results of which were published by the Museum of Comparative Zoölogy, Cambridge, Massachusetts. In 1869 L. Agassiz addressed to Professor Pierce a report bearing upon the general results of these dredgings,[2] showing how instructive they were in accounting for the manner in which certain geological strata have been deposited in the ocean. The Corals dredged from the Pourtalès Plateau have some affinity with Tertiary and Cretaceous types, while the Echinoderms have some resemblance to those of the chalk; *Voluta junonia*, also found there, is related to *Voluta lamberti* of the Crag and *Voluta mirabilis* of the Miocene strata of Virginia and Maryland. Two common Brachiopods contribute to give the fauna an archaic character. Beyond this plateau the bottom descends rapidly to 500 or 600, and even 800, fathoms, and is covered with a thick adhesive mud presenting the aspect of a Cretaceous marl; [3] life here diminishes, which he thinks is due to the very nature of the bottom.

Louis Agassiz on the Permanence of Continents and Oceans.

Agassiz is of opinion that the exploration of the sea must prove of advantage to the study of geology, and states that what he had seen of deep-sea deposits seemed to indicate that no recent or ancient formation ever occurred in very deep water. He concludes that the present continental areas within the 200-fathom line, as well as the oceans, have preserved their outlines and positions from the earliest times.[4] The

[1] Report U.S. Coast Survey for 1869, p. 224.
[2] Report upon deep-sea dredgings in the Gulf Stream during the third cruise of the U.S.S. "Bibb," *Bull. Mus. Comp. Zoöl.*, vol. i. pp. 363-386, 1869.
[3] *Ibid.*, p. 367.
[4] *Ibid.*, pp. 368, 369.

continents have always been areas of gradual upheaval, with weak oscillations, while the oceans have always been areas of subsidence. Geologists, he says, have often had recourse to the hypothesis of marine currents to explain the presence of incoherent matters scattered over the sea-bottom, but he sought in vain in the trough of the Gulf Stream for traces of the characteristic mud thrown out by the Amazon, which discolours the sea for a long distance seaward. It has often been supposed that the absence of fossils denotes a deep sea, but, he remarks, we now know that organisms exist even at the greatest depths. Taken in its *ensemble*, the basin of the Gulf Stream, between Cuba and Florida and further north and east, with its very abrupt slopes, presents features of configuration differing widely from continental areas of like extent. Speaking of the formation of the rocks of the Keys, especially the oolitic rocks, he concludes that no rock of the Jurassic formation could have been built up of the materials found in the deepest parts of the Atlantic basin; the vast area occupied by the Keys, the reefs of Florida, and the inclined coralline plateau on the American edge of the Gulf Stream basin, may be compared with the Jurassic formations of the European and Asiatic continents, but their stratigraphic relations show that, during the geological middle ages, the Jurassic rocks were formed on the submarine border of a growing continent, just as the Pourtalès Plateau forms to-day the southern border of North America. Returning to the idea of the permanence of continents and ocean basins, he concludes by saying: "If this view is correct, it naturally follows that the main outlines and circumscription of the continents and of the oceans must have been determined at the very beginning of the formation of inequalities upon the earth's surface, and remained essentially the same through all geological ages, varying only as to their relative height and depth, as well as to their respective extension."[1]

DELESSE'S CHARTS AND RESEARCHES ON THE LITHOLOGY OF THE BOTTOM OF THE NORTH ATLANTIC.

In 1871 Delesse published his work on the lithology of the bottom of the sea,[2] embodying the results of long, laborious, and methodical researches, dealing more especially with the coast sediments of the seas of France. He takes account of the agents assisting in the formation of these deposits, and indicates the samples collected up to that time by the hydrographic offices of various countries. His charts are founded upon the charts published by the maritime nations of Europe and America, and where the soundings are sufficiently numerous he represents the contours of the bottom by curves; he also represents the orography of the bottom corresponding to the orography of the neighbouring land, and indicates the limits of the hydrographic basins, the annual rainfall, and indeed all the data bearing directly on the formation of marine deposits, such as currents, tides, prevailing direction of the winds, &c. He divides recent deposits into sand, gravel, gravelly sand, boulders, ooze, clay or argillite, slimy sand, sandy mud, gravelly mud, calcareous ooze, and coralline ground. In addition to the deposits of the coasts of

[1] *Ibid.*, p. 377.

[2] M. Delesse, Lithologie du fond des mers, with folio atlas, Paris 1871.

France, Delesse studied those of the Mediterranean, Atlantic, English Channel, German Ocean, and also the ancient seas and great lakes. He traces the orography of America, its hydrographic basins, and rainfall; he gives a lithological description of the great North American lakes, Caribbean Sea, Gulf of Mexico, the American Atlantic Ocean from the West Indies to Labrador, part of the Arctic Seas, and the American Pacific Ocean. His results are given in three large maps, remarkable for their execution: 1st, of the French seas; 2nd, of the European seas; and 3rd, of the North American seas. He then applies himself to the study of the French seas during the principal geological periods, and in five special maps indicates the submarine orography of the Silurian, Triassic, Liassic, Eocene, and Pliocene seas. A sixth map affords a large amount of information relating to the depths of the French seas, the quantity of carbonate of lime in the coast sediments, the beds of shells, the distribution of the oyster, and the slow oscillations of the coasts. In seven tables he summarises his results as regards the relative frequency of the winds, the materials forming dunes, the distribution of rain, the river deposits, the deposits in littoral lakes and ponds, the littoral marine deposits, and the submarine deposits.

The subject of deep-sea dredging was not neglected in Great Britain. In the autumn of 1868, in consequence of a suggestion of Professor Wyville Thomson to Dr. W. B. Carpenter, the Royal Society laid before the Admiralty a statement of the advantages to science likely to result from a short dredging cruise in the North Atlantic. The Admiralty responded by placing the surveying ship "Lightning," Captain May, at the disposal of Drs. Thomson and Carpenter. The conditions of work in the "Lightning" were very unfortunate both as regards the vessel and the weather which prevailed during the six weeks that the cruise lasted. In spite of all difficulties, dredging was carried on to a depth of 650 fathoms, and temperature results of the greatest interest were observed, which ultimately led to the discovery of the Wyville Thomson Ridge in the Faroe Channel in 1880 by Tizard and Murray. Professor Wyville Thomson thus sums up the results of the "Lightning" expedition:—

"Lightning" Expedition.

Wyville Thomson's Statement of Results of Deep-Sea Exploration in 1868.

"It had been shown beyond question that animal life is varied and abundant, represented by all the invertebrate groups, at depths in the ocean down to 650 fathoms at least, notwithstanding the extraordinary conditions to which animals are there exposed.

"It had been determined that, instead of the water in the sea beyond a certain depth varying according to latitude having a uniform temperature of 4° C., an indraught of Arctic water may have at any depth beyond the influence of the direct rays of the sun a temperature so low as $-2°$ C.; or, on the other hand, a warm current may have at any moderate depth a temperature of $6°{\cdot}5$ C., and it had been shown that great masses of water at different temperatures are moving about, each in its particular course; maintaining a remarkable system of oceanic circulation, and yet keeping so distinct from one another that an hour's sail may be sufficient to pass from the extreme of heat to the extreme of cold.

"Finally, it had been shown that a large proportion of the forms living at great depths in the sea belong to species hitherto unknown, and that thus a new field of boundless extent and great interest is open to the naturalist. It had been further shown that many of these deep-sea animals are specifically identical with tertiary fossils hitherto believed to be extinct, while others associate themselves with and illustrate extinct groups of the fauna of more remote periods; as, for example, the vitreous sponges illustrate and unriddle the ventriculites of the chalk."[1]

"Porcupine" Expeditions.

In consideration of the value and novelty of these results, the Royal Society urged the Admiralty to provide means of extending the observations. In 1869 the surveying ship "Porcupine," Captain Calver, was appointed for this service. In addition to the temperature observations, which had turned out so interesting in the cruise of the "Lightning," it was decided to make a number of chemical observations on the water. For this purpose, the chartroom was fitted up as a laboratory, and a chemist was invited to join the biologists on the cruise. A number of arrangements were also made for facilitating dredging and the subsequent observations. The "Porcupine" was well adapted for the purpose, and between May and September 1869 she made three distinct trips. The first of these was under the scientific direction of Mr. Gwyn Jeffreys, and it was chiefly devoted to dredging off the west coast of Ireland and in the channel between Scotland and Rockall. The deepest dredging was in 1470 fathoms, and no lack of life was found at that depth. It was accordingly resolved that, during the second trip, under the direction of Professor Wyville Thomson, an attempt should be made to dredge in the deepest water within reach, so that a definite answer to the general question of the existence of life at great depths could be arrived at. The "Porcupine" was steered for the Bay of Biscay, and at a point about 250 miles west of Ushant two highly successful hauls of the dredge were taken in water over 2000 fathoms deep, and in both animal forms from the Protozoa to the Mollusca were abundant.[2] It was on this cruise that Captain Calver suggested the employment of hempen tangles attached to the dredge frame, which resulted in the capture of many new animals. The third cruise of 1869, during which Dr. Carpenter was the naturalist in charge, was intended to be a repetition of that of the "Lightning" in the previous autumn. The observations of the earlier expedition were confirmed and extended in various directions.

The "Shearwater" Observations.

In 1870 Mr. Gwyn Jeffreys and Dr. Carpenter continued the work in the "Porcupine" by a highly interesting series of soundings and dredgings in the Mediterranean and current observations in the Strait of Gibraltar. Dr. Carpenter resumed the study of this region in the following year in the "Shearwater," commanded

[1] Thomson, *op. cit.*, pp. 79, 80.
[2] *Ibid.*, pp. 96, 97.

by Captain G. S. Nares, and this expedition was no less interesting or important than those that went before.

The chemical and physical work of the "Porcupine" expeditions was not so satisfactory as might be wished. Marine chemistry was so entirely new, that a great deal of preliminary work had to be done in order to gain the experience necessary for further more accurate experiments. Indeed, it was in the way of suggesting improvements for future use that the chemical work of the "Porcupine" was most valuable. Frémy in 1837,[1] Morren in 1843,[2] and Lewy in 1846, had previously analysed the gases of sea-water, but these were not more successful than those of the "Porcupine." A great advance was, however, made by Jacobsen during the expedition of the "Pommerania" in the North Sea in 1872. He introduced the slip water bottle for collecting deep water, and devised an ingenious modification of Bunsen's method for collecting the gases, which left little to be desired, and was afterwards used on the Challenger and other expeditions.[3] Gases in Sea-Water.

In December of 1871 and early in 1872 the U.S. Coast Survey Steamer "Hassler," under the scientific direction of Professor Louis Agassiz, dredged in considerable depths off the coast of South America, but with no striking results. Before starting on this expedition Agassiz left in the hands of Professor Pierce a very remarkable document,[4] in which, from various considerations, he ventures "to foretell what we are likely to find in the deepest abysses of the sea, from which thus far nothing has been secured." Among the organisms he expected to discover are mentioned representatives of Ganoids, of Cestraciontes or Hybodontes among Selachians, as well as representatives of other extinct types.

F. THE EXPLORATIONS OF THE CHALLENGER AND SUBSEQUENT EXPEDITIONS.

The cruises of the "Porcupine," together with preceding and contemporary expeditions, had clearly established that organisms lived at vast depths in the ocean, that with the proper appliances these deep-sea organisms could be satisfactorily investigated, and that the physical and chemical conditions obtaining in deep water and on the floor of the ocean, even in adjoining areas, were by no means constant and uniform. The efforts of the previous decade had been directed to the strips of water along the coasts, or to enclosed or partially enclosed seas; the vast ocean basins lay scientifically unexplored. This consideration led to the conception of a great exploring expedition, which should circumnavigate the globe, sound the most profound abysses, and investigate the physical, chemical, and biological conditions of the great oceans with all the methods and apparatus suggested by preceding researches. On the receipt of representations from the Royal Society and other learned bodies, the British Government undertook to fit out such an Conception of the Challenger Expedition.

[1] *Comptes Rendus*, tom. vi. p. 616, 1838.

[2] *Ann. chim. et phys.*, ser. 3, tom. xii. p. 5.

[3] See Narr. Chall. Exp., vol. i. p. 16.

[4] *Bull. Mus. Comp. Zoöl.*, vol. iii. pp. 49–53, 1872.

expedition. The Challenger, a steam corvette of 2306 tons displacement and 1234 horse power, was selected for this service. She was fitted out under the direction of Admiral G. H. Richards, the Hydrographer of the time, and a committee of the Royal Society. In addition to an accomplished and experienced staff of Naval Officers, she carried six civilian scientific men appointed on the recommendation of the Royal Society Committee.[1] From December 1872 till May 1876 the Expedition was engaged in traversing all the Great Ocean Basins, taking observations and making collections. Every branch of Oceanographic science has in consequence been enriched by a grand accumulation of new facts. Large collections were sent home and brought home, and have been described by specialists belonging to almost every civilised nation. The results have now been published by the Government in fifty large royal quarto volumes, the present volumes being the concluding ones of the series. The Expedition was successful beyond the expectations of its promoters, and opened out a new era in the study of Oceanology.

Scope of the Challenger Investigations.

Since the return of the Challenger, the work of the Expedition has been largely intermixed with all subsequent abysmal researches carried out by British and foreign expeditions, these being, in many respects, supplementary or limited to special regions of the ocean, none of them partaking of the world-wide and general character of the Challenger explorations. It is not proposed in this place to do more than indicate generally the scope of the investigations carried out by these subsequent expeditions.

American Expeditions. "Tuscarora."

At the same time that the Challenger was engaged in the exploration of the Pacific, the U.S. Ship "Tuscarora" ran several important lines of soundings across that ocean. Wire sounding lines were made use of, and one greater depth was recorded than the Challenger's deepest sounding. In addition to temperature observations, a large and valuable collection of deep-sea deposits was preserved which threw much light on the distribution of organic and inorganic materials on the Pacific sea-floor.[2]

"Blake" Expeditions, Alexander Agassiz.

Between the years 1877 and 1880, the U.S.S. "Blake" was engaged in a detailed examination of the basins of the Caribbean Sea, the Gulf of Mexico, and the Florida coasts of North America, under the able direction of Alexander Agassiz. The scientific results of these expeditions have been made known in a large number of publications issued from the Museum of Comparative Zoölogy of Harvard University at Cambridge, and Agassiz has summarised the results and discussed their bearing in a general account of the voyages.[3]

The U.S.S. "Albatross," while engaged in the work of the U.S. Fish Commission, has

[1] Professor C. Wyville Thomson, J. Y. Buchanan, H. N. Moseley, John Murray, R. von Willemoes-Suhm, and J. J. Wild.

[2] G. E. Belknap, Deep-sea soundings in the North Pacific Ocean, obtained in the U.S.S. "Tuscarora," U.S. Hydrographic Office No. 54, Washington, 1874.

[3] See Agassiz, Three cruises of the U.S. Coast and Geodetic Survey steamer "Blake," from 1877 to 1880, *Bull. Mus. Comp. Zoöl.*, vols. xiv., xv., Boston and New York, 1888.

carried on extensive explorations off the Atlantic sea-board of the United States at all depths, and for many years past the results have been given in the various publications issued from the office of the Commission at Washington.[1] "ALBATROSS" EXPEDITIONS IN ATLANTIC.

"ALBATROSS" EXPEDITION IN THE PACIFIC WITH ALEXANDER AGASSIZ.

In the beginning of 1891 the "Albatross" took a series of observations off the Pacific coast of Central America, under the personal superintendence of Alexander Agassiz. Three trips were made from Panama, extending from February 22 till April 23, and 84 stations were occupied where the trawl, tangles, and tow-nets were used, and in addition 5 stations where surface and submarine tow-nets alone were in use. One of the special features of the expedition was the experiments with submarine tow-nets, which could be closed at any intermediate depth by means of a messenger sent down the line. From the results of these experiments, Agassiz concludes that "in the open sea, even when close to the land, the surface pelagic fauna does not descend beyond a depth of 200 fathoms, and that there is no intermediate pelagic fauna living between that depth and the bottom, and that even the free-swimming bottom species do not rise to any great distance, as we found no trace of anything within 60 fathoms from the bottom, where it had been fairly populated."[2] From his experience in the Gulf of California he thinks that "in a comparatively closed sea, at a small distance from the land, there may be a mixture of the surface species with the deep-sea bottom species."[3] The dredgings in the Panamic district showed that the deep-sea fauna was allied to that of the West Indies and the Atlantic Coast of North America. Mixed with the strictly deep-sea Panamic types were a number of forms the wide geographical distribution of which was already known. The richness of the Panamic deep-sea fauna does not compare with that of the West Indian side, or that off the eastern coast of the United States, and Agassiz believes that "this comparative poverty is due to the absence of a great oceanic current like the Gulf Stream, bringing with it on its surface a large amount of food which serves to supply the deep-sea fauna along its course."[4] In addition to the faunic observations already indicated, investigations were made on the topography of the bottom, the character of the bottom deposits, serial temperatures, specific gravity, and the colour of deep-sea types, while the Galapagos Islands were examined as regards their geology and fauna and flora.

The "Albatross" and the "Thetis" were subsequently engaged in running lines of soundings between the coast of California and the Hawaiian Islands, in connection with a proposed telegraphic cable between these places. The published results give an excellent idea of the relief of this portion of the Pacific sea-bed.[5]

The deep-sea soundings of the "Gettysburg" in the Atlantic in 1876, by the "Enterprise" in 1883–86,[6] in the Pacific and Indian Oceans, and the exploration of the

[1] See Reports and Bulletins of the U.S. Fish Commission.

[2] *Bull. Mus. Comp. Zoöl.*, vol. xxi. p. 194, 1891. [3] *Ibid.*, p. 199. [4] *Ibid.*, p. 186.

[5] See Report on the Practicability of laying a telegraphic cable between the United States and the Hawaiian Islands, Government Printing Office, Washington, 1892.

[6] Barker, Deep-sea sounding on the U.S.S. "Enterprise" during 1883–1886.

Gulf Stream by the officers of the United States Coast Survey, have all added much to our knowledge of the physics and biology of the ocean.[1]

German Expeditions. "Gazelle."

The German War Ship "Gazelle," under the command of Baron von Schleinitz, circumnavigated the world at the same time as the Challenger, and was accompanied by Studer and Börgen, to whom, as well as to other investigators, we are indebted for an account of the observations made during the cruise on currents, deep-sea temperatures, pelagic organisms, deep-sea deposits, and coral islands.[2]

"Drache."

In the years 1881, 1882, and 1884, the ship "Drache" carried on investigations in the North Sea, the physical, chemical, and biological results being made known through reports by Jacobsen, Gümbel, Möbius, and others.[3]

German Polar Expeditions.

The International Polar Expeditions between 1882 and 1883, especially the German Polar Expedition to South Georgia, yielded important meteorological and biological results bearing more or less directly on the science of Oceanography.[4]

"National" or Plankton Expedition under Hensen.

In the year 1889 the "National" or Plankton Expedition spent from July to November in the North Atlantic, chiefly engaged in the study of the surface fauna and flora after new methods suggested and carried out by Professor Hensen,[5]—an extension, in fact, of the important marine work carried on for many years by the Kiel Commission. This expedition was accompanied by a scientific staff consisting of Krümmel, Brandt, Dahl, Fischer, Schütt, and Eschke. The collections have been placed in the hands of a large number of specialists, and the detailed results are now in course of publication.

Norwegian North Atlantic Expedition. "Vöringen."

During the summers of 1876, 1877, and 1878, the Norwegian North Atlantic Expedition, in the "Vöringen," was despatched for the scientific investigation of the region lying between Norway and Greenland, under the direction of Professors Mohn, G. O. Sars, and other Norwegian experts. In the first cruise, from June 1 till August 26, 1876, 98 soundings were taken, the greatest depth being 1861 fathoms; in the second cruise, extending from June 11 till August 23, 1877, 160 soundings, 27 dredgings, 9 trawlings, and 37 serial temperature observations were taken, the greatest depth being 2005 fathoms; in the third cruise, extending from June 15 till September 4, 1878, 117 soundings, 15 dredgings, 24 trawlings, and 57 serial temperature observations were taken, the greatest

[1] See Reports of the U.S. Coast and Geodetic Survey; J. E. Pillsbury, The Gulf Stream and its Investigation, Rep. U.S. Coast Survey for 1890.

[2] Die Forschungsreise S.M.S. "Gazelle," Berlin, 1889.

[3] See Die Ergebnisse der Untersuchungsfahrten S. M. Knbt. "Drache" in der Nordsee, Berlin, 1886.

[4] Die Internationale Polarforschung 1882–1883, Die Beobachtungs-Ergebnisse der Deutschen Stationen, Süd-Georgien, Bd. ii., Berlin, 1886; Die Deutschen Expeditionen und ihre Ergebnisse, Bd. i. and ii., Berlin, 1890 and 1892.

[5] See Die Ergebnisse der Plankton Expedition; Pt. i. O. Krümmel, Reisebeschreibung der Plankton-Expedition, Kiel, 1892, etc.; also V. Hensen, Ueber die Bestimmung des Planktons oder des im Meere treibenden Materials an Pflanzen und Thieren, Fünfter Bericht d. Komm. zur Wiss. Unters. d. deutschen Meere, in Kiel, für die Jahre 1882–1886, Berlin, 1887; Krümmel, Die Plankton-Expedition im Sommer 1889, *Verhandl. d. Gesellsch. f. Erdk. zu Berlin*, Dezember 1889; V. Hensen, Einige Ergebnisse der Plankton-Expedition der Humboldt-Stiftung, *Sitzb. d. k. preuss. Akad. d. Wiss. zu Berlin*, Phys.-Math. Cl., Bd. xiv. pp. 243–253, 1890; see also E. Haeckel, Plankton-Studien, Jena, 1890.

depth being 1985 fathoms. The expedition visited the Vestmanna Islands, Iceland, Jan Mayen, Bear Island, Spitzbergen, the Faroe Islands, and reached a latitude of 80° N. Important observations were made bearing on meteorology, temperature, currents, chemistry, marine zoology, and the contour of the sea-bed, and the reports on the scientific results are published in both Norwegian and English in parallel columns with numerous illustrations in the form of lithographic plates, maps, and woodcuts.[1]

ITALIAN EXPEDITIONS. "WASHINGTON."

In the summers of 1881 to 1883 the Italian Government despatched the "Washington," under Captain Magnaghi, to investigate by means of dredgings and temperature observations a portion of the western basin of the Mediterranean; some valuable temperature results were obtained, and Professor Giglioli recorded the capture, in depths of from 300 to 1000 fathoms, of Crustaceans, Fishes, Brachiopods and Starfishes, closely allied to those obtained by the Challenger and other expeditions at similar depths in the open ocean.[2] The results were considered important, as bearing on the previous observations of Forbes and Carpenter. In the years 1882 to 1885 the "Vettor Pisani" circumnavigated the globe, with Chierchia on board, who made interesting and extensive collections of the pelagic fauna and flora, which have created much interest among zoologists.[3]

"VETTOR PISANI."

FRENCH EXPEDITIONS. "TRAVAILLEUR." "TALISMAN."

During the years 1880 to 1883 important series of deep-sea investigations were carried on by the French Government in the ships "Travailleur" and "Talisman" in the Bay of Biscay and the eastern parts of the Atlantic as far south as the Cape Verde Islands. These explorations were carried out under the direction of a scientific commission, of which Professor H. Milne-Edwards was president, the other members being the Marquis de Folin, Professors A. Milne-Edwards, Vaillant, Marion, Perrier and Fischer. Dr Gwyn Jeffreys and the Rev. A. M. Norman took part in one of the excursions. The important zoological and other results of these expeditions are now in course of publication in a valuable series of memoirs prepared under the able direction of Professor Alphonse Milne-Edwards, and issued under the auspices of the French Government.[4]

PRINCE OF MONACO'S EXPEDITIONS. "HIRONDELLE."

Since the year 1885 Prince Albert the First, of Monaco, has carried out a series of most interesting observations on the currents of the North Atlantic by means of floats sent off from his yacht the "Hirondelle" at various positions and at stated times. The results of these experiments have been published on an elaborate chart. By means of ingeniously arranged traps let down into comparatively deep water, the Prince has made important zoological discoveries. These marine investigations are now being continued in a new steam yacht, the "Princesse Alice," which is probably the first ship especially

[1] Den Norske Nordhavs-Expedition, Christiania, 1880–1891.

[2] Enrico H. Giglioli, Prima Campagna Talassographica del R. Piroscafo "Washington," Roma, 1881

[3] See G. Chierchia, Collezioni per studi di scienze naturali fatte nel viaggio intorno al mondo dalla R. Corvett "Vettor Pisani," Roma, 1885.

[4] See Expéditions Scientifiques du Travailleur et du Talisman pendant les Années 1880, 1881, 1882, 1883, Paris, 1891, &c.

"Princesse Alice."

built and equipped for deep-sea exploration. The zoological investigations are under the direction of Baron Jules de Guerne, and under his able editorship the results are being published at Monaco in an excellent style, with splendid illustrations.[1]

Russian Observations in the Black Sea and Pacific Ocean.

The Russian explorations in the Black Sea in the years 1890 and 1891 have shown that the deeper waters of the basin are devoid of life, and the chemical composition of the deposits and of the water of the deeper layers reveals an enormous accumulation of sulphuretted hydrogen and sulphides arising apparently from the deoxidation of sea-water salts by organic matter on the floor of that basin.[2]

"Vitiaz."

The researches of Admiral Makaroff on board the ship "Vitiaz" in the North Pacific, with reference to the temperature and specific gravity of the sea, form an important and valuable contribution to this department of oceanology.[3]

Austrian Expeditions in the Mediterranean, "Pola."

The "Pola" expeditions in the eastern basin of the Mediterranean during the summers of 1890 to 1893, under the auspices of the Austrian Government, have already yielded much new information, and the results that have been published are of great interest, including the chemical investigations of Dr. Natterer regarding the deep-water deposits.[4]

British Expeditions and Explorations. "Knight Errant" and "Triton."

In 1880 and again in 1882, Tizard and Murray re-explored the Faroe Channel in the "Knight Errant"[5] and "Triton," and discovered the Wyville-Thomson Ridge separating the areas with different temperatures and faunæ, the distribution of which was such a puzzle in the earlier expeditions of the "Lightning" and "Porcupine." Large zoological collections were made on either side of the ridge, and many of the species have been described in the Challenger Reports. A number of Her Majesty's ships, under the direction of the Hydrographic Office, have in recent years made a very large number of important observations, especially in sounding the ocean and in taking deep-sea temperatures, such as the "Egeria" in the Indian and Pacific Oceans in 1887–89; the "Rambler" in the same oceans in 1888–90. The reports of Dr. Bassett Smith on his dredgings on the Macclesfield Bank, in H.M.SS. "Rambler," "Penguin," and "Egeria," have for the first time given an excellent idea of the biological and physical conditions prevailing on a submerged coral atoll. The "Investigator" in the Indian Ocean has likewise, under the direction of the Indian Government, conducted many important sounding,

"Egeria." "Rambler." "Penguin." "Investigator."

[1] See Résultats des Campagnes Scientifiques accomplies sur son Yacht par Albert I^er^ Prince Souverain de Monaco publiés sous sa direction, avec le concours du Baron Jules de Guerne, Imprimerie de Monaco, Fascicules I. to VII.; also several papers by Prince Albert in the *Comptes Rendus*.

[2] Andrussow, Preliminary account of deep-sea soundings in the Black Sea, St. Petersburg, 1890; Woeikow, Die Tiefseeforschungen im Schwarzen Meere im Jahre 1890, *Petermann's Mitteilungen*, Bd. xxxvii. p. 33, 1891.

[3] Makaroff, Le "Vitiaz" et l'Océan Pacifique: Observations hydrologiques faites par les officiers de la corvette "Vitiaz" pendant un voyage autour du monde, exécuté de 1886 à 1889, et recueil des observations sur la température et le poids spécifique de l'eau de l'Océan Pacifique Nord, St. Petersburg, 1894.

[4] See Berichte der Commission fur Erforschung des ostlichen Mittelmeeres, in *Denkschr. d. math.-naturw. Cl. d. k. Akad. d. Wiss. Wien*, Bd. lix.–lxi., 1892–4.

[5] See Tizard and Murray, Exploration of the Faroe Channel, during the summer of 1880, in H.M. hired ship "Knight Errant," *Proc. Roy. Soc. Edin.*, vol. xi. pp. 638–677, 1882; Deep Sea Exploration in Faroe Channel, by H.M.S. "Triton" 1882, commanded by Staff-Commander T. H. Tizard (Admiralty Blue-Book).

temperature, and dredging operations in deep water. During the last twenty years the British Telegraph ships have furnished a large amount of information regarding the depth and nature of the deposits on the floor of the ocean, especially the ships belonging to the Telegraph Construction and Maintenance Company, and those of the India-Rubber, Gutta-Percha, and Telegraph Works Company.[1] The specimens of deposits procured by these ships, as well as those of the British Navy, have enabled Murray and Renard to give a much more complete idea of the distribution of the various kinds of deposits in the different regions and depths throughout nearly all oceans than was possible from the study of the Challenger collections alone. TELEGRAPH SHIPS. HER MAJESTY'S SHIPS.

From 1886 to 1892 a detailed physical and biological exploration of the conditions of the lochs and fjords of the coast of Scotland has been conducted by Murray, assisted by Mill, Irvine, Anderson, and others, interesting results as to the distribution of temperature, salinity, and the effect of winds on the circulation of the water having been obtained. The chemical composition of the water associated with the deposits has been systematically investigated and compared with that of the superincumbent layers, and much light has been thrown on the formation of manganese nodules, as well as on the changes taking place in deep-sea deposits. The distribution of organisms in the deeper lochs has also been carefully studied.[2] Some excellent work has been carried out by Mill, Gibson, and Dickson, on board the ship "Jackal," with reference to the specific gravity and temperature of the sea-water off the northern coasts of Scotland in recent years,[3] these observations during the summer of 1893, under the charge of Mr. Dickson, being simultaneous with like observations by Swedish investigators at the entrance to the Baltic. MURRAY'S OBSERVATIONS ON THE SCOTTISH COASTS.

No better instance of a detailed piece of oceanographical work can be cited than that now being carried on by the Swedish authorities in the Baltic and north-eastern portions of the North Sea at all seasons of the year. Professor Otto Pettersson has given a most excellent account of these detailed investigations, which have thrown much light on the movements of large bodies of water from different sources, and on the influence of these movements on the distribution of marine organisms at different seasons of the year.[4] SWEDISH INVESTIGATIONS. PETTERSSON.

[1] See J. Y. Buchanan, On oceanic shoals discovered in the s.s. "Dacia" in October 1883, *Proc. Roy. Soc. Edin.*, vol. xiii. p. 428, 1886; On the land slopes separating continents and ocean basins, especially those on the West Coast of Africa, *Scot. Geogr. Mag.*, vol. iii. p. 217, 1887; The exploration of the Gulf of Guinea, *Scot. Geogr. Mag.*, vol. iv. pp. 177 and 233, 1888.

[2] See Murray, On the effects of winds on the distribution of temperature in the sea and fresh water lochs of the West of Scotland, *Scot. Geogr. Mag.*, vol. iv. p. 345, 1888; H. R. Mill, The Clyde Sea-Area, *Trans. Roy. Soc. Edin.*, vol. xxxvi. p. 641, 1891, and vol. xxxviii. p. 1, 1894; Murray and Irvine, On the chemical changes which take place in the composition of the Sea-Water associated with Blue Muds on the floor of the ocean, *Trans. Roy. Soc. Edin.*, vol. xxxvii. p. 481, 1893; Murray and Irvine, On the Manganese Oxides and Manganese Nodules in Marine Deposits, *Trans. Roy. Soc. Edin.*, vol. xxxvii. pp. 721–742, 1894; W. S. Anderson, On the determination of sea-water densities by hydrometers and Sprengel tubes, *Scot. Geogr. Mag.*, vol. x. pp. 574–590, 1894.

[3] See H. N. Dickson, Report on Physical Investigations carried out on board H.M.S. "Jackal," 1893-94, 12th Annual Report of the Fishery Board for Scotland, p. 336, 1894.

[4] Otto Pettersson, A Review of Swedish Hydrographic Research in the Baltic and North Seas, *Scot. Geogr. Mag.*, vol. x. pp. 281, 352, 413, 449, 525, 1894.

Dr. Gerhard Schott's observations on currents, temperature, and specific gravity of sea-water, on a sailing voyage to China, show how important additions to oceanographical knowledge can be made on such a voyage.[1]

The great advances in the Science of Oceanography during recent years, through the researches and expeditions indicated above, will be evident to all who may compare the knowledge possessed thirty years ago with what is now known concerning the depth of the ocean, as represented on the bathymetrical charts which accompany these volumes, with the data in regard to the temperature and specific gravity of the ocean at different depths as exhibited on the maps in Dr. Buchan's Report on Oceanic Circulation, or with the information on the biology of the Great Ocean Basins contained in the following pages.

[1] Petermann's Mitteil., Erganzungsheft No. 109, 1893.

Hooke's Sounding Machine and Water-bottle (see pp. 57 and 66).

GENERAL SUMMARY OF THE SCIENTIFIC OBSERVATIONS AND RESULTS AT EACH OF THE CHALLENGER OBSERVING STATIONS.

In the following summaries of the observations carried out, and of the scientific results obtained, at each of the Challenger observing stations at sea, the descriptions are almost exclusively limited to those investigations which were undertaken with the view of ascertaining the physical and biological conditions of the ocean.

The date, number, and position of the sounding and dredging or trawling station are stated in the first instance, the numbers of the charts and diagrams on which the positions of the stations, the temperature results, and the nature of the deposits are represented being given within brackets.

The temperature of the air at noon and the mean temperature for the day are then noted, followed by the temperatures of the sea-water which may have been obtained at different depths from the surface to the bottom. These figures showing the temperature of the sea-water are, with the exception of those near the Antarctic regions, taken from the curves of temperature published in the Physical Reports,[1] where the actual readings of the thermometers can be found.

The density of the surface, bottom, or intermediate waters of the ocean, uniformly reduced to the temperature of 60° F., is given, as well as the quantity of carbonic acid in the samples when this was determined, these results being taken from Mr. Buchanan's Report.[2]

The depth of the sea is recorded along with the nature of the deposit on the sea-floor, the percentage of carbonate of lime being always mentioned, as this gives the best indication of the chemical composition of the deposit.

The above general results are usually shown in tabular form, and precede paragraphs which recount the proceedings of the ship during the day and give an account of the more important operations on board, such as the times when the thermometers, trawl, or other instruments were lowered into the sea and hauled up again, the quantity of line paid out with the dredge or trawl, a note of any special experiments, and a general statement of the success attending the day's work, along with information as to the weather, direction of the wind and current, and unusual occurrences.

The names of the genera and species of fishes and invertebrates (exclusive of the Protozoa), which were captured in the trawl or dredge, are then stated in systematic order. After the name of each species, particulars are added as to the number of specimens secured, their condition at the time of capture, their occurrence at other Challenger

[1] Phys. Chem. Chall. Exp., Part iii.

[2] Phys. Chem. Chall. Exp., Part ii.

stations, and their general distribution so far as made known by the Challenger researches. The distribution of each species is given in full only under the first station at which it was taken, and in the case of previously-described species the geographical distribution is indicated only so far as discussed in the Challenger Reports. In many of the lists of animals from dredge and trawl will be found species belonging to intermediate or even surface waters; if an opinion be expressed by the author of the special report as to the habitat of the species, it is indicated in brackets after the name of the species.

The lists thus prepared from the special Zoological Reports were compared with the lists of animals entered in the Station Book by the naturalists on board ship, and a special note is made of any specimens which may not have reached the specialists owing to their mutilated condition or from some other cause.

A short paragraph in **heavy type** states the number of specimens and species of Metazoa procured at each station by means of the trawl or dredge, the number belonging to new genera and species, and the number of these species not obtained elsewhere by the Expedition. Should the manuscript journals and note-books contain any remarks on the organisms which seemed to be of interest, these have been extracted; when not taken from my own journals the remarks are always placed within inverted commas, and the name of the authority attached to the extract. Interpolations in square brackets [ ] indicate the names now in use for genera and species otherwise designated by the naturalists in their journals on board ship.

At a large number of stations representative of the different areas and depths, lists are given of the shells, frustules, and skeletons of Pteropods, Heteropods, Foraminifera, Radiolaria, and Diatoms found in the deposits. In the case of the Foraminifera, those species which are pelagic are indicated by a cross ×, for these shells often make up more than 80 per cent. of the carbonate of lime present in the deposit.

Under the heading of **Surface Organisms** very complete lists of the Diatoms, Foraminifera, Radiolaria, Cœlenterates, Vermes, Crustacea, pelagic Molluscs and Fishes captured near the surface are occasionally given, but, as a rule, the notes here inserted are those entered in the journal on the evening of the day on which the observations were made. On every available opportunity tow-nets were dragged through the surface and sub-surface waters of the ocean, and were occasionally sent down to great depths. When these nets were hauled on board their contents were subjected to microscopic examination by the naturalists, and the general characters of the organisms, with special notes regarding any interesting species, entered in the journals. Frequently, when the weather was favourable, a boat was lowered, and one or more of the naturalists examined the surface water by means of water-glasses, hand-nets, tow-nets, and other appliances, and notes on observations of this kind conclude the descriptions.

A. ATLANTIC OCEAN (outward voyage).

The fitting out of the Challenger for the special work in which she was to be engaged commenced in June 1872, and the ship was commissioned on 15th November. When the provisions and stores had been received on board, the ship was carefully swung to ascertain the errors of the magnetic instruments. She sailed from Sheerness on 7th December, arriving at Portsmouth on the 11th, after a stormy passage, one of the quarter boats being lost in a gale.

The Challenger left Portsmouth on the 21st December 1872, and in her passage across the Bay of Biscay experienced heavy weather. On the 29th December the tow-nets were dragged in the surface water, and specimens of *Acanthometra*, *Collosphæra*, Medusæ, Crustacea, *Carinaria*, and *Salpa* were captured. On the 30th December the first attempts were made at sounding and dredging, the object being chiefly to exercise the seamen in the use of the apparatus.

Station I.[1] (Sounding 1), Cape Finisterre to Lisbon (see Chart 2). STATION I.

December 30, 1872; lat. 41° 58′ N., long. 9° 42′ W.
Temperature of air at noon, 54°·3; mean for the day, 53°·6.
Temperature of water at surface, 55°·0.
Depth, 1125 fathoms; deposit, Blue Mud.

At 8.10 A.M. took first sounding, and made first attempt at dredging. In hauling in, the sounding line carried away, and a thermometer was lost. At 1 P.M. the dredge came up capsized, and at 2.20 P.M. was sent down again in about 1000 fathoms. At 3.30 P.M. commenced heaving in dredge, which came up at 5.30 P.M. with a few specimens.

Position of ship at noon, about 40 miles W. of Vigo Bay; Burlings Islands distant 153 miles. Made good 137 miles. Amount of current for the day 4 miles, direction W.

The following is a list of the animals recorded in the Zoological Reports from the dredge at this Station:— ANIMALS FROM DREDGE.

ASTEROIDEA (Sladen, Zool. pt. 51).

Hymenaster membranaceus, Wyville Thomson, n.sp. One specimen (of a rich crimson colour when brought up); obtained at no other locality.

[1] The Roman numerals I. to VIII. were used in the note-books for the preliminary Stations where the working of the apparatus was tested. The regular observing Stations of the Expedition commenced on leaving Tenerife (see page 136).

STATION I.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophioglypha lepida, Lyman, var. (?). Obtained also at Stations 45, 46, 76, 343, and Bermuda, 420 to 1350 fathoms.

AMPHIPODA (Stebbing, Zool. pt. 67).

Platamon longimanus, n.g., n.sp. One specimen and fragment; obtained at no other locality. Only species of the genus.

FISHES (Günther, Zool. pt. 57).

Argyropelecus olfersii, Cuvier. One specimen (probably from surface or subsurface waters); obtained at no other locality by the Challenger. Recorded from the Atlantic. This specimen showed signs of life and was highly phosphorescent when brought up.

In addition to the foregoing, the following are recorded in the Station-book:—*Astropecten* sp. (?), two Ophiuroidea of two species (only one species reported), several specimens of *Eteone*, probably a new species (see M'Intosh, Zool. pt. 34, p. ii), with tubes composed of *Globigerina* shells, Peneid shrimp of a fine red colour, and empty shells of Pteropoda.

Excluding the Protozoa, over 20 specimens of invertebrates and fishes were obtained at this Station, belonging to about 9 species, of which 2 are new to science, a new genus being represented; the 2 new species and new genus were not obtained elsewhere.

Willemoes-Suhm writes: "One of the specimens of *Eteone* was found without its tube, and seemed to show some motion; perhaps it was brought up alive, though all the rest were dead. I spent the day in examining this little *Eteone* and in making drawings of it. Its anatomy showed nothing not already known from other species, though it is remarkable for its blindness, all the other species of the genus known to me and to Claparède (Annél. de Naples) having got eyes."

ORGANISMS FROM SURFACE-NETS

Surface Organisms.—In the surface tow-nets specimens of *Diphyes*, Amphipoda, and *Diacria* [= *Cavolinia*], were obtained.

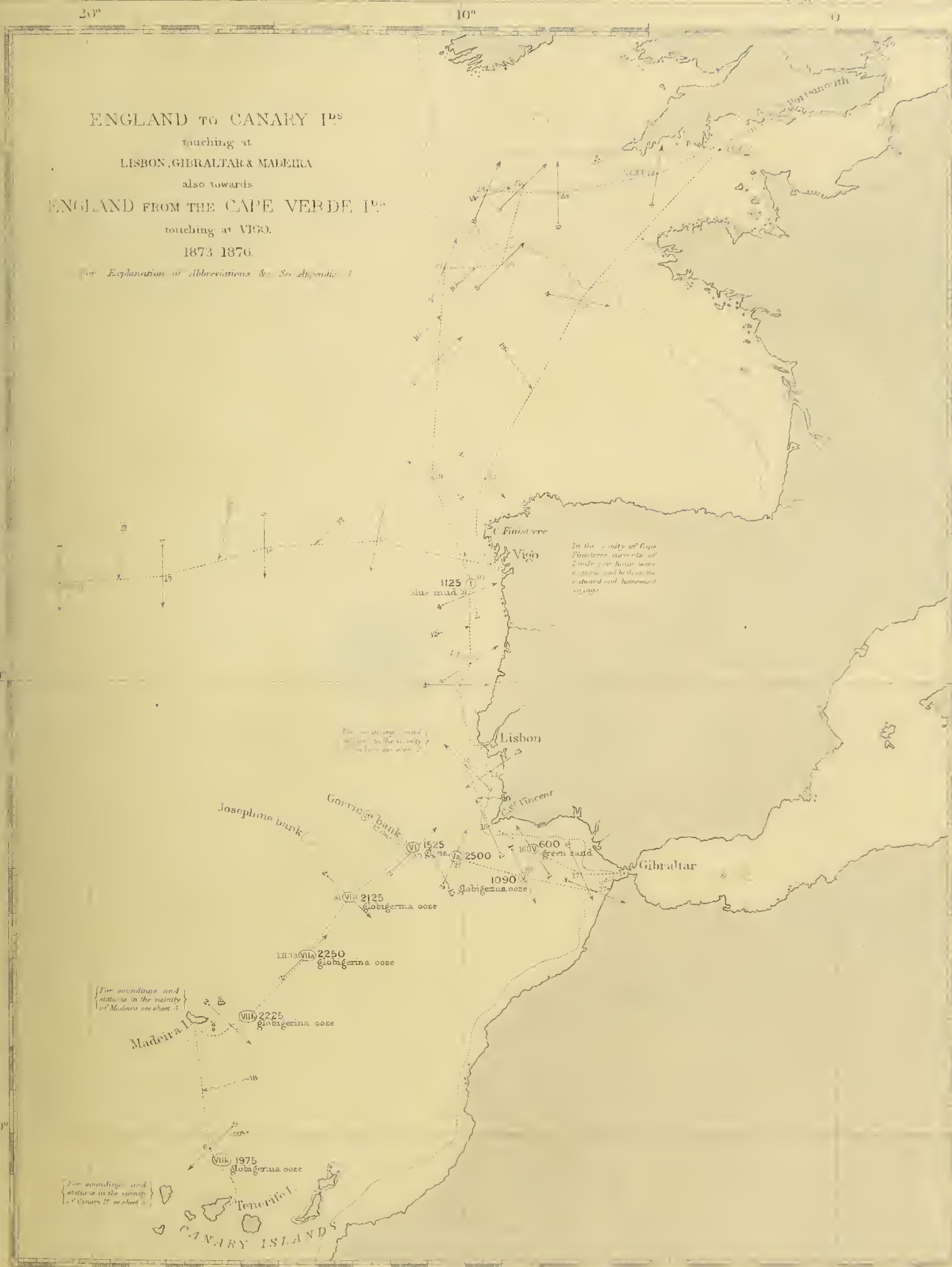
STATIONS IA TO IC.

Stations IA. to IC. (Soundings 2 to 4), Cape Finisterre to Lisbon (see Chart 3).

January 1, 1873; lat. 40° 23′ N., long. 9° 43′ W.

Temperature of air at noon, 57°·3; mean for the day, 57°·3.

Temperature of water at surface, 57°·0.


ENGLAND TO CANARY I^DS
touching at
LISBON, GIBRALTAR & MADEIRA
also towards
ENGLAND FROM THE CAPE VERDE I^DS
touching at VIGO.
1873 1876.
20°
10°
0
30°
C. Finisterre
Vigo
1125
blue mud
Lisbon
C. St Vincent
Gorringe bank
Josephine bank
1525
2500
600
green sand
Gibraltar
1090
Globigerina ooze
2125
Globigerina ooze
2250
Globigerina ooze
2225
Globigerina ooze
Madeira I.
1975
Globigerina ooze
Teneriffe I.
CANARY ISLANDS


SOUNDINGS AND STATIONS
in the vicinity of
LISBON
For explanation of abbreviations &c. see Appendix 1
13°
12°
11°
10°
9°
40°
Lisbon
325
hard ground
730
950
hard ground
1975
280
84
green mud
560
green sand
green mud
1290
blue mud
1475
blue mud
1380
blue mud
470
green mud
1270
green mud
1800
blue mud
900
green sand
1000
green mud
525
green sand
Gorringe Bk.
(30 fms.)
1525
2500
600
11° Long. West from Greenwich

At 7 A.M. sounded in 325 fathoms, Hard Ground, bottom temperature 52°·0 (Station IA.), and at 9 A.M. in 730 fathoms, Hard Ground, bottom temperature 49°·5 (Station IB.). At 11 A.M. sounded in 950 fathoms, Hard Ground (Station IC.), but the line carried away owing to a bad splice. At 11.30 A.M. put dredge over in about 1000 fathoms; it came up without mud at 4 P.M., having apparently not been on the bottom, but contained one small fish, some small Crustacea, and Pteropoda. Between Vigo Bay and Burlings Islands the tow-net was used. At night the sea showed luminosity due apparently to small Crustacea. STATIONS IA. TO IC.

Position at noon, about 40 miles west of Cape Mondego; Burlings Islands distant 59 miles. Made good 86 miles. Amount of current 12 miles, direction N. 75° E.

Surface Organisms.—Crustacea and Pteropoda were obtained in the surface tow-net. ORGANISMS FROM SURFACE-NETS.

Station ID. (Sounding 5), Cape Finisterre to Lisbon (see Chart 3). STATION ID.

January 2, 1873; lat. 39° 55′ N., long. 10° 5′ W.
Temperature of air at noon, 57°·3; mean for the day, 56°·7.
Temperature of water at surface, 57°·0.
Depth, 1975 fathoms.

At 9 A.M. sounded in 1975 fathoms, but the line was carried away, owing to a bad splice, making the third sounding line and third thermometer which have been lost. At 10.30 A.M. lowered dredge in about 2000 fathoms, and commenced heaving in at 2 P.M. At 9.20 P.M. the dredge-rope was carried away, about 2000 fathoms of line being lost along with the dredge, which probably fouled something at the bottom, as there was a heavy strain on the line, and only a fathom or two could be hauled in at a time.

Position at noon, about 40 miles N.W. of Burlings Islands, coast of Portugal. Made good 30 miles. Amount of current 7 miles, direction S. 56° E.

The Challenger remained at anchor off Lisbon from 1 P.M. on January 3 till 5 P.M. on January 12, 1873. AT LISBON.

Stations II. and IIA. (Soundings 6 and 7), off the mouth of the Tagus (see Chart 3). STATIONS II. AND IIA.

January 13, 1873; lat. 38° 10′ N., long. 9° 14′ W.
Temperature of air at noon, 54°·3; mean for the day, 55°·0.
Temperature of water at surface, 57°·0.

At 7.30 A.M. sounded in 470 fathoms, deposit Green Mud, containing about 40

STATIONS II. AND IIA.

per cent. of carbonate of lime (Station II.), and at 7.50 A.M. put over dredge—with 2 cwt. 150 fathoms in front of it—veering 750 fathoms of rope. At 11 A.M. the dredge came up with a large quantity (about 1½ cwt.) of mud and a number of specimens. At 1.50 P.M. sounded in 1270 fathoms, deposit Green Mud (Station IIA.), and at 2.30 P.M. put over dredge. At 5.50 P.M. commenced hauling in dredge, which came up at 8 P.M. bottom up, but with two starfishes.

Position at noon, about 20 miles S.W. of Cape Espichel.

The following species are recorded in the Zoological Reports as having been obtained by the dredge at Station II. :—

ANIMALS FROM DREDGE.

ANNELIDA (M'Intosh, Zool. pt. 34).

Allmaniella setubalensis, n.g., n.sp. One fragmentary specimen; obtained at no other locality. Only species of the genus.

Syllis setubalensis, n.sp. One fragmentary specimen; obtained at no other locality.

Glycera capitata, Œrsted. One specimen; obtained also at Station 75, 450 fathoms. A widely-distributed species.

Praxilla (?) *challengeriæ*, n.sp. One fragmentary specimen; obtained at no other locality.

Euthelepus setubalensis, n.g., n.sp. One fragmentary specimen; obtained at no other locality. The only other species of the genus (*Euthelepus chilensis*) was obtained at Station 299, 2160 fathoms.

Protula lusitanica, n.sp. One fragmentary specimen, which was afterwards unfortunately lost; obtained at no other locality.

Nephthys malmgreni, Théel (?). One fragmentary specimen; obtained at no other locality by the Challenger. Recorded from the North Atlantic ("Porcupine" and "Knight Errant").

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Limopsis minuta (Philippi). Many specimens; obtained also at Stations VIIP., VIII., 24, and 75, 70 to 620 fathoms.

Leda rectidorsata, Seguenza (?). A single valve; obtained at no other locality by the Challenger.

Pecten sulcatus, Müller, var. (*crebricostata*, Sars). One specimen (several dead specimens noted in Station-book); obtained at no other locality by the Challenger.

SOUNDINGS AND STATIONS

in the vicinity of

MADEIRA ISLAND

For explanation of abbreviations &c. see Appendix I

SCAPHOPODA and GASTEROPODA (Watson, Zool. pt. 42).

Dentalium capillosum, Jeffreys, var. *paucicostatum*, nov. One specimen; the species was also obtained at Stations 24 (?), 73, and 78, 390 to 1000 fathoms. Recorded from North Atlantic, 208 to 1785 fathoms ("Valorous" and "Porcupine"), and Gulf of Mexico.

Dentalium entalis, Linné, var. *orthrum*, nov. Obtained also at Stations 75 and 145, 450 and 140 fathoms. The species obtained also at Stations VIII., 49, and 344. Recorded from the whole North Atlantic and Mediterranean. Fossil—European Pliocenes.

Dentalium circumcinctum, n.sp. Obtained also at Stations 23, 56, and 122, 350 to 1075 fathoms.

Trochus (*Margarita*) *rhysus*, n.sp. Obtained also at Station 23, 450 fathoms.

Fusus (*Neptunea*) *despectus* (Linné). One specimen; obtained at no other locality by the Challenger. Recorded from North Atlantic, Arctic, Bering Strait, and Japan. Fossil—glacial beds of Norway.

Fusus (*Siphonorbis*) *amblyterus*, n.sp. One injured specimen; obtained at no other locality by the Challenger. Recorded from North Atlantic ("Porcupine").

Columbella (*Anachis*) *haliæeti*, Jeffreys. Several specimens; obtained also at Station 75, 450 fathoms. Recorded from North Atlantic and Arctic. Fossil—Upper Miocene of Vienna basin.

Bittium gemmatum, n.sp. Obtained at no other locality by the Challenger. Recorded from south coast of Spain ("Porcupine").

The following species are recorded in the Zoological Reports from the coast of Portugal, without distinctive Station number, but they are all evidently from this Station:—

TETRACTINELLIDA (Sollas, Zool. pt. 63).

Corallistes bowerbanki (Johnson). One specimen (coast of Portugal); obtained at no other locality by the Challenger. Recorded from Madeira and Cape St. Vincent.

HEXACTINELLIDA (Schulze, Zool. pt. 53).

Chonelasma sp. (?). Several fragments (coast of Portugal).

Dactylocalyx (?) *patella*, n.sp. Several specimens (coast of Portugal); obtained also at Station 56, 1075 fathoms.

Stations II and IIA.

Asteroidea (Sladen, Zool. pt. 51).

Pararchaster armatus, n.g., n.sp. (Coast of Portugal); obtained also at Stations 46 and 50, 1350 and 1250 fathoms.

Plutonaster bifrons (Wyville Thomson). (Coast of Portugal—probably from Station V.); obtained also at Station 47 (see Station V.).

Ophiuroidea (Lyman, Zool. pt. 14).

Ophioglypha irrorata, n.sp. (?). (Coast of Portugal, 470 to 1125 fathoms); obtained also at Stations 143 and 164, 1900 and 410 fathoms.

Ophioglypha confragosa, n.sp. (Coast of Portugal, 470 to 1090 fathoms?); obtained also at Station 320, 600 fathoms. Recorded subsequently from New England.

Ophiomusium planum, Lyman. (Coast of Portugal, 470 to 1090 fathoms); obtained at no other locality by the Challenger. Recorded from West Indies.

Ophiomusium lymani, Wyville Thomson. (Coast of Portugal); for distribution see Station 45.

Echinoidea (Agassiz, Zool. pt. 9).

Salenia hastigera, n.sp. (Coast of Portugal); for distribution see Station 106.

Aerope rostrata, Wyville Thomson, n.g., n.sp. (Coast of Portugal); obtained also at Station 191, 800 fathoms.

In addition to the foregoing, the following are recorded in the Station-book:—Several specimens of *Antedon sarsii* [= *Antedon tenella*], two specimens of *Brissopsis lyrifera* (one very young), small Amphipod, *Pagurus* in *Dentalium*, *Dorynchus* [= *Lispognathus*] *thomsoni* (female with ova), *Dacrydium vitreum*, *Hornera* and several other Polyzoa, and Tunicates.

Excluding the Protozoa, nearly 100 specimens of invertebrates were obtained at this Station, belonging to about 40 species, of which 17 are new to science, 4 new genera being represented; 7 of the new species and 1 new genus were not obtained elsewhere.

Willemoes-Suhm writes:—"Among the worms I recognise *Glycera alba*, *Praxilla*, *Eunice*, *Sabella*, and *Syllis*, all in single specimens or in fragments. Among them also perhaps one of *Chætopterus* and the tube of this worm."

Organisms from the Deposit.

Foraminifera (Brady, Zool. pt. 22).—The following is a list of the Foraminifera observed in the deposit from this Station (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.); the pelagic species, which make up 25 per cent. of the carbonate of lime present in the deposit, are marked thus × :—

STATIONS II. AND IIA.

Biloculina bulloides, d'Orbigny.
„ *comata*, Brady.
„ *depressa*, d'Orbigny.
„ *ringens* (Lamarck).
„ *tubulosa*, Costa.
Spiroloculina limbata, d'Orbigny.
Miliolina seminulum (Linné).
Planispirina celata (Costa).
„ *communis*, Seguenza.
Psammosphæra fusca, Schulze.
Kalamopsis (?) sp.
Hyperammina ramosa, Brady.
Rhabdammina abyssorum, Sars.
Botellina labyrinthica, Brady.
Reophax sp. (?).
Haplophragmium latidorsatum (Bornemann).
Placopsilina vesicularis, Brady (?).
Ammodiscus incertus (d'Orbigny).
Webbina clavata, Jones and Parker.
Cyclammina cancellata, Brady.
Bigenerina capreolus, d'Orbigny.
Valvulina fusca (Williamson).
Clavulina communis, d'Orbigny.
„ *parisiensis*, d'Orbigny.
Bulimina inflata, Seguenza.
„ *pyrula*, d'Orbigny.
Bolivina amygdalæformis, Brady.
„ *punctata*, d'Orbigny.
Lagena lævis (Montagu).
„ *sulcata* (Walker and Jacob).
Nodosaria comata (Batsch) (?).
„ (*Glandulina*) *lævigata*, d'Orbigny.
„ *scalaris* (Batsch).
„ *soluta*, Reuss.
Lingulina carinata, d'Orbigny, var. *seminuda*, Hantken.
Marginulina costata (Batsch).
Vaginulina legumen (Linné).
Cristellaria articulata, Reuss.
„ *calcar* (Linné).
„ *compressa*, d'Orbigny.
„ *cultrata* (Montfort).
„ *italica* (Defrance).
„ *rotulata* (Lamarck).
„ *vortex* (Fichtel and Moll).
„ sp. (?)
Uvigerina angulosa, Williamson.
„ *pygmæa*, d'Orbigny.
× *Globigerina bulloides*, d'Orbigny.
× „ *conglobata*, Brady.
× „ *inflata*, d'Orbigny.
× „ *rubra*, d'Orbigny.
× *Orbulina universa*, d'Orbigny.
Pullenia sphæroides (d'Orbigny).
Truncatulina pygmæa, Hantken.
Anomalina ariminensis (d'Orbigny).
„ *coronata*, Parker and Jones.
Carpenteria balaniformis, Gray.
Rupertia stabilis, Wallich.
× *Pulvinulina canariensis* (d'Orbigny).
„ *elegans* (d'Orbigny).
× „ *micheliniana* (d'Orbigny).
„ *punctulata* (d'Orbigny).
„ sp. (?).
Rotalia orbicularis, d'Orbigny.
Gypsina globulus (Reuss).
Nonionina umbilicatula (Montagu).
Operculina ammonoides (Gronovius).

ORGANISMS FROM SURFACE-NETS.

Surface Organisms.—Willemoes-Suhm writes:—"Among the surface things were found a beautiful *Gammarus* with enormous eyes, a Crustacean larva offering a curious combination of Phyllopodal and Copepodal characters, and the little *Hyperia* inhabiting the *Salpæ*."

STATIONS IIB. TO IIH.

Stations IIB. to IIH. (Soundings 8 to 14), off the mouth of the Tagus (see Chart 3).

On January 14, 1873, soundings were taken successively in 84 fathoms, deposit

Stations IIb. to IIh.

Green Mud (Station IIb.); in 280 fathoms, deposit Green Mud (Station IIc.); in 560 fathoms, deposit Green Sand, containing 31·81 per cent. of carbonate of lime, bottom temperature 52°·0 (Station IId.); in 1290 fathoms, deposit Blue Mud, containing 19 per cent. of carbonate of lime (Station IIe.); in 1475 fathoms, deposit Blue Mud, containing 26·50 per cent. of carbonate of lime, bottom temperature 37°·5 (Station IIf.); in 1380 fathoms, deposit Blue Mud, containing 28·86 per cent. of carbonate of lime, bottom temperature 38°·0 (Station IIg.); and in 1800 fathoms, deposit Blue Mud, containing 19·88 per cent. of carbonate of lime, bottom temperature 37°·0 (Station IIh.).

Distance at noon from Cape St. Vincent, 81 miles. Made good 21 miles.

Organisms from Surface Nets.

Surface Organisms.—Willemoes-Suhm writes:—"Among the surface things were some *Acanthometræ*, the common Copepoda, and a Crustacean larva (Brachyuran)."

Stations IIj. and IIk.

Stations IIj. and IIk. (Soundings 15 to 17), Lisbon to Gibraltar (see Chart 3).

January 15, 1873; lat. 36° 58′ 50″ N., long. 9° 14′ 20″ W.

Temperature of air at noon, 62°·3; mean for the day, 60°·1.

Temperature of water:—

	°		°
Surface,	60·0	125 fathoms,	56·3
25 fathoms,	60·0	150 ,,	55·3
50 ,,	60·0	175 ,,	54·8
75 ,,	59·2	200 ,,	54·5
100 ,,	57·5		

At 9.30 a.m. sounded in 1000 fathoms, deposit Green Mud, containing 18·88 per cent. of carbonate of lime, bottom temperature 39°·5 (Station IIj.). At noon sounded in 525 fathoms, deposit Green Sand, bottom temperature 54°·0 (Station IIk.), and at 12.45 p.m. lowered dredge, which came up at 3.45 p.m. At 12.45 p.m. Naturalists went away in a boat for surface collecting.

Station III.

Station III.

At 4.45 p.m. sounded in 900 fathoms, deposit Green Sand (Station III.), and put over dredge. At 7.45 p.m. commenced heaving in dredge, which came up at 10 p.m. full of mud and with a few specimens.

Position at noon, 12 miles off Cape St. Vincent. Made good 81 miles. Amount of current 10 miles, direction W.

The following three species are recorded in the Zoological Reports from the dredge at this Station :— STATION III.

CORALS (Moseley, Zool. pt. 7).

Flabellum apertum, n.sp. Two specimens; obtained also at Station 145, 310 fathoms. ANIMALS FROM DREDGE.

ANNELIDA (M'Intosh, Zool. pt. 34).

Nothria conchylega, Sars. One specimen; obtained also at Station 49, 85 fathoms. A widely-distributed species.

CIRRIPEDIA (Hoek, Zool. pt. 25).

Scalpellum velutinum, n.sp. (?). Three specimens; obtained also at Station 335, 1425 fathoms.

In addition to the foregoing, the following are recorded in the Station-book :—*Chondrocladia virgata*, two specimens of *Euplectella suberea*, spicules of *Hyalonema*, three specimens of *Mopsea*, two young specimens of *Funiculina quadrangularis*, *Palythoa*, *Tubularia*, several young specimens of *Archaster* [= *Plutonaster*] *bifrons*, and *Limopsis*.

Excluding Protozoa, about 30 specimens of invertebrates were obtained at this Station, belonging to about 12 species, of which 2 are new to science.

Surface Organisms.—The following were taken in the surface tow-nets :—*Collosphæra*, *Velella*, *Cydippe*, *Ianthina*, *Carinaria atlantica*, and *Salpa*, also a small turtle (*Chelone imbricata*). ORGANISMS FROM SURFACE-NETS.

Willemoes-Suhm writes : " Among the surface things were big blackish Copepods with large paws (denticulated), beautiful *Salpæ* and *Velellæ*; on the latter *Ianthina* was feeding."

Station IV. (Sounding 18), Lisbon to Gibraltar (see Charts 2 and 3). STATION IV.

January 16, 1873 ; lat. 36° 25′ N., long. 8° 12′ W.

Temperature of air at noon, 58°·8 ; mean for the day, 59°·1.

Temperature of water at surface, 60°·0.

Depth, 600 fathoms ; deposit, Green Sand.

At 8 A.M. sounded in 600 fathoms. At 8.30 A.M. put over dredge, which came up about noon with very few specimens, but with great masses of a Gorgonoid entangled in the rope and about the mouth of the dredge. On this occasion it was suggested that the ordinary deep-sea trawl should be tried, in order to go over more ground, and to take, if possible, animals belonging to some of the higher groups. The result fully justified the experiment, for the trawl was sent down at 1 P.M., and on being hauled up about 4 P.M., was found to contain a number of forms.

STATION IV.

Position at noon, about 60 miles S.E. of Cape St. Vincent; Cape Trafalgar distant 106 miles. Made good 60 miles. Amount of current 6 miles, direction N.

ANIMALS FROM DREDGE AND TRAWL.

The following species are recorded in the Zoological Reports from the dredge and trawl at this Station:—

TETRACTINELLIDA (Sollas, Zool. pt. 63).

Thenea schmidtii, n.n. One specimen; obtained also at Stations 24 and 73, 390 and 1000 fathoms. Recorded from Florida.

HEXACTINELLIDA (Schulze, Zool. pt. 53).

Hyalonema lusitanicum, Bocage (?). One specimen; obtained at no other locality by the Challenger. Recorded from off Setubal and Porto Rico (?).

Euplectella suberea, Wyville Thomson, n.sp. One specimen; obtained also at Stations V. and 124, 1090 and 600 fathoms. Taken subsequently by the "Travailleur," off the Berlingues, in 3307 metres (about 1650 fathoms).

ALCYONARIA (Wright and Studer, Zool. pt. 64).

Strophogorgia challengeri, n.g., n.sp. Numerous specimens; obtained at no other locality.

DEEP-SEA MEDUSÆ (Haeckel, Zool. pt. 12).

Pectanthis asteroides, Haeckel. One specimen; obtained at no other locality by the Challenger. Recorded from the Mediterranean.

Drymonema victoria, Haeckel. One fragmentary specimen; obtained at no other locality by the Challenger. Recorded from the Mediterranean.

FISHES (Günther, Zool. pt. 57).

Macrurus æqualis, n.sp. Two specimens; obtained at no other locality.

In addition to the foregoing, the following are recorded in the Station-book:— *Mopsea*, Actinian, two specimens of *Astrogonium longimanum* [= *Iconaster longimanus*], spines of *Cidaris hystrix*, *Pagurus* (very large), large crab, *Tellina* sp., many living specimens of *Neæra* sp., *Dentalium*, and *Mora mediterranea* (?).

Excluding Protozoa, about 50 specimens of invertebrates and fishes were obtained at this Station, belonging to about 17 species, of which 3 are new to science, including representative of a new genus; 2 of the new species were not obtained elsewhere.

STATION IV.

ORGANISMS FROM SURFACE-NETS.

Surface Organisms.—Willemoes-Suhm mentions: Velellidæ; *Sagitta;* Copepods; a small oceanic crab, the legs of which are big, with long and light hairs, especially adapted for swimming; *Ianthina*, with air-bladder; *Firoloida; Salpa* and *Appendicularia.* Among the large quantity of animals examined, no larvæ of worms nor of Echinoderms, nor *Cyphonautes* were found.

AT GIBRALTAR.

The Challenger remained at anchor at Gibraltar from 8 A.M. on January 18 till 6 P.M. on January 26.

January 26 and 27, 1873.

ORGANISMS FROM SURFACE-NETS.

Surface Organisms.—Willemoes-Suhm writes: "Near Gibraltar, on January 26, a specimen of *Orthagoriscus mola* was seen at the surface. Among the surface things taken on January 27, I find the first swimming worm, a *Syllis*, remarkable for long prolongations of the feet; the animal examined is not, however, full-grown. Among the Copepods I find *Copilia denticulata*, Claus [= *Copilia mirabilis*, Dana], a remarkable Saphirinoid, in which the red-coloured eyes are at a great distance from the cornea in the front; the anterior part of the body shows exceedingly well the nervous system, the otolith, and the innervation of the glands described by Haeckel in *Saphirina edwardsii.* There were also many specimens of *Beroë, Cydippe, Sagitta*, megalopa stage of crab, *Carinaria*, Pteropods, *Appendicularia, Salpa*, and *Doliolum.* Worm larvæ, Echinoderm larvæ, and *Cyphonautes* observed for the first time abundantly to-day."

Station V. (Sounding 19), Gibraltar to Madeira (see Chart 2).

STATION V.

January 28, 1873; lat. 35° 47′ N., long. 8° 23′ W.
Temperature of air at noon, 58°·3; mean for the day, 56°·3.
Temperature of water:—

Surface, ...	61·0	110 fathoms, . . .	57·0
10 fathoms, . . .	61·0	120 „ . . .	56·6
20 „ . . .	61·0	130 „ . . .	56·2
30 „ . . .	60·9	140 „ . . .	55·7
40 „ . . .	60·7	150 „ . . .	55·2
50 „ . . .	60·5	160 „ . . .	54·9
60 „ . . .	60·3	170 „ . . .	54·6
70 „ . . .	59·6	180 „ . . .	54·3
80 „ . . .	58·7	190 „ . . .	54·1
90 „ . . .	57·9	200 „ . . .	54·0
100 „ . . .	57·4	Bottom, . . .	38·5

Depth, 1090 fathoms; deposit, Globigerina Ooze, containing 66·84 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 11 A.M. sounded in 1090 fathoms; at 1 P.M. the trawl was lowered, and came up at 4 P.M., containing several specimens.

Station V.

Position at noon, about 90 miles S.E. of Cape St. Vincent; Madeira distant 530 miles. Made good 98 miles. No current.

Animals from Trawl.

The following species are recorded in the Zoological Reports as having been obtained in the trawl at this Station:—

Hexactinellida (Schulze, Zool. pt. 53).

Euplectella suberea, Wyville Thomson, n.sp. One specimen; obtained also at Stations IV. and 124.

Asteroidea (Sladen, Zool. pt. 51).

Plutonaster bifrons (Wyville Thomson). Obtained also at Station 47, 1340 fathoms. Recorded from North Atlantic ("Porcupine," "Knight Errant," and "Triton"), and from Barent's Sea.

Holothurioidea (Théel, Zool. pts. 13 and 39).

Euphronides depressa, n.g., n.sp. One specimen; obtained also at Station 300, 1375 fathoms. Only species of the genus.

Benthodytes typica, n.g., n.sp. Numerous injured specimens; obtained at no other locality.

Holothuria murrayi, n.sp. (var. ?). One specimen; the species was obtained also at Station 219, 150 fathoms (var. *parva*), and Station 300, 1375 fathoms.

Amphipoda (Stebbing, Zool. pt. 67).

Cystisoma spinosum (Fabricius). One specimen; obtained also at Stations 101, 107, 170A, 196 (?), 214 (?), and 224, 500 to 2500 fathoms. A widely-distributed species.

Fishes (Günther, Zool. pt. 57).

Macrurus sclerorhynchus, Valenciennes (?). One specimen; obtained at no other locality by the Challenger. Recorded from the Mediterranean.

Bathytroctes microlepis, n.g., n.sp.. One specimen; obtained at no other locality.

Halosaurus macrochir, n.sp. One specimen; obtained also at Station 146, 1375 fathoms. Taken subsequently by U.S. Coast Survey expeditions in Central Atlantic.

In addition to the foregoing, the following are recorded in the Station-book:— Pennatulid, three specimens of *Ophiomusium lymani* and two of another species, *Diadema* (?) sp.

Excluding Protozoa, about 30 specimens of invertebrates and fishes were obtained at this Station, belonging to about 13 species, of which 6 are new to science, 3 new genera being represented; 2 of the new species were not obtained elsewhere. STATION V.

Surface Organisms.—Two species of Heteropoda: *Pterotrachea* sp.(?), and *Carinaria* n.sp. (?), are recorded by Smith (Zool. pt. 72), and the following are also given in the note-books: Radiolaria, Siphonophoræ, *Syllis*, and Pteropods. ORGANISMS FROM SURFACE-NETS.

Station VA. January 29, 1873.

STATION VA.

At 9.15 A.M. on this date a sounding was taken in 2500 fathoms, but in heaving in the line carried away.

Station VI. (Sounding 21), Gibraltar to Madeira (see Charts 2 and 3).

STATION VI.

January 30, 1873; lat. 36° 23′ N., long. 11° 18′ W.
Temperature of air at noon, 60°·8; mean for the day, 58°·9.
Temperature of water at surface, 58°·0; bottom, 36°·0.
Depth, 1525 fathoms; deposit, Globigerina Ooze, containing 67·54 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 7.30 A.M. sounded in 1525 fathoms, and lowered trawl, which came up at 4 P.M. containing a number of interesting forms.

Distance from Madeira at noon, 346 miles. Made good 52 miles. Amount of current 15 miles, direction N. 26° W.

The following species are recorded in the Zoological Reports from the trawl at this Station:— ANIMALS FROM TRAWL.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Phormosoma uranus, Wyville Thomson, n.sp. Obtained also at Station 78, 1000 fathoms.

ANNELIDA (M'Intosh, Zool. pt. 34).

Evarne tenuisetis, n.sp. One fragmentary specimen; obtained at no other locality.

Nereis longisetis, n.sp. One fragmentary specimen; obtained at no other locality.

Maldane malmgreni, n.sp. One fragmentary specimen; obtained at no other locality.

Amphicteis gunneri (Sars). One fragmentary specimen; obtained also at Station 63, 2750 fathoms (var. *atlantica*, nov.). Recorded from Europe and America.

STATION VI

CIRRIPEDIA (Hoek, Zool. pt. 25).

Scalpellum insigne, n.sp. One specimen; obtained at no other locality.

Verruca obliqua, n.sp. Four specimens, and a fifth specimen probably representing a variety; obtained at no other locality.

POLYZOA (Busk, Zool. pt. 30).

Kinetoskias cyathus (Wyville Thomson), n.sp. Four specimens; obtained also at Station 325, 2650 fathoms.

In addition to the foregoing, the following are recorded in the Station-book:—Two specimens of *Euplectella* sp., *Iphiteon* sp., *Tethya* sp., fragments of *Holtenia* [= *Pheronema*] or *Asconema*, several new Sponges, *Hymenaster* sp., six specimens of *Ophiomusium* sp. and two of another species, *Diadema* sp., six specimens of *Salenia* sp., *Stichopus* (?) sp., and a Molluscoid.

Excluding Protozoa, over 40 specimens of invertebrates were obtained at this Station, belonging to about 20 species, of which 7 are new to science; 5 of the new species were not obtained elsewhere.

Willemoes-Suhm writes: "The worms brought up by the trawl include *Nereis*, *Sabellides*, an Aphroditid, *Clymene*, and some fragments. They present nothing extraordinary in their structure or morphology."

ORGANISMS FROM SURFACE-NETS.

Surface Organisms.—Willemoes-Suhm writes: "The little *Phronima sedentaria* was got in the morning from the surface, and in its transparent house by the trawl. Only the females have, according to Claus, a house; they are smaller than the males, have more hairs on the antennæ, &c. A large specimen of *Tomopteris* was captured, but being only slightly transparent was not kept." *Physalia* is also recorded in the note-books.

STATION VII

Station VII. (Sounding 22), Gibraltar to Madeira (see Chart 2).

January 31, 1873; lat. 35° 20′ N., long. 13° 4′ W.
Temperature of air at noon, 58°·8; mean for the day, 57°·9.
Temperature of water at surface, 60°·0; bottom, 37°·0.
Depth, 2125 fathoms; deposit, Globigerina Ooze.

At 9.15 A.M. sounded in 2125 fathoms, and at 11.30 A.M. lowered trawl; at 3 P.M. commenced heaving in trawl, which came up at 6.30 P.M. with a few specimens.

Position at noon, about 230 miles S.W. of Cape St. Vincent; distance from Madeira 238 miles. Made good 107 miles. Amount of current 3 miles, direction W.

The following species is recorded from the trawl at this Station:—

Pennatulida (Kölliker, Zool. pt. 2). Station VII. Animals from Trawl.

Umbellula thomsoni, n.sp. Two specimens; obtained at no other locality. The larger specimen had a stem 3 feet in length, and showed most brilliant phosphorescence, which, on being examined with the spectroscope, gave a very restricted spectrum, extending from about *b* to D.

In the Station-book are noted also: *Archaster* [=*Plutonaster*] *bifrons* (?), and three specimens of *Stichopus* (?) sp.

Surface Organisms.—The following species are recorded from the carapace of a turtle taken at the surface at this Station:— Organisms from the Surface.

Hydroida (Allman, Zool. pt. 70).

Campanularia cheloniæ, n.sp.

Cirripedia (Hoek, Zool. pt. 25).

Conchoderma virgatum (Spengler), var. *chelonophilus*, Leach.

Amphipoda (Stebbing, Zool. pt. 67).

Platophium cheloniæ, n.sp.

Brachyura (Miers, Zool. pt. 49).

Nautilograpsus minutus (Linné).

Willemoes-Suhm writes:—"A specimen of *Chelone imbricata* was caught by Murray, and beneath the fore-paddles we found *Conchoderma*, a Lepadid with rudimentary chalk pieces, with young larvæ in the Cypris stage just attached, besides also a *Lepas*. The swimming Brachyurous crab, caught once before, was also sitting upon it."

Station VIIa. (Sounding 23), Gibraltar to Madeira (see Chart 2). Station VIIa.

February 1, 1873; lat. 34° 4′ N., long. 14° 18′ W.
Temperature of air at noon, 62°·8; mean for the day, 61°·8.
Temperature of water at surface, 61°·0; bottom, 37°·0.
Depth, 2250 fathoms; deposit, Globigerina Ooze, containing 74·77 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 10 a.m. sounded in 2250 fathoms, and at 11.30 a.m. proceeded under steam. Distance at noon from S.E. Rock, Porto Santo, 114 miles. Made good 99 miles. Amount of current 3 miles, direction S. 62° W.

Stations VIIb. to VIIf. (Soundings 24 to 28), off Madeira (see Charts 2 and 4). Stations VIIb. to VIIf.

On February 2, 1873, soundings were taken as follows:—At 7 a.m., in 2225 fathoms, deposit Globigerina Ooze, containing 53·13 per cent. of carbonate of lime, bottom temperature 37°·0 (Station VIIb.); at 1.40 p.m., in 670 fathoms, deposit Calcareous Sand, Station VIIc to VIIf.

containing 96·27 per cent. of carbonate of lime, bottom temperature 46°·8 (Station VIIc.); at 3 P.M., in 1150 fathoms, deposit Volcanic Mud, containing 38·40 per cent. of carbonate of lime (Station VIId.); at 5 P.M., in 930 fathoms, deposit Volcanic Mud, containing 29·20 per cent. of carbonate of lime, bottom temperature 43°·5 (Station VIIe.); and at 8 P.M., in 1500 fathoms, deposit Volcanic Mud, containing 36·93 per cent. of carbonate of lime (Station VIIf.). At 9.45 P.M. the trawl was lowered with 2000 fathoms of rope. Next morning the trawl was observed stretching the accumulators to their utmost tension, having probably fouled something at the bottom, and in endeavouring to clear it the rope was carried away and the trawl was lost.

Organisms from the Deposit.

Foraminifera (Brady, Zool. pt. 22).—The following species of Foraminifera were observed during the examination of the deposit from Station VIIc., 670 fathoms (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.); the pelagic species, which make up less than 5 per cent. of the carbonate of lime present in the deposit, are marked thus × :—

Biloculina elongata, d'Orbigny.
,, *ringens* (Lamarck).
Spiroloculina limbata, d'Orbigny.
Miliolina circularis (Bornemann).
,, *gracilis* (d'Orbigny) (?).
,, *seminulum* (Linné).
,, sp. (?).
Psammosphæra fusca, Schulze.
Rhabdammina abyssorum, Sars.
Bigenerina capreolus (d'Orbigny).
,, *pennatula* (Batsch).
Gaudryina rugosa, d'Orbigny.
Cassidulina calabra (Seguenza).
,, *subglobosa*, Brady.
Nodosaria sp. (?).
Cristellaria articulata, Reuss.
,, *calcar* (Linné).
,, *orbicularis* (d'Orbigny).
Uvigerina angulosa, Williamson.
× *Globigerina æquilateralis*, Brady.
× ,, *bulloides*, d'Orbigny.
× ,, *conglobata*, Brady.
× ,, *inflata*, d'Orbigny.
× ,, *rubra*, d'Orbigny.
× ,, *sacculifera*, Brady.
× *Orbulina universa*, d'Orbigny.
× *Pullenia obliquiloculata*, Parker and Jones.
,, *quinqueloba*, Reuss.
× *Sphæroidina dehiscens*, Parker and Jones.
Discorbina rugosa (d'Orbigny).
,, *vilardeboana* (d'Orbigny).
Truncatulina lobatula (Walker and Jacob).
,, *refulgens* (Montfort).
,, *variabilis*, d'Orbigny.
,, sp. (?).
Anomalina ariminensis (d'Orbigny).
,, *coronata*, Parker and Jones.
Carpenteria balaniformis, Gray (?).
,, *proteiformis*, Goës.
Rupertia stabilis, Wallich.
× *Pulvinulina canariensis* (d'Orbigny).
,, *concentrica*, Parker and Jones.
,, *elegans* (d'Orbigny).
× ,, *micheliniana* (d'Orbigny).
,, *punctulata* (d'Orbigny).
,, *repanda* (Fichtel and Moll).
Rotalia orbicularis, d'Orbigny.
Gypsina inhærens (Schultze).
Nonionina umbilicatula (Montagu).
Polystomella crispa (Linné).

Organisms from Surface-Nets.

Surface Organisms.—The following species are recorded from the surface on this date:—

Pteropoda (Pelseneer, Zool. pt. 65).
Clio (Creseis) acicula (Rang).
Cavolinia trispinosa (Lesueur).
,, *gibbosa* (Rang).

Stations VIIg. to VIIj. (Soundings 29 to 31), off Madeira (see Chart 4). STATIONS VIIg. TO VIIj.

On February 3, 1873, soundings were taken as follows:—At 7 A.M., in 1150 fathoms, deposit Volcanic Mud, bottom temperature 39°·0 (Station VIIg.); at 9 A.M., in 790 fathoms, deposit Volcanic Mud, bottom temperature 45°·0 (Station VIIh.); and at 10 A.M., in 490 fathoms, deposit Volcanic Mud (Station VIIj.).

The Challenger remained at anchor at Funchal, Madeira, from 11 A.M. on February 3 till 2.30 P.M. on February 5. AT MADEIRA.

The two following species are recorded as having been obtained at Madeira;—

ANOMURA (Henderson, Zool. pt. 69). ANIMALS FROM MADEIRA.

Eupagurus excaratus (Herbst), var. *meticulosa*, Roux. Two specimens; obtained also at Cape Verdes. Recorded from Mediterranean and North Atlantic.

BRACHYURA (Miers, Zool. pt. 49).

Leptopodia sagittaria (Fabricius). Several specimens; obtained also at Station 122, Cape Verdes, and Bahia. Recorded from North and South Atlantic, and Pacific coasts of Central and South America.

Station VIIk. (Sounding 32), Madeira to Tenerife (see Charts 2 and 5). STATION VIIk.

February 6, 1873; lat. 29° 19′ N., long. 16° 38′ W.
Temperature of air at noon, 62°·8; mean for the day, 61°·7.
Temperature of water at surface, 62°·5; bottom, 36°·2.
Depth, 1975 fathoms; deposit, Globigerina Ooze.

At 4 P.M. sounded in 1975 fathoms. Anaga Rock, Tenerife, distant at noon, 74 miles. Made good 174 miles since leaving Madeira yesterday, at an average rate of 8 knots per hour.

The ship remained at anchor in Santa Cruz Bay, Tenerife, from 8 A.M. on February 7 till 5.30 A.M. on February 10. AT TENERIFE.

Stations VIIl. to VIIs. (Soundings 33 to 40), off Tenerife, Canary Islands (see Chart 5). STATIONS VIIl. TO VIIs.

On February 10 the ship went on a sounding trip round the island, the following soundings being taken:—At 6.45 A.M., in 278 fathoms, deposit Volcanic Mud, containing 10·36 per cent. of carbonate of lime (Station VIIl.); at 7.30 A.M., in 630 fathoms, deposit

STATIONS VIIL TO VIIS.

Volcanic Mud, containing 11·84 per cent. of carbonate of lime, bottom temperature 45°·0 (Station VIIM.); at 8.40 A.M., in 975 fathoms, deposit Volcanic Mud, bottom temperature 41°·0 (Station VIIN.); at 10 A.M., in 560 fathoms, deposit Volcanic Mud, containing 25·93 per cent. of carbonate of lime, bottom temperature 45°·5 (Station VIIO.); at 10.30 A.M., in 78 fathoms, deposit Volcanic Sand, containing 45·09 per cent. of carbonate of lime (Station VIIP.). At the same time dredgings were taken in shallow water, the animals noted below being recorded, but at 3.30 P.M. the dredge-rope parted and the dredge was lost, having fouled something at the bottom. Soundings were then taken in 179 fathoms, Hard Ground (Station VIIQ.); at 5 P.M., in 640 fathoms, deposit Volcanic Mud, containing 31·70 per cent. of carbonate of lime, bottom temperature 45°·8 (Station VIIR.); and at 5.45 P.M., in 1390 fathoms, deposit Volcanic Mud, bottom temperature 38°·5 (Station VIIS.). Proceeded thence under steam round the north-east extremity of the island.

STATION VIIP. ANIMALS FROM DREDGE.

The following species are recorded in the Zoological Reports as having been obtained in the shallow dredgings (70 to 78 fathoms) on this date (Station VIIP.):—

MACRURA (Spence Bate, Zool. pt. 52).

Arctus pygmæus, n.sp. One specimen; obtained at no other locality.
„ sp. (?). Two young specimens.

ANOMURA (Henderson, Zool. pt. 69).

Pagurus calidus, Risso. One young specimen; obtained also at Cape Verdes. Recorded from the Mediterranean, Madeira, and Canaries.
Spiropagurus elegans, Miers. One specimen; obtained at no other locality by the Challenger. Recorded from Goree Island, Senegambia.
Anapagurus pusillus, n.sp. Many specimens; obtained also at Station 75, and Simon's Bay, Cape, 18 to 90 fathoms.
Galathea dispersa, Spence Bate. Two specimens; obtained at no other locality by the Challenger. Recorded from British seas.

BRACHYURA (Miers, Zool. pt. 49).

Pisa (Arctopsis) tribulus (Linné). One specimen; obtained also at Station 75, 50 to 90 fathoms. Recorded from North Atlantic and Mediterranean.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Gastrochæna dubia (Pennant). Obtained also at Cape Verdes. Recorded from North Atlantic and Mediterranean.

Ervilia castanea (Montagu). Obtained also at Stations 75 and 78, 450 and 1000 fathoms. STATION VIIp.

Psammobia costulata, Turton. Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean.

Venerupis irus (Linné). Obtained at no other locality by the Challenger. Recorded from North Atlantic.

Venus (*Ventricola*) *casina*, Linné. Obtained also at Station 75, 450 fathoms. Recorded from North Atlantic and Mediterranean.

„ („) *effossa*, Bivona. Obtained also at Station 75, 450 fathoms.

Cytherea (*Callista*) *chione*, Linné. Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil—Coralline Crag and Tertiary formations of Italy and Sicily.

Circe minima (Montagu). Obtained also at Station 75, 450 fathoms. Recorded from North Atlantic and Mediterranean.

Cardium (*Acanthocardium*) *papillosum*, Poli. Obtained also at Station 75, 50 to 450 fathoms.

„ (*Papyridea*) *transversale*, Deshayes. Obtained also at Station 75, 450 fathoms. Recorded from Alboran Island.

Chama gryphoides, Linné. Obtained also at Station 75, 450 fathoms. Recorded from North Atlantic and Mediterranean.

Diplodonta apicalis, Philippi. Obtained at no other locality by the Challenger. Recorded from Canaries.

Astarte macandrewi, Smith. Obtained at no other locality by the Challenger. Recorded from Canaries.

Cardita calyculata (Linné). Obtained also at Station 162, 38 to 40 fathoms. Recorded from Mediterranean and Fiji.

Pectunculus stellatus (Bruguière). Obtained at no other locality by the Challenger.

Limopsis minuta (Philippi). Obtained also at Stations II., VIII., 24, and 75.

Lima squamosa, Lamarck. Obtained also at Station 212, 10 fathoms. A widely-distributed species.

Pecten pusio (Linné). Obtained also at Station 75, 450 fathoms.

„ *corallinoides*, d'Orbigny. Obtained also at Cape Verdes. Recorded from Canaries.

GASTEROPODA (Watson, Zool. pt. 42).

Trochus (*Ziziphinus*) *striatus*, Linné. Obtained also at Stations 75 and 122, 450 and 350 fathoms. Recorded from North Atlantic and Mediterranean. Fossil—Upper Miocene all over Europe onwards.

STATION VIIr. *Phasianella pulla* (Linné). Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil—Middle Pliocene onwards.

Scalaria (*Acirsa*) *subdecussata*, Cantraine. Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil—Pliocene of Altavilla.

Nassa (*Cæsia*) *limata* (Chemnitz). Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil—Miocene onwards.

Columbella rustica (Linné). Obtained also at Cape Verdes, 7 to 25 fathoms. Recorded from Mediterranean, Africa, and Antilles. Fossil—Upper Pliocene onwards.

Fasciolaria armata (Adams). Obtained at no other locality by the Challenger. Recorded from California.

Marginella (*Gibberula*) *guancha*, d'Orbigny. Obtained at no other locality by the Challenger. Recorded from Tenerife.

,, (,,) *miliaria* (Linné). Obtained also at Station 75, 450 fathoms. Recorded from Mediterranean and Madeira. Fossil—Miocene onwards.

Ranella (*Aspa*) *marginata* (Gmelin). Obtained at no other locality by the Challenger. Recorded from North-West Africa. Fossil—Italian Middle Pliocene onwards.

Cypræa spurca, Linné. Obtained also at Stations 113A and 122, 7 to 350 fathoms. Recorded from North Atlantic and Mediterranean.

,, (*Trivia*) *candidula*, Gaskoin. Obtained also at Station 75, 450 fathoms. Recorded from Mexico, North Atlantic, and Mediterranean.

Natica variabilis, Recluz. Obtained also at Station 75, 450 fathoms. Recorded from Madeira and Canaries.

,, (*Mamma*) *porcellana*, d'Orbigny. Obtained also at Cape Verdes, 7 to 25 fathoms. Recorded from Bahia, Madeira, and Canaries. Fossil—Post-Pliocene of Calabria.

Cæcum elegantissimum, Carpenter. Six specimens; obtained at no other locality by the Challenger.

,, *vitreum*, Carpenter. Obtained at no other locality by the Challenger. Recorded from Tenerife.

,, *pollicare*, Carpenter. One specimen; obtained at no other locality by the Challenger. Recorded from Tenerife.

Turritella bicingulata, Lamarck. Obtained at no other locality by the Challenger. Recorded from Cape Verdes.

Odostomia turrita, Hanley. Obtained also at Station 122 (?), 350 fathoms. Recorded from North Atlantic and Mediterranean. Fossil —Post-Tertiaries of Scotland. STATION VII$_P$.

Aclis mizon, n.sp. Obtained at no other locality.

Eulima philippii, Weinkauff. Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil—Post-glacial beds of Norway.

Bittium lacteum (Philippi). Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil —Middle Pliocene onwards.

,, *reticulatum* (Costa). Obtained also at Station 75, 450 fathoms. Recorded from North Atlantic and Mediterranean. Fossil —Upper Miocene of Middle and Southern Europe onwards.

Triforis perversa (Linné). Obtained also at Stations 75 and 122, 450 and 350 fathoms. Recorded from North Atlantic and Mediterranean. Fossil—Upper Miocene all over Europe onwards.

Rissoa costulata, Alder. Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil —Middle Pliocene onwards.

,, *similis*, Scacchi. Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil —Pliocene of Calabria, Pleistocene of Sicily, and recent clays of both.

,, (*Alvania*) *canariensis*, d'Orbigny, and var. of Manzoni. Obtained at no other locality by the Challenger. Recorded from Canaries and Madeira.

,, (,,) *costata* (Adams). Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil—Middle Pliocene onwards.

,, (,,) *leacocki*, Watson. Obtained at no other locality by the Challenger. Recorded from Madeira.

,, (*Onoba*) *striata* (Adams). Obtained at no other locality by the Challenger. Recorded from Arctic, North Atlantic, and Mediterranean. Fossil—Pleistocene of Britain and Norway.

,, (,,) *watsoni*, Schwartz. Obtained at no other locality by the Challenger. Recorded from Madeira.

,, (*Cingula*) *glabrata* (Mühlfeldt). Obtained at no other locality by the Challenger. Recorded from Mediterranean and Madeira.

Station VIIp.

Rissoa (*Setia*) *albugo*, Watson. Obtained at no other locality by the Challenger. Recorded from Madeira.

" (") *callosa*, Manzoni. Obtained at no other locality by the Challenger. Recorded from Canaries.

Utriculus mamillatus (Philippi). Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil—Middle Pliocene of Europe onwards.

" *tornatus*, n.sp. Obtained at no other locality by the Challenger. Recorded subsequently from Madeira.

Philine aperta (Linné). Obtained also at Cape Verdes, 7 to 25 fathoms. Recorded from Great Britain, Mediterranean, Cape, and Philippines.

Professor Wyville Thomson mentions also a fine *Synapta*.

Excluding Protozoa, over 80 specimens of invertebrates were obtained at this place, belonging to about 63 species, of which 4 are new to science; 3 of the new species were not obtained elsewhere.

Organisms from the Deposit.

Diatomaceæ.—The following species of Diatoms were observed by Mr Thomas Comber in the deposit from Station VIIp. (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.) :—

Amphora robusta, Gregory.
" *proteus*, Gregory.
" *bigibba*, Grunow.
" *arcuata*, A. Schmidt.
" *spectabilis*, Gregory.
" *grevilleana*, Gregory.
" *littoralis*, Donkin.
" *obtusa*, Gregory.
" *crassa*, Gregory.
Navicula retusa, Brebisson.
" *kennedyii*, W. Smith.
" *clavata*, Gregory.
" *sandriana*, Grunow.
" *maxima*, Gregory.
" *angulosa*, Gregory.
" *carinifera*, Grunow.
" *pelagi*, A. Schmidt.
" *fusca*, Ralfs.
" *graeffii*, A. Schmidt.
" *lineata*, Donkin.
" *nicobarica*, Grunow.
" *donkinii*, A. Schmidt.
" *coffeæformis*, A. Schmidt.
Navicula pandura, Brebisson.
" *bomboides*, A. Schmidt.
" *didyma*, Kutzing.
" *splendida*, Gregory
" *aspera*, Ehrenberg.
" *consors*, A. Schmidt.
" sp. (?).
Cocconeis scutellum, Ehrenberg.
" *moorei* (= *Rhaphoneis*, O'Meara).
Amphiprora alata, Kutzing.
Nitzschia panduriformis, Gregory.
" *plana*, W. Smith.
" *jelinekii*, Grunow.
" *spathulata*, Brebisson.
Surirella fastuosa, Ehrenberg.
" *mexicana*, A. Schmidt.
" *patens*, A. Schmidt.
" *lata*, W. Smith.
Coscinodiscus radiatus, Ehrenberg.
" *nitidus*, Gregory.
" *elegans*, Greville
Paralia sulcata, Cleve.
Hyalodiscus scoticus, Grunow.

Stations VIIt. to VIIv. (Soundings 41 to 43), off Canary Islands (see Chart 5).

Stations VIIt. to VIIv.

February 11, 1873.

Temperature of air at noon, 65°·8 ; mean for the day, 64°·3.

Temperature of water :—

Surface,	65·0	600 fathoms,	44·7
100 fathoms,	59·3	700 „	43·2
200 „	55·0	800 „	41·9
300 „	51·6	900 „	40·8
400 „	48·9	1000 „	40·0
500 „	46·5		

At 6.40 A.M. sounded in 1750 fathoms, deposit Volcanic Mud, containing 36·50 per cent. of carbonate of lime, bottom temperature 37°·5 (Station VIIt.); at 12.30 P.M. sounded in 1340 fathoms, deposit Volcanic Mud, bottom temperature 38°·5 (Station VIIu.); and at 4.45 P.M. in 1620 fathoms, deposit Volcanic Mud, bottom temperature 37°·5 (Station VIIv.). At 7.30 P.M. made all plain sail, and proceeded towards Gomera Island.

The following species of Crustacea is recorded in error as having been obtained at this Station :—

MACRURA (Spence Bate, Zool. pt. 52).

Eryoneicus cæcus, n.g., n.sp. One specimen. This is undoubtedly an error as to locality; the specimen was procured at Station 87 (which see).

Organisms from Surface-nets.

Surface Organisms.—The following are noted as having been captured in the surface tow-nets :—*Porpita*, and shells of *Spirula*.

Station VIII. (Sounding 44), off Canary Islands (see Chart 5).

Station VIII.

February 12, 1873 ; lat. 28° 3′ 15″ N., long. 17° 27′ W.

Temperature of air at noon, 63°·8 ; mean for the day, 61°·7.

Temperature of water :—

Surface,	64·5	200 fathoms,	57·6
50 fathoms,	64·0	300 „	54·2
100 „	63·0		

Depth, 620 fathoms ; deposit, Volcanic Mud, containing 29·02 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

STATION VIII. At 10.15 A.M. sounded in 620 fathoms, near the coast of Gomera Island, and lowered dredge, which was hauled in at 2 P.M. containing numerous specimens. A jar of the mud brought up by the dredge was put aside, containing a weighed coil of steel-covering wire for electric cables, to test the action of the mud upon it. At 3 P.M. proceeded under steam.

ANIMALS FROM DREDGE. The following species are recorded in the Zoological Reports from the dredge at this Station :—

ECHINOIDEA (Agassiz, Zool. pt. 9).

Hemiaster zonatus, n.sp. One specimen; obtained also at Station 126, 750 fathoms.

Aceste bellidifera, Wyville Thomson, n.g., n.sp. One specimen; obtained also at Stations 272 and 323, 2600 and 1900 fathoms.

ANNELIDA (M'Intosh, Zool. pt. 34).

Hyalinœcia tubicola, Müller, var. *longibranchiata*, nov. Two specimens (were alive when brought up); the species obtained also at Stations 75, 167, 186, 235, and 320. A widely-distributed species.

OSTRACODA (Brady, Zool. pt. 3).

Macrocypris canariensis, n.sp. One specimen ; obtained at no other locality.

Bairdia sp. (?).

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Neæra teres, Jeffreys. Many specimens; obtained at no other locality by the Challenger.

Lyonsia formosa, Jeffreys. One specimen ; obtained at no other locality by the Challenger.

Cryptodon croulinensis (Jeffreys). One specimen; obtained also at Stations 33 and 78, 435 and 1000 fathoms. Recorded from North Atlantic and Mediterranean. Fossil—Pliocene and Post-Tertiary formations.

Montacuta pura, n.sp. Obtained also at Station 75, 450 fathoms.

Leda messanensis, Seguenza. Several specimens; obtained also at Station 75, 450 fathoms.

Limopsis minuta (Philippi). Several specimens; obtained also at Stations II., VIIP., 24, and 75.

SCAPHOPODA and GASTEROPODA (Watson, Zool. pt. 42). STATION VIII.

Dentalium entalis, Linné, var. *agile*, Sars. Four specimens; for distribution see Station II.

Nassa (*Tritia*) *brychia*, n.sp. Obtained at no other locality.

Marginella (*Glabella*) *musica*, Hinds. Obtained also at Station 142, 150 fathoms. Recorded from West Africa.

In addition to the foregoing, many specimens of *Cidaris hystrix* are recorded in the Station-book, and Willemoes-Suhm refers to a new genus of Annelids allied to *Sternaspis*, but showing more the characters of true Annelids than that form, the specimens of which were alive when brought up, and were afterwards mounted on slides.

Excluding the Protozoa, over 50 specimens of invertebrates were procured at this Station, belonging to about 16 species, of which 6 are new to science, a new genus being represented; 2 of the new species were not obtained elsewhere.

ORGANISMS FROM THE DEPOSIT.

The following species of Pteropoda, Foraminifera, and Diatoms were observed in the deposit from this Station (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.):—

PTEROPODA (Pelseneer, Zool. pt. 65).

Limacina inflata (d'Orbigny).
Limacina lesueuri (d'Orbigny).
,, *bulimoides* (d'Orbigny).
Peraclis bispinosa, n.sp.
Clio (*Styliola*) *subula* (Quoy and Gaimard).
,, *pyramidata*, Linné.
Cavolinia quadridentata (Lesueur).
,, *inflexa* (Lesueur).

FORAMINIFERA (Brady, Zool. pt. 22).—The pelagic species, which make up about 58 per cent. of the carbonate of lime present in the deposit, are marked thus ×:—

Biloculina comata, Brady.
,, *irregularis*, d'Orbigny.
,, *ringens* (Lamarck).
,, *tubulosa*, Costa.
Spiroloculina acutimargo, Brady.
,, *limbata*, d'Orbigny.
,, *robusta*, Brady.
,, *tenuiseptata*, Brady.
,, sp. (?).
Miliolina auberiana (d'Orbigny).
,, *circularis* (Bornemann).
,, *gracilis* (d'Orbigny).
,, *oblonga* (Montagu).
,, *seminulum* (Linné).
Ophthalmidium inconstans, Brady.
Planispirina communis, Seguenza.
Cornuspira foliacea (Philippi).
Cornuspira involvens, Reuss.
Pelosina cylindrica, Brady.
Technitella raphanus, Brady (?).
Saccammina sphærica, Sars.
Hyperammina ramosa, Brady.
Rhabdammina cornuta, Brady (?).
Haplophragmium emaciatum, Brady.
,, *globigeriniforme* (Parker and Jones).
,, *glomeratum*, Brady.
Trochammina pauciloculata, Brady.
,, *proteus*, Karrer (?).
,, *squamata*, Jones and Parker.
Webbina clavata, Jones and Parker.
Cyclammina pusilla, Brady.
Textularia aspera, Brady.
,, *gramen*, d'Orbigny.

Station VIII.

Textularia luculenta, Brady.
,, *quadrilatera*, Schwager.
Bigenerina capreolus (d'Orbigny).
,, *nodosaria* (d'Orbigny).
,, *pennatula* (Batsch).
Gaudryina pupoides, d'Orbigny.
Clavulina parisiensis, d'Orbigny.
Bulimina aculeata, d'Orbigny.
,, *affinis*, d'Orbigny.
,, *convoluta*, Williamson
,, *elongata*, d'Orbigny.
,, *inflata*, Seguenza.
,, *pupoides*, d'Orbigny.
,, *pyrula*, d'Orbigny.
,, *rostrata*, Brady.
Bolivina beyrichi, Reuss.
,, *punctata*, d'Orbigny.
,, *pygmæa*, Brady.
,, *textilarioides*, Reuss.
Cassidulina crassa, d'Orbigny.
Ehrenbergina serrata, Reuss.
Chilostomella ovoidea, Reuss.
Lagena aspera, Reuss.
,, *lævigata* (Reuss).
,, *lagenoides* (Williamson).
,, *marginata* (Walker and Boys).
,, *orbignyana* (Seguenza).
,, *squamosa* (Montagu).
,, *striata* (d'Orbigny).
,, *striatopunctata*, Parker and Jones.
,, *sulcata* (Walker and Jacob), var. *interrupta*, Williamson.
Nodosaria communis, d'Orbigny.
,, *filiformis*, d'Orbigny.
,, (*Glandulina*) *lævigata*, d'Orbigny.
,, *obliqua* (Linné).
,, *proxima*, Silvestri.
,, *pyrula*, d'Orbigny.
,, *roemeri* (Neugeboren) (?).
,, *scalaris* (Batsch).
,, *simplex*, Silvestri.
,, *soluta*, Reuss.
,, *vertebralis* (Batsch).
,, sp. (?).
Lingulina carinata, d'Orbigny, var. *seminuda*, Hantken.
Haplophragmium minutum, Reuss.
Marginulina glabra, d'Orbigny.
Cristellaria cultrata (Montfort).
,, *gemmata*, Brady.
,, *rotulata* (Lamarck).
,, *variabilis*, Reuss.
Uvigerina angulosa, Williamson.
,, ,, var. *spinipes*, Brady.
,, *asperula*, Czjzek.
,, ,, var. *ampullacea*, Brady.
,, *pygmæa*, d'Orbigny.
Sagrina columellaris, Brady.
,, *dimorpha* (Parker and Jones).
× *Globigerina æquilateralis*, Brady.
× ,, *bulloides*, d'Orbigny.
× ,, ,, var. *triloba*, Reuss.
× ,, *conglobata*, Brady.
× ,, *inflata*, d'Orbigny.
× ,, *rubra*, d'Orbigny.
× ,, *sacculifera*, Brady.
× *Orbulina universa*, d'Orbigny.
× *Hastigerina pelagica* (d'Orbigny).
× *Pullenia obliquiloculata*, Parker and Jones.
,, *quinqueloba*, Reuss.
Sphæroidina bulloides, d'Orbigny.
Spirillina vivipara, Ehrenberg.
Patellina corrugata, Williamson.
Discorbina rarescens, Brady.
Planorbulina mediterranensis, d'Orbigny.
Truncatulina haidingerii (d'Orbigny).
,, *lobatula* (Walker and Jacob).
,, *reticulata* (Czjzek).
,, *variabilis*, d'Orbigny.
Anomalina ammonoides (Reuss).
,, *ariminensis* (d'Orbigny).
,, *coronata*, Parker and Jones.
,, *grosserugosa* (Gümbel).
× *Pulvinulina canariensis* (d'Orbigny).
,, *elegans* (d'Orbigny).
× ,, *menardii* (d'Orbigny).
× ,, *michelinicana* (d'Orbigny).
× ,, *patagonica* (d'Orbigny).
Rotalia broeckhiana, Karrer.
,, *calcar*, d'Orbigny.
,, *soldanii*, d'Orbigny.
Gypsina inhærens (Schultze).
Polytrema miniaceum (Linné).
Polystomella macella (Fichtel and Moll).

Diatomaceæ.—The following species of Diatoms were observed by Mr. Comber :— Station VIII.

Navicula hennedyii, W. Smith.
,, *lyra*, Ehrenberg, var. *elliptica*, A. Schmidt.
,, *donkinii*, O'Meara.
,, *spectabilis*, Gregory.
,, *clavata*, Gregory.
,, *prætexta*, Ehrenberg.
,, *polysticta*, Greville, var. *circumsecta*, Grunow.
,, *californica*, Greville.
,, *smithii*, Brebisson.
,, *lineatus*, Donkin.
,, *multicostata*, Grunow.
,, *bomboides*, A. Schmidt.
,, *campylodiscus*, Grunow.
,, *aspera*, Ehrenberg.
Nitzschia panduriformis, Gregory.
Surirella lata, W. Smith.
Campylodiscus ralfsii, W. Smith.
,, *horologium*, Williamson.
Triceratium atlanticum, Castracane.
Triceratium pentacrinus, Wallich, forma *tetragona*.
Stictodiscus parallelus, Castracane (= *Triceratium*, Greville), forma *hexagona*.
Actinoptychus undulatus, Ehrenberg.
,, *splendens*, Ralfs.
Coscinodiscus excentricus, Ehrenberg.
,, *nitidus*, Gregory.
,, *lineatus*, Ehrenberg.
,, *auguste-lineatus*, A. Schmidt.
,, *curvatulus*, Grunow.
,, *denarius*, A. Schmidt.
,, *radiatus*, Ehrenberg.
,, *oculus-iridis*, Ehrenberg.
,, *crassus*, Bailey.
,, *elegans*, Greville.
,, *griseus*, Greville.
Ethmodiscus sp. (?).
Melosira arenaria, Moore.

At anchor in Santa Cruz Bay, Tenerife, from 8 a.m. on February 13 till 7.30 p.m. on February 14. At Tenerife

The following species are recorded in the Zoological Reports as having been obtained during the stay at the Canary Islands :— Animals from the Canary Islands.

Ophiuroidea (Lyman, Zool. pt. 14).

Ophionereis dubia (Müller and Troschel) (?). (Gomera); obtained also at Amboina and Fiji (?).

Echinoidea (Agassiz, Zool. pt. 9).

Dorocidaris (*Cidaris*) *papillata* (Leske). (Gomera, 70 fathoms); for distribution see Station 24.

Holothurioidea (Théel, Zool. pt. 39).

Synapta lappa, Müller. Several fragments (Gomera, 70 fathoms); obtained at no other locality by the Challenger. Recorded from West Indies.

Brachyura (Miers, Zool. pt. 49).

Xanthodes melanodactylus, M.-Edwards. One specimen (Gomera, 75 fathoms); obtained also at Cape Verdes and Azores. Recorded from North and South Atlantic.

CANARY ISLANDS.

Neptunus (*Amphitrite*) *hastatus* (Linné). Four specimens (Gomera or Tenerife, 75 or 78 fathoms); obtained at no other locality by the Challenger.

GASTEROPODA (Watson, Zool. pt. 42).

Trochus (*Trochocochlea*) *colubrinus*, Gould. (Rocks at Santa Cruz); obtained at no other locality by the Challenger. Recorded from North Atlantic.

Ranella (*Lampas*) *thomæ*, d'Orbigny. (Rocks at Santa Cruz); obtained at no other locality by the Challenger. Recorded from West Indies and Madeira.

Litorina striata, King. (Shore, Santa Cruz); obtained at no other locality by the Challenger. Recorded from North and South Atlantic.

BRACHIOPODA (Davidson, Zool. pt. 1).

Megerlia truncata (Linné). Many specimens (off Gomera, 70 or 75 fathoms); obtained at no other locality by the Challenger. A widely-distributed species. Fossil—Upper Tertiaries of Europe.

Argiope decollata (Chemnitz). Many specimens (off Gomera, 70 or 75 fathoms); obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil—Miocene and Pliocene of Europe.

TUNICATA (Herdman, Zool. pt. 17).

Ciona flemingi, n.sp. One specimen (Gomera, 75 or 78 fathoms); obtained at no other locality.

In the foregoing list 11 species are enumerated from the shore and shallow water at the Canary Islands, of which 1 is new to science.

STATION 1.

Station 1[1] (Sounding 45), Tenerife to Sombrero (see Charts 5 and 6, and Diagram 1).

February 15, 1873; lat. 27° 24′ N., long. 16° 55′ W.

Temperature of air at noon, 63°·5; mean for the day, 61°·5.

Temperature of water:—

Surface, ...	64°·5	600 fathoms, ...	44°·9
100 fathoms, . . .	61·8	700 „	43·2
200 „ . . .	56·0	800 „	41·8
300 „ . . .	51·7	900 „	40·7
400 „ . . .	49·0	1000 „	39·9
500 „ . . .	46·8	Bottom, . . .	36·8

[1] The preceding Stations, indicated by roman numerals (I. to VIII.), were regarded during the expedition as preliminary Stations to test the working of the apparatus, the regular work of the Expedition commencing at this Station (see page 109 ante).

Density of water at 60° F. at surface, 1·02730; bottom, 1·02650. STATION 1.

Depth, 1890 fathoms; deposit, Globigerina Ooze, containing 50 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 8 A.M. sounded in 1890 fathoms, when a water-bottle was sent down for the first time with the sounding lead. At 9 A.M. the dredge was put over At noon Siemens' thermometric apparatus was tried for the first time down to a depth of 1000 fathoms, with fair results. At 1.30 P.M. commenced to haul in dredge, and at 2 P.M. obtained temperatures at various depths by means of thermometers and Siemens' apparatus. The dredge came up empty at 4 P.M., having probably fouled the rope in paying out.

Position at noon about 40 nautical miles south of the southern extremity of Tenerife Island; Sombrero Island distant 2620 miles. Made good 76 miles. Amount of current 8 miles, direction S. 75° W.

ORGANISMS FROM SURFACE-NETS.

Surface Organisms.—The following are recorded in the note-books as having been captured at the surface :—

Peridinium; Diphyes; Sagitta; Alciopa, Terebella; Hyalophyllum [= *Saphirinella*], *Copilia, Hyperia, Phronima, Mysis,* Zoëæ; *Atlanta, Firoloida; Styliola, Diacria* [= *Cavolinia*], *Heterofusus* (?) [= *Limacina*]; Cephalopod; *Salpa, Appendicularia, Doliolum;* and young fishes.

February 16, 1873.

ORGANISMS FROM SURFACE-NETS.

Surface Organisms.—The following are recorded in the note-books as having been captured in the surface tow-nets, which skimmed the surface only as the vessel was moving fast:—Siphonophoræ, Copepods, *Idothea, Lucifer, Phyllosoma,* many Zoëæ, *Cavolinia, Styliola,* two empty shells of *Spirula.*

Willemoes-Suhm writes: "I found a young specimen belonging to the Saphirinæ with two long pigment bodies, but only one large cornea; perhaps it may divide later, or it may be that this is a species in which the cornea is undivided. We found for the first time the singular genus *Lucifer,* which is referred by Claus to the Decapods, and by Gerstaecker to a family intermediate between the Squillinæ and the Schizopods."

Station 2 (Sounding 46), Tenerife to Sombrero (see Chart 6 and Diagram 1).

STATION 2.

February 17, 1873; lat. 25° 52′ N., long. 19° 22′ W.

Temperature of air at noon, 65°·3; mean for the day, 64°·2.

Station 2.

Temperature of water :—

Surface,	67·0	500 fathoms,	46·0
50 fathoms,	67·0	600 ,,	44·2
100 ,,	62·0	700 ,,	42·9
200 ,,	56·0	800 ,,	41·9
300 ,,	52·1	900 ,,	41·0
400 ,,	48·8	Bottom,	36·8

Density at 60° F. at surface, 1·02739 ; bottom, 1·02602.

Depth, 1945 fathoms; deposit, Globigerina Ooze, containing 64·55 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 5.15 A.M. put over dredge, veering 2700 fathoms. At 7 A.M. sounded in 1945 fathoms. At 8 A.M. the barge went away to obtain a series of temperatures at various depths, and returned at 1.30 P.M. At 1.30 P.M. commenced heaving in dredge, which came up at 3.30 P.M. half full of Globigerina Ooze.

Position at noon, about 260 miles west of Cape Bojador; Sombrero Island distant 2482 miles. Made good 95 miles. Amount of current 10 miles, direction S. 11° W.

Animals from Dredge.

The following species is recorded from the dredge at this Station :—

CEPHALOPODA (Hoyle, Zool. pt. 44).

Mastigoteuthis agassizii, Verrill. Fragments of tentacles; obtained at no other locality by the Challenger. Recorded from North Carolina.

In addition to the above Cephalopod fragment, the dredge contained a mutilated specimen of a worm belonging to the Gephyrea, thus described by Willemoes-Suhm: "The animal shows characters of both the Sipunculacea and the Priapulacea: it has no tentacles (Priapulacea); the anus is near the mouth in the anterior part of the body (Sipunculacea); and it has no proboscis (Priapulacea). The pharynx is very short, and is attached to the walls of the body by four retractores. The pharynx shows six or seven folds, being composed of prominences covered by 'Pflasterepithel,' and at their ends by a chitinous border. At the entrance of the mouth these papillæ with chitinous borders are more pointed and stronger; in each are seen some unicellular glands, granular bodies showing a nucleus and a nucleolus. Owing to the state of the specimen, nothing can be said about the rest of the body."

Organisms from the Deposit.

FORAMINIFERA (Brady, Zool. pt. 22).—The ooze was carefully sifted, and was found to contain many otoliths of fishes and Pteropod shells (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.). The following species of Foraminifera were also observed;

the pelagic species, which make up about 85 per cent. of the carbonate of lime present in the deposit, are marked thus × :— STATION 2.

Biloculina depressa, d'Orbigny.
Miliolina seminulum (Linné).
,, *venusta* (Karrer).
,, sp. (?).
Pelosina cylindrica, Brady.
Psammosphæra fusca, Schulze.
Hyperammina elongata, Brady.
,, *ramosa*, Brady.
,, *vagans*, Brady.
Rhizammina algæformis, Brady.
Reophax fusiformis (Williamson).
,, *scorpiurus*, Montfort.
Haplophragmium agglutinans (d'Orbigny).
,, *globigeriniforme* (Parker and Jones).
,, *rotulatum*, Brady.
Ammodiscus gordialis (Jones and Parker).
Trochammina pauciloculata, Brady.
,, *squamata*, Jones and Parker.
,, *trullissata*, Brady.
Textularia agglutinans, d'Orbigny.
Bigenerina capreolus (d'Orbigny).
Gaudryina pupoides (d'Orbigny).
Pleurostomella subnodosa, Reuss.
Cassidulina subglobosa, Brady.
Lagena auriculata, Brady.
,, *marginata* (Walker and Boys).
,, *orbignyana* (Seguenza).
,, *truncata*, Brady.
Nodosaria communis, d'Orbigny.
Uvigerina pygmæa, d'Orbigny.
× *Globigerina æquilateralis*, Brady.
× ,, *bulloides*, d'Orbigny.
× ,, ,, var. *triloba*, Reuss.
× ,, *conglobata*, Brady.
× ,, *dubia*, Egger.
× ,, *inflata*, d'Orbigny.
× ,, *rubra*, d'Orbigny.
× ,, *sacculifera*, Brady.
× *Orbulina universa*, d'Orbigny.
× *Hastigerina pelagica* (d'Orbigny).
× *Pullenia obliquiloculata*, Parker and Jones.
× *Sphæroidina dehiscens*, Parker and Jones.
Discorbina allomorphinoides (Reuss).
,, *patelliformis*, Brady.
Truncatulina haidingerii (d'Orbigny).
,, *refulgens* (Montfort).
,, *wuellerstorfi* (Schwager).
× *Pulvinulina canariensis* (d'Orbigny).
× ,, *crassa* (d'Orbigny).
,, *elegans* (d'Orbigny).
× ,, *menardii* (d'Orbigny).
× ,, ,, var. *fimbriata*, Brady.
× ,, *micheliniana* (d'Orbigny).
,, *pauperata*, Parker and Jones.
× ,, *tumida*, Brady.
,, sp. (?).
Rotalia broeckhiana, Karrer.
,, *orbicularis*, d'Orbigny.
,, *soldanii*, d'Orbigny.

Surface Organisms.—The following are recorded in the note-books as having been captured in the surface tow-nets :— ORGANISMS FROM SURFACE-NETS.

Acanthometra, *Collosphæra*; *Physalia*, *Rhizophysa filiformis* (?), *Diphyes*, *Cuboides*; *Calanella* [= *Eucalanus*], *Hyalophyllum* [= *Saphirinella*], *Corycæus*, *Hyperia*, *Lucifer*, Zoëæ ; *Styliola*, *Hyalæa* [= *Cavolinia*] ; *Appendicularia*, *Doliolum*.

Moseley writes : "A large *Physalia* was caught, and I obtained good preparations of the cnidæ by placing one of the nematophorous threads at full stretch on a glass slip and allowing it to dry there. As the thread dried all the cells shot their threads, and these latter formed a fluffy margin to the dried mass plainly visible to the naked eye. By drying a thread rapidly over a spirit-lamp preparations were obtained in which the threads were not ejected."

Station 3.

Station 3 (Sounding 47), Tenerife to Sombrero (see Chart 6 and Diagram 1).

February 18, 1873; lat. 25° 45′ N., long. 20° 14′ W.
Temperature of air at noon, 67°·8; mean for the day, 66°·6.
Temperature of water at surface, 65°·0; bottom, 37°·0.
Density at 60° F. at surface, 1·02719.
Depth, 1525 fathoms; deposit, Pteropod Ooze, containing about 70 per cent. of carbonate of lime, manganese concretions, and dead fragments of Coral coated with manganese (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 9 A.M. sounded in 1525 fathoms, but the machine brought up no bottom; sounded again in 1530 fathoms with a similar result. At 10 A.M. lowered dredge with 2 cwt. at 300 fathoms from it, and with 2200 fathoms of line. At 1 P.M. boats went away to pick up surface animals, and returned at 4 P.M., when the trawl was put over. At 5.30 P.M. the dredge came up with many specimens; a small quantity of the deposit was obtained from the basal portions of the large Sponges. At 7 P.M. hauled in the trawl.

Position at noon, 160 miles south-west of the island of Ferro; Sombrero Island distant 2438 miles. Made good 46 miles. Amount of current 9 miles, direction W.

The following species are recorded in the Zoological Reports from the dredge and trawl at this Station:—

Animals from Dredge and Trawl.

HEXACTINELLIDA (Schulze, Zool. pt. 53).

Poliopogon amadou, Wyville Thomson, n.g., n.sp. Two specimens; obtained at no other locality. The only other species of the genus (*Poliopogon gigas*) was obtained at Station 170A, 630 fathoms.

ALCYONARIA (Wright and Studer, Zool. pt. 64).

Anthomastus canariensis, n.sp. One specimen; obtained at no other locality.

Pleurocorallium johnsoni, Gray. Many fragments (coated with peroxide of manganese); obtained also at Station 35, 1125 fathoms. Recorded from Madeira.

Acanella arbuscula (Johnson). Several specimens; obtained at no other locality by the Challenger. Recorded from North Atlantic.

CORALS (Moseley, Zool. pt. 7).

Cryptohelia pudica, M.-Edwards and Haime. Several specimens; obtained also at Stations 24, 171, 236 and 320, 390 to 775 fathoms. Recorded from New Guinea and South Pacific.

Caryophyllia berteriana, Duchassaing. One specimen and fragments; obtained at no other locality by the Challenger.

ASTEROIDEA (Sladen, Zool. pt. 51). STATION 3.

Nymphaster protentus, n.g., n.sp. Obtained at no other locality. Recorded subsequently from Indian Ocean ("Investigator").

Colpaster scutigerula, n.g., n.sp. One specimen; obtained at no other locality. Only species of the genus.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophiacantha nodosa, n.sp. One injured specimen; obtained at no other locality.

Ophiomitra chelys (Wyville Thomson), n.sp. Several specimens; obtained also at Stations 33 (var. ?) and 85, 435 and 1125 fathoms. Recorded subsequently from North Atlantic ("Blake").

ANNELIDA (M'Intosh, Zool. pt. 34).

Chloenea atlantica, n.sp. Two specimens (found on the Sponge *Poliopogon amadou*); obtained at no other locality.

Polynoë (*Robertianella*) *synophthalma*, n.sp. One injured specimen; obtained also at Station 124, 1600 fathoms.

Dalhousia atlantica, n.g., n.sp. One specimen; obtained at no other locality. Only species of the genus.

POLYZOA (Busk, Zool. pt. 30).

Bugula leontodon, n.sp. Obtained at no other locality.

In addition to the foregoing, the following are recorded in the Station-book:—Several other Sponges (besides *Poliopogon amadou*), a Hydroid Zoophyte, and a Gammarid Crustacean, which seemed to be identical with *Eusirus cuspidatus*.

Excluding Protozoa, over 50 specimens of invertebrates were procured at this Station, belonging to about 25 species, of which 10 are new to science, including representatives of 4 new genera; 8 of the new species and 2 of the new genera were not obtained elsewhere.

Willemoes-Suhm writes: "The dredge brought up among other things a beautiful Palmyrid with large white palettes, having besides these apparently no setigerous feet at all. There was another Annelid allied to the Syllids, which I have drawn, and one Heteronereid animal, living in Professor Thomson's new sponge, which was very much damaged. There was also a little Gammarid with large pairs of claws on a pair of the ambulatory legs."

Station 3. Organisms from the Deposit.

Pteropoda (Pelseneer, Zool. pt. 65).—The following species of Pteropoda were observed in the deposit from this Station :—

Limacina inflata (d'Orbigny).
,, *lesueuri* (d'Orbigny).
,, *bulimoides* (d'Orbigny).
Clio (Styliola) subula (Quoy and Gaimard).
Clio pyramidata, Linné.
Cavolinia quadridentata (Lesueur).
,, *inflexa* (Lesueur).

Organisms from Surface-Nets.

Surface Organisms.—The following are recorded as having been obtained in the surface tow-nets on this date :—

Annelida (M'Intosh, Zool. pt. 34).

Halodora reynaudii, Andouin and M.-Edwards (?).

Amphipoda (Stebbing, Zool. pt. 67)

Phronimella elongata, Claus.

In addition, the following are mentioned in the note-books :—*Collosphæra* and *Acanthometra* in enormous abundance on the very surface; small Medusæ, *Agalma* (without air-bladder), *Diphyes*, *Physalia*, *Velella;* many Copepods, *Thaumops pellucida* [= *Cystisoma spinosum*], large larva of Decapod, *Ianthina*, *Pterotrachea*, *Hyalæa* [= *Cavolinia*], *Styliola*, *Octopus*; *Oikopleura*.

Willemoes-Suhm writes : "In the morning another specimen of *Thaumops pellucida* was captured by the tow-net. It does not show the genital papilla nor the enlarged claw of the fifth pair of legs; it seems to be a male, but is very much spoiled. The trawl brought up a *Phronimella elongata*."

Moseley writes : "I went out with Murray in a boat to search for surface animals. The sun was shining brightly, yet I caught three Pteropods swimming in the most lively manner on the very surface, so high as to break the water around them, and thus become conspicuous. Radiolarians (*Collosphæra*, &c.), abounded in an astonishing manner, the surface being in places quite full of them, and a single scoop of the net bringing up thirty or forty. Sometimes they were aggregated into circular patches containing a dozen or more, and at others attached to one another in strings of four or five; the majority were free. Large *Velellæ*, *Physalia*, and *Ianthina* were abundant. I examined the colouring matter of *Ianthina* with the spectroscope, and found that it gave a different spectrum in acid and alkaline solutions. The flies first began to be troublesome to-day and suddenly swarmed everywhere; they even accompanied Murray and me in our boat excursion in such numbers as to be a pest."

Station 4 (Sounding 48), Tenerife to Sombrero (see Chart 6 and Diagram 1). STATION 4.

February 19, 1873; lat. 25° 28′ N., long. 20° 22′ W.
Temperature of air at noon, 67°·8; mean for the day, 66°·1.
Temperature of water:—

Surface,	66·0°	800 fathoms,	42·0°
100 fathoms,	63·0	900 "	41·2
200 "	56·8	1000 "	40·5
300 "	52·0	1100 "	39·9
400 "	49·0	1200 "	39·3
500 "	46·3	1300 "	38·7
600 "	44·3	1400 "	38·1
700 "	43·0	1500 "	37·5

Density at 60° F. at surface, 1·02720.
Depth, 2220 fathoms.

At 9 A.M. sounded in 2220 fathoms, but the weights were not disengaged at the bottom, and the line broke in hauling in, the attached water-bottle, pressure-gauge, thermometers, and 2000 fathoms of line being lost. Took serial temperatures at intervals of 100 fathoms down to 1500 fathoms.

Sombrero Island distant at noon, 2428 miles. Made good 19 miles. Amount of current 4 miles, direction S. 24° W.

Surface Organisms.—The following are recorded in the note-books:—*Collosphæra* and other Radiolaria; *Velella, Physalia;* several large specimens of *Alciopa;* Copepods, *Phronima sedentaria, Idothea,* many larvæ of *Squilla; Cardiopoda,* and small *Octopus* (?). ORGANISMS FROM SURFACE-NETS.

Willemoes-Suhm writes: "The tow-nets captured much more in the last two nights than during the day; at noon, and in the earlier hours of the afternoon especially, the animals seem to retire from the heated surface as much as possible."

Moseley writes: "Went out in a boat at mid-day; a few Radiolarians were noticed. A pilot fish (*Naucrates ductor*) played all day under our bows, keeping quite close to the cut-water, within a foot or two, swimming every now and then a little ahead and then dropping back again. The fish is a Scomberoid, and its dark transverse markings make it a striking object in the deep blue water as one looks down from the bowsprit. A shark was said to have been seen about the ship."

Station 5.

Station 5 (Sounding 49), Tenerife to Sombrero (see Chart 6 and Diagram 1).

February 21, 1873; lat. 24° 20′ N., long. 24° 28′ W.

Temperature of air at noon, 66°·8; mean for the day, 66°·4.

Temperature of water:—

Surface,	68°·0	500 fathoms,	46°·3
100 fathoms,	62·6	1000 ,,	40·0
200 ,,	57·2	1500 ,,	37·5
300 ,,	52·5	Bottom,	37·0
400 ,,	49·0		

Density at 60° F. at surface, 1·02753; bottom, 1·02744.

Depth, 2740 fathoms; deposit, Red Clay, containing 12·00 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 2.15 P.M. proceeded under steam, head to wind as necessary for sounding, and sounded at 3 P.M. in 2740 fathoms. At 5 P.M. put over dredge, with 2 cwt. attached 400 fathoms from the dredge, and at 7.20 P.M. veered dredge-rope to 3400 fathoms. At 1.15 A.M. next morning commenced heaving in dredge, which came up at 5.45 A.M. full of Red Clay.

Position at noon, about 500 miles south-west of Tenerife; Sombrero Island distant 2220 miles. Made good 144 miles. Amount of current 14 miles, direction S. 78° W.

Animals from Dredge.

The following species are recorded in the Zoological Reports from the dredge at this Station:—

OSTRACODA (Brady, Zool. pt. 3).

Cythere dasyderma, n.sp. Widely distributed; obtained at Stations 5, 70, 85, 122, 146, 164, 167, 185, 191, 218, 246, 296, 300, 302, 305, 311, 317, 332, 335, and 346, 150 to 2740 fathoms.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Leda ultima, n.sp. One specimen and single valve; obtained at no other locality.

Limopsis cristata, Jeffreys, var. (?). One specimen and a few odd valves; obtained at no other locality by the Challenger.

Arca (*Scapharca*) *inæquisculpta*, n.sp. One specimen; obtained also at Station 24, 390 fathoms.

In addition, two apparently new forms of Polyzoa are noted in the Station-book.

FORAMINIFERA (Brady, Zool. pt. 22).—The following species of Foraminifera were observed during the examination of the deposit at this Station (see also Murray and

Renard, Deep-Sea Deposits Chall. Exp.); the pelagic species, which make up about 75 per cent. of the carbonate of lime present in the deposit, are marked thus × :— STATION 5.

ORGANISMS FROM THE DEPOSIT.

Biloculina depressa, d'Orbigny.
„ *ringens* (Lamarck).
Miliolina amygdaloides, Brady.
„ *venusta* (Karrer).
Aschemonella catenata (Norman).
Reophax difflugiformis, Brady.
„ *scorpiurus*, Montfort.
Haplophragmium agglutinans (d'Orbigny).
„ *globigeriniforme* (Parker and Jones).
„ *glomeratum*, Brady.
„ *latidorsatum* (Bornemann).
„ *rotulatum*, Brady.
„ *tenuimargo*, Brady.
Thurammina papillata, Brady.
Hormosina globulifera, Brady.
Ammodiscus gordialis (Jones and Parker).
Trochammina galeata, Brady.
„ *trullissata*, Brady.
Webbina clavata, Jones and Parker.
Verneuilina pygmæa (Egger).
Gaudryina pupoides, d'Orbigny.
„ *siphonella*, Reuss.
Bulimina aculeata, d'Orbigny.
Virgulina schreibersiana, Czjzek.
Bolivina punctata, d'Orbigny.
Cassidulina subglobosa, Brady.
Lagena alveolata, Brady.
„ *apiculata*, Reuss.
„ *auriculata*, Brady.
„ *bicarinata* (Terquem).
„ *desmophora*, Rymer Jones.
„ *formosa*, Schwager.
„ *globosa* (Montagu).
Lagena lagenoides (Williamson).
„ *longispina*, Brady.
„ *ovum* (Ehrenberg).
„ *stelligera*, Brady.
„ *striata* (d'Orbigny).
„ *sulcata* (Walker and Jacob).
„ *truncata*, Brady.
Nodosaria communis, d'Orbigny.
Marginulina glabra, d'Orbigny.
Cristellaria convergens, Bornemann.
× *Globigerina æquilateralis*, Brady.
× „ *bulloides*, d'Orbigny.
× „ *conglobata*, Brady.
× „ *dubia*, Egger.
× „ *inflata*, d'Orbigny.
× „ *rubra*, d'Orbigny.
× „ *sacculifera*, Brady.
× *Orbulina universa*, d'Orbigny.
× *Pullenia obliquiloculata*, Parker and Jones.
„ *quinqueloba*, Reuss.
„ *sphæroides* (d'Orbigny).
× *Sphæroidina dehiscens*, Parker and Jones.
Truncatulina lobatula (Walker and Jacob).
„ *pygmæa*, Hantken.
„ *tumidula*, Brady.
× *Pulvinulina crassa* (d'Orbigny).
„ *exigua*, Brady.
× „ *menardii* (d'Orbigny).
× „ *micheliniana* (d'Orbigny).
× „ *tumida*, Brady.
Rotalia soldanii, d'Orbigny.
Nonionina depressula (Walker and Jacob).
„ *umbilicatula* (Montagu).

Oroscena huxleyi, Haeckel, was observed in the deposit among other Radiolaria.

Station 6 (Sounding 50), Tenerife to Sombrero (see Chart 6 and Diagram 1). STATION 6.

February 23, 1873; lat. 23° 14′ N., long. 28° 22′ W.
Temperature of air at noon, 67°·8; mean for the day, 66°·8.
Temperature of water at surface, 69°·2; bottom, 37°·0.
Density at 60° F. at surface, 1·02760; bottom, 1·02745.
Depth, 2950 fathoms; deposit, Red Clay.

Ship going before the north-east trades at an average rate of 7 knots per hour. Several flying fish were observed, and also a number of large specimens of *Physalia*, Station 6 although there was a great deal of motion on the surface of the sea. At 4 P.M. sounded in 2950 fathoms, and at 7.30 P.M. proceeded under all plain sail.

Distance at noon from Sombrero Island, 2013 miles. Made good 164 miles. Amount of current 9 miles, direction S. 77° W.

Station 7.

Station 7 (Sounding 51), Tenerife to Sombrero (see Chart 6 and Diagram 1).

February 24, 1873 ; lat. 23° 23′ N., long. 31° 31′ W.
Temperature of air at noon, 67°·8 ; mean for the day, 67°·5.
Temperature of water at surface, 68°·0 ; bottom, 36°·9.
Density at 60° F. at surface, 1·02763 ; bottom, 1·02609.
Depth, 2750 fathoms ; deposit, Red Clay, containing 4·11 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 3 P.M. shortened sail and got up steam to sound, and at 4.30 P.M. sounded in 2750 fathoms. At 7.30 P.M. proceeded under all plain sail.

Distance at noon from Sombrero Island, 1841 miles. Made good 172 miles. Amount of current 10 miles, direction S. 61° W.

Station 8.

Station 8 (Sounding 52), Tenerife to Sombrero (see Chart 6 and Diagram 1).

February 25, 1873 ; lat. 23° 12′ N., long. 32° 56′ W.
Temperature of air at noon, 72°·8 ; mean for the day, 68°·6.
Temperature of water :—

	°		°
Surface,	67·0	600 fathoms,	44·0
100 fathoms,	64·5	700 ,,	42·5
200 ,,	59·0	800 ,,	41·6
300 ,,	53·4	900 ,,	40·8
400 ,,	49·0	1000 ,,	40·0
500 ,,	46·0	Bottom,	37·0

Density at 60° F. at surface, 1·02773 ; bottom, 1·02613.
Depth, 2700 fathoms ; deposit, Red Clay, containing 16·42 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.30 A.M. the dredge was put over, with 2 cwt. attached 500 fathoms from the dredge, and 3500 fathoms of rope. At 7.30 A.M. sounded in 2700 fathoms. A series of temperatures was obtained at intervals of 100 fathoms down to 1000 fathoms. At 5.15 P.M. dredge came up quite empty, probably never having reached the bottom. Whilst sounding the current-drag was tried, and indicated a south-western current.

Sombrero Island distant at noon, 1730 miles. Made good 111 miles. Amount of current 21 miles, direction S. 7° W.

Station 9 (Sounding 53), Tenerife to Sombrero (see Chart 6 and Diagram 1). STATION 9

February 26, 1873 ; lat. 23° 23′ N., long. 35° 11′ W.
Temperature of air at noon, 75°·3 ; mean for the day, 70°·1.
Temperature of water at surface, 69°·0 ; bottom, 36°·8.
Density at 60° F. at surface, 1·02778 ; bottom, 1·02653.
Depth, 3150 fathoms ; deposit, Red Clay, containing 3·11 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At noon sounded in 3150 fathoms; while sounding a current-drag was put down to a depth of 200 fathoms, and during the whole operation the ship scarcely moved from her position. At 2.15 P.M. the dredge went down with two swabs, and, attached to the iron bar below the dredge, a Hydra-detaching instrument with 3 cwt.; two weights of 1 cwt. each, were attached to the line 200 fathoms in advance of the dredge, 3600 fathoms of line being paid out. At 4.45 P.M. commenced heaving in dredge, which came up at 10.15 P.M. quarter full of Red Clay. This was the deepest dredging which had up to that time been taken. The stem of the Hydra-machine had gone deep into the deposit, and was bent apparently by the dredge and weights falling upon it. The dredge had taken a deep scoop of the clay, and the line was entangled in a coil over the weights.

Sombrero Island distant at noon, 1607 miles. Made good 124 miles. Amount of current 14 miles, direction S. 60° W.

FORAMINIFERA (Brady, Zool. pt. 22).—The following species of Foraminifera were observed during the examination of the deposit at this Station (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.) ; the pelagic species, which make up about 70 per cent. of the carbonate of lime present in the deposit, are marked thus × :— ORGANISMS FROM THE DEPOSIT.

Hyperammina ramosa, Brady.
Reophax nodulosa, Brady.
Haplophragmium rotulatum, Brady.
× *Globigerina bulloides*, d'Orbigny.
× „ *inflata*, d'Orbigny.
× „ *pachyderma* (Ehrenberg) (?).
× *Globigerina rubra*, d'Orbigny.
× *Orbulina universa*, d'Orbigny.
Truncatulina pygmæa, Hantken.
× *Pulvinulina crassa* (d'Orbigny).
× „ *menardii* (d'Orbigny).
× „ *micheliniana* (d'Orbigny).

Two species of Radiolaria (*Haliomma horridum*, Stöhr, and *Octopyle hexastyle*, Haeckel) were also observed in the deposit, of which Professor Thomson wrote : "In the last few Stations the mud has been gradually altering its character, becoming less calcareous and less rich in Foraminifera. This mud consists almost entirely of reddish clay in a state of excessively fine division ; it scarcely effervesces with acid, and there is an almost total absence of calcareous shells. No living thing could be detected except one or two Foraminifera with tests of fine brown grains."

Station 10.

Station 10 (Sounding 54). Tenerife to Sombrero (see Chart 6 and Diagram 1).

February 28, 1873; lat. 23° 10′ N., long. 38° 42′ W.
Temperature of air at noon, 72°·8; mean for the day, 70°·7.
Temperature of water :—

Surface,	71°·0	400 fathoms,	48°·0
10 fathoms,	71·8	500 ,,	44·5
20 ,,	71·8	600 ,,	42·2
30 ,,	71·8	700 ,,	40·8
40 ,,	71·6	800 ,,	40·0
50 ,,	71·4	900 ,,	39·6
60 ,,	71·2	1000 ,,	39·2
70 ,,	70·5	1100 ,,	38·9
80 ,,	69·3	1200 ,,	38·6
90 ,,	68·2	1300 ,,	38·2
100 ,,	67·0	1400 ,,	37·9
200 ,,	58·0	1500 ,,	37·6
300 ,,	52·5	Bottom,	36·5

Density at 60° F. at surface, 1·02774; bottom, 1·02753.

Depth, 2720 fathoms; deposit, Red Clay, containing 13·30 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 7.30 A.M. sounded in 2720 fathoms. Obtained serial temperatures at intervals of 10 fathoms down to 100 fathoms, thence at intervals of 100 fathoms down to 1500 fathoms. The carbonic acid was determined in the bottom water, and found to amount to 40·0 milligrammes per litre.

Distance from Sombrero Island at noon, 1141 miles. Made good 110 miles. Amount of current 12 miles, direction S. 69° W.

Organisms from Surface Nets.

Surface Organisms.—Moseley writes: "Went out in a boat about 1 P.M.; sun very hot and sea rough. I saw one *Velella* and caught a few Copepods, amongst them a *Corycæus* and one or two Radiolarians, one of which last was a social one like *Collosphæra*, but with an intensely violet coloration of the whole contents of each capsule, except the central vesicle. The surface was, however, on the whole very barren; in fact, as oceanic animals generally come to the surface usually in calm weather, it is difficult to understand what their habits must be in the region of the trades. Are there very few in that region? or do those there never come to the surface? or is the fauna different? Three flying fish were seen in the early morning, but they are very scarce."

Willemoes-Suhm made drawings of a small Copepod (male and female), which he thus describes: "It is 0·87 mm. long and 0·35 mm. broad. The genus to which it belongs seems to me to be *Corycæus* [= *Corycæus pellucidus*, Dana (see Brady, Zool. pt. 23, pp. 112-114)], the differences between it and the described species being very peculiar ones, but not important enough to justify a generic separation. The peculiarities consist in a 'processus pectoralis,' receiving the two long pigmented bodies which form parts of the eyes of these Crustaceans, and in the post-abdomen of the female, which has rather an inflated and peculiar form. The male differs from the female, as usual, in having a larger second pair of antennæ, the legs larger and broader, the spine at the end of the abdomen less prominent, and the post-abdomen with larger caudal appendages on the 'furca.' The males are of a greyish colour, while the females, which in our specimens were just bearing empty spermatophores, were of a beautiful blue colour, due for the most part to the vitelli of the eggs in the ovary. They were not remarked in great numbers." Station 10.

Station 11 (Sounding 55), Tenerife to Sombrero (see Chart 6 and Diagram 1). Station 11.

March 1, 1873 ; lat. 22° 45′ N., long. 40° 37′ W.

Temperature of air at noon, 78°·1 ; mean for the day, 70°·3.

Temperature of water :—

Surface,	72·2	120 fathoms,	64·5
20 fathoms,	72·1	140 „	61·3
40 „	72·0	160 „	59·8
60 „	72·0	180 „	59·2
80 „	71·2	200 „	58·6
100 „	67·9	Bottom,	36·5

Density at 60° F. at surface, 1·02767 ; bottom, 1·02621.

Depth, 2575 fathoms ; deposit, Globigerina Ooze, containing 51·16 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.15 A.M. shortened and furled sails, and got up steam to sound. At 7 A.M. sounded in 2575 fathoms. The stop-cock water-bottle was attached 500 fathoms from the Hydra. At 9.55 A.M. the small dredge was sent down with 3000 fathoms of rope, 1 cwt. being attached 300 fathoms in front of the dredge, and later in the day an additional ½ cwt. was slipped down the line. At 11.45 A.M. the current-drag was sent down to a depth of 500 fathoms, and appeared to indicate a considerable surface current, but the drag was lost, probably owing to a slight leak in the current-buoy. Serial temperatures were taken at intervals of 20 fathoms down to 200 fathoms, and samples of water from depths of 500 and 1000 fathoms. At 3 P.M. commenced heaving in dredge, which came up at 5.20 P.M. bottom upwards and quite empty. The upsetting of the dredge was probably owing to the twist in the new rope, as the double chain, to which the dredge was immediately attached, was twisted into a close spiral.

STATION 11.

Distance from Sombrero Island at noon, 1307 miles. Made good 109 miles. Amount of current 12 miles, direction W.

ORGANISMS FROM THE SURFACE.

Surface Organisms.—A few surface animals were taken in the tow-net from a boat, including a beautiful young specimen of *Rhizophysa*.

Moseley writes: "We seem to have got into a region where forms allied to *Corycæus* abound; I saw three species this morning. A large animal, which I believe to have been a grampus (*Orca gladiator*), but which some of the sailors thought to have been a shark, was about the ship for some time. It appeared to be 20 or 25 feet long, and showed the white on its belly and under side of the fins well; I also saw the dorsal fin out of the water once."

STATION 12.

Station 12 (Sounding 56), Tenerife to Sombrero (see Chart 6 and Diagram 1).

March 3, 1873; lat. 21° 57′ N., long. 43° 29′ W.

Temperature of air at noon, 73°·8; mean for the day, 71°·9.

Temperature of water at surface, 73°·0; bottom, 36°·9.

Density at 60° F.:—

Surface, . . .	1·02761	980 fathoms, . .	1·02611
400 fathoms, . .	1·02634	Bottom, . . .	1·02641

Depth, 2025 fathoms; deposit, Globigerina Ooze, containing 44·88 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.45 A.M. shortened and furled sails, and proceeded under steam to sound and dredge. At 8 A.M. sounded in 2025 fathoms, and at 8.45 A.M. put over dredge and current-drag. At 9 A.M. boat put off to test current, and returned at 11 A.M. At 10 A.M. naturalists went out in boat to collect surface animals. At 2 P.M. Siemens' resistance coil was lowered and temperatures obtained at different depths. At 4 P.M. the dredge came up empty, having fouled the lower part of the dredge-rope.

Position at noon, 1140 miles from Sombrero Island. Made good 84 miles. Amount of current 16 miles, direction S. 74° W.

ORGANISMS FROM SURFACE NETS.

Surface Organisms.—Moseley writes: "The tow-net put out at night (March 2–3) brought up specimens of *Phyllosoma*, *Lucifer*, *Corycæus*, and *Calanella* [=*Eucalanus*]. With a boat were obtained two specimens of *Glaucus* and several fine specimens of *Porpita*, on which *Glaucus* is said to feed. *Glaucus* is very active in its movements and reminds one rather of a turtle in the way in which it floats with its head up. When turned on its back it recovers its position at once by a vigorous motion of its large swimming appendages. Some shells of *Spirula* picked up on the surface were infested with Cirripeds, *Acineta*, and

Diatoms. Oscillatoriaceæ (*Trichodesmium* ?) were present in considerable quantities in the tow-net, but in isolated small bundles, not in masses as they are said to occur frequently." STATION 12.

Station 13 (Sounding 57), Tenerife to Sombrero (see Chart 6 and Diagram 1). STATION 13.

March 4, 1873; lat. 21° 38′ N., long. 44° 39′ W.

Temperature of air at noon, 75°·3; mean for the day, 72°·9.

Temperature of water :—

Surface,	72·0°	900 fathoms,	39·1°
100 fathoms,	66·0	1000 ,,	38·7
200 ,,	60·3	1100 ,,	38·3
300 ,,	54·5	1200 ,,	38·0
400 ,,	49·5	1300 ,,	37·7
500 ,,	45·0	1400 ,,	37·4
600 ,,	42·0	1500 ,,	37·2
700 ,,	40·5	Bottom,	36·8
800 ,,	39·7		

Density at 60° F. :—

Surface,	1·02777	300 fathoms,	1·02661
200 fathoms,	1·02775	Bottom,	1·02695

Depth, 1900 fathoms; deposit, Globigerina Ooze, containing 74·50 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6 A.M. sounded in 1900 fathoms, and at 7.30 A.M. put over dredge with $1\frac{1}{2}$ cwt. attached at 500 fathoms from it, with 2600 fathoms of rope. The tow-net had been out all night, and in the morning was found to contain some interesting specimens. At 10 A.M. sent down a stop-cock water-bottle to 300 fathoms, and slip water-bottle to the bottom, and obtained serial temperatures. At 1.30 P.M. commenced heaving in dredge, which came up about 4 P.M. with several specimens.

Sombrero Island distant at noon, 1074 miles. Made good 68 miles. Amount of current 16 miles, direction S. 73° W.

The following species are recorded in the Zoological Reports from the dredge at this Station :— ANIMALS FROM DREDGE.

MACRURA (Spence Bate, Zool. pt. 52).

Willemœsia leptodactyla (Willemoes-Suhm), n.g., n.sp. One specimen (of a fine red colour when brought up); obtained also at Stations 133, 298, and 300, 1375 to 2225 fathoms. Recorded subsequently from off Sardinia ("Washington").

Bentheocaris stylorostratis, n.g., n.sp. Two specimens; obtained at no other locality.

STATION 13.

POLYZOA (Busk, Zool. pt. 30).

Farciminaria delicatissima, n.sp. Obtained also at Stations 14, 64, 68, 89, and 106, 1850 to 2700 fathoms.

Bifaxaria reticulata, n.g., n.sp. Two or three fragments; obtained also at Station 68, 2175 fathoms.

Salicornaria magnifica, n.sp. Obtained also at Stations 122, 157, and 323, 350 to 1950 fathoms.

Tessaradoma boreale (Busk). Obtained also at Station 23, 450 fathoms. Recorded from North Atlantic and Arctic.

BRACHIOPODA (Davidson, Zool. pt. 1).

Terebratula sp. (?). Two fragments (too incomplete for identification).

In addition to the foregoing, the following are recorded in the Station-book :—An undescribed Sponge looking like a Polyzoon, three specimens of *Leda* sp.(?), and three specimens of a Gasteropod allied to *Solarium*.

Excluding Protozoa, about 20 specimens of invertebrates were procured at this Station, belonging to about 10 species, of which 5 are new to science, including representatives of 3 new genera ; one of the new species was not obtained elsewhere.

Willemoes-Suhm writes : "The fine red Decapod got in the dredge does not differ in character from the Astacidæ family, except in having pairs of claws on all the legs, the Astacidæ having them only on three pairs. The shrimp obtained seems to be allied to *Palæmon*.

ORGANISMS FROM THE DEPOSIT.

FORAMINIFERA (Brady, Zool. pt. 22). — The following species of Foraminifera were observed during the examination of the deposit at this Station (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.) ; the pelagic species, which make up about 88 per cent. of the carbonate of lime present in the deposit, are marked thus × :—

Biloculina depressa, d'Orbigny.
Miliolina gracilis (d'Orbigny) (?).
,, *seminulum* (Linné).
,, *venusta* (Karrer).
Pelosina rotundata, Brady (?).
Rhizammina algæformis, Brady.
Haplophragmium emaciatum, Brady.
Trochammina trullissata, Brady.
Gaudryina pupoides, d'Orbigny.
Valvulina fusca (Williamson).
Virgulina subsquamosa, Egger.
Cassidulina crassa, d'Orbigny.
,, *parkeriana*, Brady.
,, *subglobosa*, Brady.
Lagena apiculata, Reuss.
,, *desmophora*, Rymer Jones.
,, *formosa*, Schwager.
,, *longispina*, Brady.
,, *orbignyana* (Seguenza) (?).
,, *quadricostulata*, Reuss.
,, *truncata*, Brady.
Nodosaria communis, d'Orbigny.

STATION 13.

Nodosaria (*Glandulina*) *rotundata*, Reuss.
,, sp. (?).
Polymorphina lactea (Walker and Jacob).
,, *sororia*, Reuss.
× *Globigerina æquilateralis*, Brady.
× ,, *bulloides*, d'Orbigny.
× ,, ,, var. *triloba*, Reuss.
× ,, *conglobata*, Brady.
× ,, *dubia*, Egger.
× ,, *inflata*, d'Orbigny.
× ,, *rubra*, d'Orbigny.
× ,, *sacculifera*, Brady.
× *Orbulina universa*, d'Orbigny.
× *Hastigerina pelagica* (d'Orbigny).
× *Pullenia obliquiloculata*, Parker and Jones.
,, *quinqueloba*, Reuss.
,, *sphæroides* (d'Orbigny).
× *Sphæroidina dehiscens*, Parker and Jones.
× *Candeina nitida*, d'Orbigny.
Discorbina araucana (d'Orbigny).
Truncatulina wuellerstorfi (Schwager).
× *Pulvinulina canariensis* (d'Orbigny).
× ,, *crassa* (d'Orbigny).
× ,, *menardii* (d'Orbigny).
× ,, *micheliniana* (d'Orbigny).
,, *pauperata*, Parker and Jones.
Rotalia broeckhiana, Karrer.
,, *soldanii*, d'Orbigny.

ORGANISMS FROM SURFACE-NETS.

Surface Organisms.—The following species is recorded from the surface at this Station :—

FISHES (Günther, Zool. pt. 78).

Leptocephalus pellucidus.

In addition, the following are recorded in the note-books :—Oscillatoriaceæ (*Trichodesmium* ?); large Medusa, Diphyidæ; *Alciopa; Cypridina, Phronima, Hyperia, Oxycephalus* (?), *Phyllosoma, Lucifer; Halobates; Oxygyrus, Pterotrachea, Cuvierina; Salpa.*

Willemoes-Suhm writes : "In the tow-net to-day we got, for the first time, *Halobates*—the representative of *Hydrometra* in sea-water; we also got *Oxygyrus*. The Hyperinæ were represented by *Hyperia*, *Phronima*, and two examples of a genus very nearly allied to *Oxycephalus*. The head in these two examples is elongated and very peculiar, and in the male is armed with two pairs of antennæ, the inferior of which are folded up four times and are longer than the whole animal. The anterior have a 'schaft' to which is attached the antenna, showing sensitive hairs (Riechhaare, Hensen). The body consists of six segments, in the last of which is the genital papilla in both sexes, and to which are attached six pairs of limbs. The fifth and sixth pairs have the first joint very much enlarged. *Oxycephalus* seems to have seven pairs, and this is the only difference I can find separating it from that genus. Underneath the large eyes covering the head, an otolith is to be observed above the brain. The stomach shows a square epithelium; the heart is very long, extending from the first to the sixth segments."

Station 14 (Sounding 58), Tenerife to Sombrero (see Chart 6 and Diagram 1). STATION 14.

March 5, 1873; lat. 21° 1′ N., long. 46° 29′ W.
Temperature of air at noon, 76°·8; mean for the day, 73°·1.
Temperature of water at surface, 74°·0; bottom, 36°·8.

STATION 14

Density at 60° F. at surface, 1·02756.

Depth, 1950 fathoms; deposit, Globigerina Ooze, containing 70·43 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 9 A.M. trawl with beam of 22 feet was sent down. At 10 A.M. sounded in 1950 fathoms, and sent down slip water-bottle. The latter was embedded in the ooze, a portion of which getting in between the cylinder and the lower surface, the water was not retained in the bottle. A stop-cock water-bottle, which had been attached at 1000 fathoms from the bottom, closed in lowering down, and in consequence collapsed in the deep water. The trawl came up at 5 P.M. containing very few specimens. The beam was broken through the centre, and otherwise most singularly twisted and torn by the great pressure to which it had been subjected; the wood was compressed, so as to reduce the diameter of the beam by half an inch, and the knots projected.

Sombrero Island distant at noon, 972 miles. Made good 110 miles. Amount of current 12 miles, direction S. 37° W.

ANIMALS FROM TRAWL.

The following species is recorded from the trawl at this Station :—

POLYZOA (Busk, Zool. pt. 30).

Farciminaria delicatissima, n.sp. For distribution see Station 13.

In addition to the above, other Polyzoa and a siliceous Sponge are recorded in the Station-book, in which is written : "Moseley, who has put Sponge and Polyzoa into Canada balsam, says there are three species of them, the one being *Naresia* [= *Kinetoskias*] *cyathus*."

STATION 15.

Station 15 (Sounding 59), Tenerife to Sombrero (see Chart 6 and Diagram 1).

March 6, 1873; lat. 20° 49′ N., long. 48° 45′ W.

Temperature of air at noon, 72°·8; mean for the day, 71°·8.

Temperature of water :—

	°		°
Surface,	72·5	900 fathoms,	39·8
100 fathoms,	66·5	1000 ,,	39·3
200 ,,	60·3	1100 ,,	38·8
300 ,,	53·8	1200 ,,	38·3
400 ,,	47·5	1300 ,,	37·9
500 ,,	43·2	1400 ,,	37·5
600 ,,	41·6	1500 ,,	37·1
700 ,,	40·7	Bottom,	36·2
800 ,,	40·2		

Density at 60° F. :— STATION 15.

Surface, . . .	1·02768	500 fathoms, . .	1·02722
300 fathoms, . .	1·02648	Bottom, . . .	1·02616

Depth, 2325 fathoms; deposit, Globigerina Ooze, containing 67·60 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 8 A.M. passed small quantity of gulf-weed. At 11.30 A.M. shortened and furled sails and got up steam to sound. At 1 P.M. sounded in 2325 fathoms, and sent down thermometer and slip water-bottle. At 2 P.M. life-boat was lowered, and naturalists went away to collect gulf-weed and surface animals; returned at 4.45 P.M. Took serial temperatures at intervals of 100 fathoms down to 1500 fathoms, and proceeded under all plain sail.

Sombrero Island distant at noon, 844 miles. Made good 126 miles. Amount of current 11 miles, direction N. 69° W.

ORGANISMS FROM THE SURFACE.

Surface Organisms.—The following are recorded in the note-books as having been procured among the gulf-weed:—*Campanularia;* Dendrocœlous Planarians, *Spirorbis; Lepas, Balanus, Mysis, Palæmon* (?), *Nautilograpsus*, larger Brachyuran; *Scyllæa pelagica; Flustra; Antennarius.* A grampus and many flying-fish were seen this morning.

Moseley writes: "We now began to see plenty of patches of gulf-weed (*Sargassum bacciferum*). I was astonished at its light yellow colour, as I had only seen dark dried specimens. Amongst the weed procured with a boat were the nests of the well-known little fish *Antennarius.* The nests consist of irregularly spherical masses of the weed, fastened together by means of highly elastic threads, which look like wetted cotton, indeed I took it for such at first sight; in the centre of the masses are the eggs. A fish was caught and was observed to use his pectoral fin as a regular prehensile organ to lay hold of the weed with; the end of the long armed fin looks very like the hand of a frog."

Station 16 (Sounding 60), Tenerife to Sombrero (see Chart 6 and Diagram 1). STATION 16.

March 7, 1873; lat. 20° 39′ N., long. 50° 33′ W.

Temperature of air at noon, 75°·8; mean for the day, 73°·1.

Temperature of water at surface, 74°·0; bottom, 36°·2.

Density at 60° F. :—

Surface, . . .	1·02770	400 fathoms, . .	1·02615
200 fathoms, . .	1·02679	500 „ . . .	1·02753
300 „ . . .	1·02660	Bottom, . . .	1·02751

Depth, 2435 fathoms; deposit, Globigerina Ooze, containing 52·22 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

Station 16. At 8 A.M. put dredge over and veered 3000 fathoms. At 10 A.M. sounded in 2435 fathoms. At 1.20 P.M. commenced heaving in dredge, which came up at 4.15 P.M. containing a considerable quantity of ooze, along with manganese concretions, sharks' teeth (two *Oxyrhina* and one *Lamna*) and valves of *Scalpellum* coated with manganese.

Sombrero Island distant at noon, 744 miles. Made good 101 miles. Amount of current 7 miles, direction S. 72° W.

Animals from Dredge. The following species is recorded from the dredge at this Station :—

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Arca (*Barbatia*) *pteroessa*, n.sp. Two specimens; obtained also at Stations 24, 71, 73, 237, and 246, 390 to 2050 fathoms. Recorded subsequently from Indian Ocean ("Investigator") (?).

Station 17.

Station 17 (Sounding 61), Tenerife to Sombrero (see Chart 6 and Diagram 1).

March 8, 1873; lat. 20° 7′ N., long. 52° 32′ W.

Temperature of air at noon, 75°·8; mean for the day, 73°·7.

Temperature of water :—

	°		°
Surface,	74·0	900 fathoms,	39·9
100 fathoms,	69·5	1000 ,,	39·4
200 ,,	62·0	1100 ,,	39·0
300 ,,	54·5	1200 ,,	38·5
400 ,,	48·5	1300 ,,	38·0
500 ,,	44·7	1400 ,,	37·5
600 ,,	42·5	1500 ,,	37·1
700 ,,	41·2	Bottom,	36·5
800 ,,	40·4		

Density at 60° F. at surface, 1·02766; 1370 fathoms, 1·02607.

Depth, 2385 fathoms; deposit, Globigerina Ooze, containing 58·40 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 1.35 P.M. shortened and furled sails, and got up steam to sound. At 2.30 P.M. sounded in 2385 fathoms. Took a series of temperatures at intervals of 100 fathoms down to 1500 fathoms. Naturalists went away in the whaler to collect surface animals. At 5.30 P.M. completed sounding and made sail.

Sombrero Island distant at noon, 642 miles. Made good 103 miles. Amount of current 2 miles, direction S. 73° W.

Organisms from Surface Nets. **Surface Organisms.**—Moseley writes: "Murray and I went away in a boat; the surface was most remarkably destitute of animal life, but full of Oscillatoriaceæ (*Trichodes-*

mium). No gulf-weed was to be seen. At night four specimens of *Halobates* were taken in the surface-net alive; when diving the insect is covered with a film of air like its near fresh-water relative *Hydrometra*, and swims in a very similar manner." STATION 17.

March 9, 1873.

Surface Organisms.—Moseley writes: "A dolphin (*Coryphæna*)[1] about a foot long was caught at the bows, this being the first. The boatswain hauled another much larger one out of the water, but the hook broke. A line I put out astern pulled the jaws off another. Gulf-weed is floating past again in considerable quantities, but still merely in small masses. There are numbers of flying-fish about. The surface-net taken in at 6 A.M. contained *Salpæ*, *Leptocephali*, and *Phyllosoma* in abundance."

Station 18 (Sounding 62), Tenerife to Sombrero (see Chart 6 and Diagram 1). STATION 18.

March 10, 1873; lat. 19° 41′ N., long. 55° 13′ W.

Temperature of air at noon, 74°·8; mean for the day, 74°·0.

Temperature of water:—

	°		°
Surface,	74·0	450 fathoms,	45·0
50 fathoms,	73·5	500 ,,	43·2
100 ,,	69·8	550 ,,	41·8
150 ,,	64·5	600 ,,	41·2
200 ,,	60·0	650 ,,	40·7
250 ,,	56·7	700 ,,	40·4
300 ,,	53·5	800 ,,	40·0
350 ,,	50·5	Bottom,	36·0
400 ,,	47·8		

Density at 60° F. at surface, 1·02732; bottom, 1·02615.

Depth, 2650 fathoms; deposit, Red Clay, containing 15·78 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 7.15 A.M. put dredge over. At 9.30 A.M. sounded in 2650 fathoms. Took serial temperatures at intervals of 50 fathoms down to 700 fathoms. At 2 P.M. commenced heaving in dredge, which came up empty at 4.50 P.M., except that it contained a young *Pyrosoma* and a small fish with very minute eyes, possibly from the bottom. Life-boat away collecting gulf-weed and surface animals.

Distance from Sombrero Island at noon, 472 miles. Made good 84 miles. Amount of current 15 miles, direction S. 79° W.

Surface Organisms.—Moseley writes: "Plenty of gulf-weed about. Five specimens of *Antennarius* were brought in and two nests. Five or six dolphins (*Coryphæna*) were about the ship, swimming leisurely round and round. When seen under water the ORGANISMS FROM THE SURFACE.

[1] This is the "dying dolphin" of sailors, and the expression "the dying dolphin's changing hues" refers to this fish and not to the Cetacean.

Station 18. back appears of a deep blue, the tail a brilliant yellow, the pectoral fins white. They would not take a bait; the 'grains[1]' were tried, a bottle being dropped on the water with a string to attract the fish, but without success. A small shark with two pilot fish came alongside and twice took a bait, but was not hooked."

Station 19.

Station 19 (Sounding 63), Tenerife to Sombrero (see Chart 6 and Diagram 1).

March 11, 1873; lat. 19° 15′ N., long. 57° 47′ W.

Temperature of air at noon, 77°·8; mean for the day, 76°·5.

Temperature of water at surface, 75°·0; bottom, 35°·5.

Density at 60° F. at surface, 1·02728; bottom, 1·02614.

Depth, 3000 fathoms; deposit, Red Clay, containing 1·49 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 3 P.M. sounded in 3000 fathoms, and at 4.30 P.M. made all plain sail. Flying-fish were very abundant, and gulf-weed floated past in considerable quantity.

Sombrero Island distant at noon, 344 miles. Made good 132 miles. Amount of current 16 miles, direction N. 86° W.

Station 20.

Station 20 (Sounding 64), Tenerife to Sombrero (see Chart 6 and Diagram 1).

March 12, 1873; lat. 18° 56′ N., long. 59° 35′ W.

Temperature of air at noon, 78°·8; mean for the day, 75°5.

Temperature of water:—

Surface,	75·0°	900 fathoms,	39·3°
100 fathoms,	68·5	1000 "	38·8
200 "	59·8	1100 "	38·3
300 "	49·7	1200 "	37·8
400 "	45·0	1300 "	37·3
500 "	42·5	1400 "	36·8
600 "	41·2	1500 "	36·3
700 "	40·5	Bottom,	36·0
800 "	39·8		

Density at 60° F. at surface, 1·02727; bottom, 1·02727.

Depth, 2975 fathoms; deposit, Red Clay, containing 3·50 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.30 A.M. put dredge over, and at 9 A.M. sounded in 2975 fathoms. At noon took a series of temperatures at intervals of 100 fathoms down to 1500 fathoms. At 1.30 P.M. commenced heaving in dredge, which came up at 5.30 P.M. half full of mud, containing about a dozen Annelid tubes, some with the animal inside.

[1] An iron instrument with four or five barbed points, and a line attached, used by sailors for striking and taking fish.

Sombrero Island distant at noon, 220 miles. Made good 121 miles. Amount of current 16 miles, direction S. 76° W. STATION 20.

The following species is recorded from the dredge at this Station :— ANIMALS FROM DREDGE.

ANNELIDA (M'Intosh, Zool. pt. 34).

Myriochele heeri, Malmgren. Many specimens; obtained also at Stations 47 (var.) and 325 (var.), 1340 and 2650 fathoms. Recorded from Arctic and North Atlantic.

Station 21 (Sounding 65), Tenerife to Sombrero (see Chart 6 and Diagram 1). STATION 21.

March 13, 1873; lat. 18° 54′ N., long. 61° 28′ W.

Temperature of air at noon, 78°·8; mean for the day, 75°·9.

Temperature of water at surface, 76°·0; bottom, 35°·5.

Density at 60° F. :—

Surface, . . .	1·02685	200 fathoms, . .	1·02682
50 fathoms, . .	1·02712	500 „ . . .	1·02613
100 „ . .	1·02740	Bottom, . . .	1·02685
150 „ . .	1·02752		

Depth, 3025 fathoms; deposit, Red Clay, containing 2·44 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 9.40 A.M. put over current-drag to ascertain current. At 2 P.M. sounded in 3025 fathoms.

Sombrero Island distant at noon, 115 miles. Made good 106 miles. Amount of current 10 miles, direction N. 42° W.

Station 22 (Sounding 66), Tenerife to Sombrero (see Charts 6 and 7, and Diagram 1). STATION 22.

March 14, 1873; lat. 18° 40′ N., long. 62° 56′ W.

Temperature of air at noon, 76°·8; mean for the day, 76°·3.

Temperature of water :—

	°		°
Surface, . . .	76·0	800 fathoms, . . .	40·0
100 fathoms, . . .	69·0	900 „ . . .	39·5
200 „ . . .	61·5	1000 „ . . .	39·2
300 „ . . .	54·3	1100 „ . . .	39·0
400 „ . . .	48·9	1200 „ . . .	38·7
500 „ . . .	45·2	1300 „ . . .	38·4
600 „ . . .	43·0	Bottom, ...	38·0
700 „ . . .	41·2		

Density at 60° F. at surface, 1·02698.

Depth, 1420 fathoms; deposit, Pteropod Ooze, containing 80·69 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

Station 22.

At 9.30 A.M. shortened and furled sails, and got up steam to sound. Sounded in 1420 fathoms. At noon obtained a series of temperatures at intervals of 100 fathoms down to the bottom. At 12.20 P.M. put trawl over and veered 2400 fathoms. At 2 P.M. jollyboat with naturalists away collecting surface animals. At 5.15 P.M. commenced heaving in trawl, which came up at 8 P.M. with the beam broken; it contained a small black fish.

Distance at noon from Sombrero Island, 30 miles. Made good 84 miles. Amount of current 6 miles, direction N. 62° W.

Organisms from Surface-Nets.

Surface Organisms.—Large quantities of Oscillatoriaceæ are recorded from the surface, and naturalists in a boat captured some pelagic Actiniæ (*Plotactis* ?), and three young Plectognathous fish (*Tetrodon*).

The following species are recorded in the Zoological Reports from the surface between Tenerife and St. Thomas, the exact date being doubtful:—

Amphipoda (Stebbing, Zool. pt. 67).
Anchylomera sp. (?).

Schizopada (Sars, Zool. pt. 37).
Siriella thompsoni (M.-Edwards).

Macrura (Spence Bate, Zool. pt. 52).
Sergestes atlanticus, M.-Edwards.
,, *parvidens*, n.sp.

Pelagic Hemiptera (White, Zool. pt. 19).
Halobates wüllerstorfi, Frauenfeld.

Cephalopoda (Hoyle, Zool. pt. 44).
Tremoctopus atlanticus (d'Orbigny), Steenstrup.

Fishes (Günther, Zool. pt. 78).
Xiphias gladius, Linné.
Cubiceps gracilis, Lowe.
Psenes cyanophrys, C. V.
Antennarius marmoratus, Günther.
Scopelus coccoi (Cocco).
Fundulus nigrofasciatus, Lesueur.
Hemirhamphus sp. (?).
Muræna sp. (?).
Tetrodon sp. (?).

Stations 23 to 23B (Soundings 67 to 69), off Sombrero Island (see Chart 7). STATIONS 23 TO 23B.

March 15, 1873.

Temperature of air at noon, 76°·8; mean for the day, 75°·8.

Temperature of water at surface, 76°·0.

At daylight observed land. At 6 A.M. sounded in 450 fathoms, deposit Pteropod Ooze, containing 84·27 per cent. of carbonate of lime (Station 23). Put over dredge and veered 800 fathoms. At 8.30 A.M. veered dredge-rope to 1000 fathoms. At 10 A.M. dredge came up with many specimens. At 10.30 A.M. sounded in 460 fathoms, deposit Pteropod Ooze (Station 23A), and put over dredge. At 1.30 P.M. hauled in dredge and proceeded to the north-west. At 2.15 P.M. sounded in 590 fathoms, deposit Pteropod Ooze (Station 23B), and at 3 P.M. put over dredge, veering 1200 fathoms. At 5.20 P.M. hove up dredge, and at 6 P.M. made all plain sail.

The haul of the dredge in the shallower water (450 fathoms, Station 23) was most productive, as will be seen from the following list of species recorded in the Zoological Reports, the only thing from the deeper water (590 fathoms) being fragments of a Hexactinellid Sponge (*Chonelasma* sp.):—

HEXACTINELLIDA (Schulze, Zool. pt. 53). ANIMALS FROM DREDGE.

Farrea sp. (?) One specimen.

Aphrocallistes bocagei, Wright. One specimen; obtained also at Stations 24, 56, 343, and 344, 390 to 1075 fathoms. Recorded from both sides of the North Atlantic.

Chonelasma sp. (?). Fragments from 590 fathoms.

ALCYONARIA (Wright and Studer, Zool. pt. 64).

Clavularia tubaria, n.sp. Obtained at no other locality.

Acanella eburnea (Pourtalès). One specimen; obtained at no other locality by the Challenger. Recorded from West Indies.

Primnoella distans, Studer. One specimen; obtained also at Station 122, 120 to 400 fathoms. Recorded from South-West Pacific.

Juncella barbadensis, Duchassaing and Michelotti (?). Two small fragments; obtained at no other locality by the Challenger. Recorded from West Indies.

CORALS (Moseley, Zool. pt. 7).

Pliobothrus symmetricus, Pourtalès. Obtained at no other locality by the Challenger. Recorded from Florida and Key West, and North Atlantic ("Porcupine").

Stenohelia profunda, n.sp. Obtained also at Station 171, 600 fathoms.

Station 23

Lophohelia prolifera, M.-Edwards and Haime. Small fragment; obtained also at Stations 24, 109, and 135, 90 to 390 fathoms. Recorded from North Atlantic ("Porcupine" and American expeditions).

,, *candida*, n.sp. Several specimens; obtained at no other locality.

HYDROIDA (Allman, Zool. pt. 70).

Lafoëa dumosa (Fleming). One specimen; obtained at no other locality by the Challenger. Recorded from Europe.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophiozona antillarum, n.sp. Obtained at no other locality.

,, (?) *dubia*, Lyman. Obtained at no other locality by the Challenger. Recorded from North Atlantic ("Blake").

Ophiomusium serratum, n.sp. Obtained at no other locality.

,, *validum*, Ljungman. Obtained also at Station 24, 390 fathoms.

Ophiopyren longispinus, n.g., n.sp. Obtained also at Stations 24 and 33, 390 and 435 fathoms.

Ophiothamnus vicarius, Lyman. Obtained at no other locality by the Challenger.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Salenia varispina, Agassiz. Obtained also at Stations 24, 70, 73, 78, 122, and 344, 350 to 1675 fathoms. Recorded from Caribbean Sea ("Blake").

HOLOTHURIOIDEA (Théel, Zool. pt. 13).

Orphnurgus asper, n.g., n.sp. One specimen; obtained at no other locality. Only species of the genus.

ANNELIDA (M'Intosh, Zool. pt. 34).

Aphrodita intermedia, n.sp. Obtained also at Station 24, 390 fathoms.

Eulepis challengeriæ, n.sp. One fragmentary specimen; obtained at no other locality.

Psammolyce occidentalis, n.sp. Two fragmentary specimens; obtained at no other locality.

Macduffia bonhardi, n.g., n.sp. One fragmentary specimen; obtained at no other locality. Only species of the genus.

Nothria sombreriana, n.sp., and var. Obtained at no other locality.

,, *tenuisetis*, n.sp. One fragmentary specimen (either from this Station or Station 24); obtained also at Station 169, 700 fathoms.

Scolecolepis cirrata, Sars, var. (?). One fragmentary specimen; another variety was obtained at Station 149, 110 fathoms. The species is widely distributed.

Chætozone atlantica, n.sp. One fragmentary specimen ; obtained at no other locality. STATION 23.

Maldane (?) *atlantica*, n.sp. One fragmentary specimen ; obtained at no other locality.

Ampharete sombreriana, n.sp. One injured specimen ; obtained at no other locality.

Melinna maculata, Webster. Two fragmentary specimens ; obtained at no other locality by the Challenger. Recorded from Virginian coast.

Pista sombreriana, n.sp. One fragmentary specimen ; obtained at no other locality.

Serpula sombreriana, n.sp. One specimen ; obtained at no other locality.

ISOPODA (Beddard, Zool. pt. 48).

Arcturus purpureus, n.sp. One specimen ; obtained at no other locality.

Typhlapseudes nereus, n.g., n.sp. Several specimens ; obtained at no other locality. Only species of the genus.

MACRURA (Spence Bate, Zool. pt. 52).

Callianassa occidentalis, n.sp. Single claw ; obtained at no other locality.

Cheramus occidentalis, n.g., n.sp. One damaged specimen ; obtained at no other locality.

Thaumastocheles zaleuca (Willemoes-Suhm), n.g., n.sp. One specimen and fragments ; obtained at no other locality. Only species of the genus.

Polycheles crucifera (Willemoes-Suhm), n.sp. One specimen ; obtained at no other locality.

Benthesicymus pleocanthus, n.g., n.sp. One specimen ; obtained also at Stations 205 and 250, 1050 and 3050 fathoms.

ANOMURA (Henderson, Zool. pt. 69).

Munida sp. (?). One imperfect specimen.

Munidopsis sigsbei (M.-Edwards). One specimen ; obtained at no other locality by the Challenger. Recorded from West Indies ("Blake").

Elasmonotus armatus, M.-Edwards. Two specimens ; obtained also at Station 24, 390 fathoms. Recorded from West Indies ("Blake").

Uroptychus nitidus (M.-Edwards). Three specimens ; obtained also at Station 24, 390 fathoms. Recorded from West Indies ("Blake").

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Neæra sp. (?). Portion of a valve.

Cryptodon sp. (?). Single valve.

Limopsis aurita (Brocchi). Obtained also at Stations 56 and 73, 1075 and 1000 fathoms.

STATION 23.

Lima (*Limatula*) *confusa*, n.sp. Obtained also at Stations 78 and 120, 1000 and 675 fathoms. Taken by "Valorous" in North-Atlantic, 1450 fathoms.

,, (,,) *laminifera*, n.sp. Obtained also at Station 24, 390 fathoms.

SCAPHOPODA and GASTEROPODA (Watson, Zool. pt. 42).

Dentalium circumcinctum, n.sp. Obtained also at Stations II., 56, and 122, 350 to 1075 fathoms.

,, *ensiculus*, Jeffreys. Obtained at no other locality by the Challenger. Recorded from the North Atlantic.

Trochus (*Margarita*) *rhysus*, n.sp. Obtained also at Station II.

Columbella (*Pyrene*) *strix*, n.sp., var. *subacta*, nov. Obtained also at Station 24, 390 fathoms. The species obtained at Station 122, 350 fathoms.

Pleurotoma (*Surcula*) *syngenes*, n.sp. Obtained also at Station 24, 390 fathoms.

,, (*Genota*) *didyma*, n.sp. One injured specimen; obtained at no other locality.

,, (*Bela*) *dyscrita*, n.sp. One injured specimen; obtained at no other locality.

,, (*Typhlomangelia*) *lithocolleta*, n.sp. Obtained at no other locality.

Clathurella hormophora, n.sp. Obtained also at Stations 24 and 122, 390 and 350 fathoms.

,, *circumvoluta*, n.sp. Obtained also at Station 24, 390 fathoms.

Natica leptalea, n.sp. Obtained at no other locality.

,, sp. *a*. Obtained also at Station 24, 390 fathoms.

Actæon pusillus (Forbes) (?). One fragmentary specimen; obtained at no other locality by the Challenger. Recorded from Mediterranean and Madeira. Fossil—Middle Pliocene of Calabria.

POLYZOA (Busk, Zool. pt. 30; Waters, pt. 79).

Pasythea eburnea (Smitt). Obtained also at Stations 24 and 122, 32 to 400 fathoms. Recorded from Gulf of Florida.

Brettia cornigera, n.sp. Obtained at no other locality.

Bugula versicolor, n.sp. Obtained also at Station 122, 350 fathoms.

Farciminaria atlantica, n.sp. Obtained also at Station 24, 390 fathoms.

Tessaradoma boreale (Busk). Obtained also at Station 13.

Porina proboscidea, Waters, n.sp. Obtained at no other locality.

FISHES (Günther, Zool. pt. 57).

Gonostoma microdon, n.sp. Seven specimens; very widely distributed, taken at Stations 23, 40, 60, 61, 101, 106, 120, 137, 156, 158, 169, 170, 171, 196, 218, 220, 223, 226, 230, 237, 265, 286, and 337, in 450 to 2900 fathoms. Recorded subsequently from Indian Ocean ("Investigator").

Stomias affinis, n.sp. One specimen; obtained at no other locality.

In addition to the foregoing, the following are recorded in the Station-book:— *Plumularia*, *Luidia*, *Astrogonium longimanum* [=*Iconaster longimanus*], *Archaster*, *Cidaris* (*Dorocidaris*) *abyssicola*, *Echinus* (*Echinocyamus*) *pusillus*, and a damaged specimen of *Sipunculus*. STATION 23.

Excluding Protozoa, about 150 specimens of invertebrates and fishes were obtained at this Station, belonging to about 78 species, of which 44 are new to science, including representatives of 7 new genera; 28 of the new species and 4 of the new genera (each represented by a single species) were not obtained elsewhere.

The following species of Pteropoda, Heteropoda, Foraminifera, and Radiolaria, were observed in the deposit from Station 23, 450 fathoms (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.):— ORGANISMS FROM THE DEPOSIT.

PTEROPODA (Pelseneer, Zool. pt. 65).

Limacina inflata (d'Orbigny).
„ *triacantha* (Fischer).
„ *lesueuri* (d'Orbigny).
„ *bulimoides* (d'Orbigny).
Peraclis reticulata (d'Orbigny).
Clio (*Creseis*) *virgula* (Rang).
„ („) *acicula* (Rang).
„ (*Styliola*) *subula* (Quoy and Gaimard).
„ *pyramidata*, Linné.
Clio cuspidata (Bosc).
Cuvierina columnella (Rang).
Cavolinia trispinosa (Lesueur).
„ *quadridentata* (Lesueur).
„ *longirostris* (Lesueur).
„ *gibbosa* (Rang).
„ *uncinata* (Rang).
„ *inflexa* (Lesueur).

HETEROPODA (Smith, Zool. pt. 72).

Atlanta peronii, Lesueur.
„ *lesueuri*, Eydoux and Souleyet.
„ *souleyeti*, Smith.
Atlanta fusca, Eydoux and Souleyet.
„ *inclinata*, Eydoux and Souleyet.

FORAMINIFERA (Brady, Zool. pt. 22).—The pelagic species, which make up about 62 per cent. of the carbonate of lime present in the deposit, are marked thus × :—

Biloculina comata, Brady.
„ *depressa*, d'Orbigny.
„ *irregularis*, d'Orbigny.
Miliolina amygdaloides, Brady.
„ *auberiana* (d'Orbigny).
„ *insignis*, Brady.
„ *linnæana* (d'Orbigny).
„ *oblonga* (Montagu).
Articulina conico-articulata (Batsch).
„ *sagra*, d'Orbigny.
Planispirina celata (Costa).
„ *sigmoidea*, Brady.
Cornuspira foliacea (Philippi).
„ *involvens*, Reuss.
Peneroplis lævigatus, Karrer.
„ *pertusus* (Forskål).
Orbiculina adunca (Fichtel and Moll).
Orbitolites complanata, Lamarck.
„ *marginalis* (Lamarck).
Pelosina cylindrica, Brady.
„ sp. (?).
Technitella legumen, Norman.
Bathysiphon filiformis, Sars.
Sorosphæra confusa, Brady.
Saccammina socialis, Brady (?).
Jaculella obtusa, Brady.
Hyperammina friabilis, Brady.
„ *ramosa*, Brady.

STATION 23.

Hyperammina subnodosa, Brady.
Marsipella elongata, Norman.
Rhabdammina discreta, Brady.
" *linearis*, Brady.
Aschemonella catenata (Norman).
Rhizammina algæformis, Brady.
" *indivisa*, Brady.
Reophax dentaliniformis, Brady.
" *scorpiurus*, Montfort.
" *spiculifera*, Brady.
Haplophragmium agglutinans (d'Orbigny).
" *calcareum*, Brady.
" *emaciatum*, Brady.
" *globigeriniforme* (Parker and Jones).
" *glomeratum*, Brady.
" *latidorsatum*, Bornemann.
" *scitulum*, Brady.
Hormosina monile, Brady.
Ammodiscus gordialis (Parker and Jones).
" *incertus* (d'Orbigny).
Trochammina conglobata, Brady.
" *coronata*, Brady.
" *pauciloculata*, Brady.
" *proteus*, Karrer.
" *squamata*, Jones and Parker.
" *trullissata*, Brady.
Webbina clavata, Jones and Parker.
Cyclammina cancellata, Brady.
Textularia agglutinans, d'Orbigny.
" *aspera*, Brady.
" *concava* (Karrer).
" *conica*, d'Orbigny.
" *gramen*, d'Orbigny.
" *luculenta*, Brady.
" *turris*, d'Orbigny.
Verneuilina pygmæa (Egger).
" *spinulosa*, Reuss.
Bigenerina capreolus (d'Orbigny).
" *pennatula* (Batsch).
" *robusta*, Brady.
Gaudryina filiformis, Berthelin.
" *scabra*, Brady.
" *subrotundata*, Schwager.
" sp. (?).
Clavulina communis, d'Orbigny.
" *cylindrica*, Hantken.
" *parisiensis*, d'Orbigny.
Bulimina aculeata, d'Orbigny.
" *buchiana*, d'Orbigny.
Bulimina inflata, Seguenza.
" *marginata*, d'Orbigny.
" *subteres*, Brady.
Bolivina punctata, d'Orbigny.
" *reticulata*, Hantken.
" *robusta*, Brady.
" *textilarioides*, Reuss.
Tritaxia caperata, Brady.
Cassidulina subglobosa, Brady.
Chilostomella ovoidea, Reuss.
Lagena acuticosta, Reuss.
" *quadrata* (Williamson).
Nodosaria comata (Batsch).
" *communis*, d'Orbigny.
" *costulata*, Reuss.
" *filiformis*, d'Orbigny.
" *hispida*, d'Orbigny.
" *intercellularis*, Brady (?).
" (*Glandulina*) *lævigata*, d'Orbigny.
" *obliqua* (Linné).
" *pyrula*, d'Orbigny.
" *raphanus* (Linné).
" *roemeri* (Neugeboren).
" *soluta*, Reuss.
" *subcanaliculata* (Neugeboren).
" *vertebralis* (Batsch).
" sp. (?).
Lingulina carinata, d'Orbigny, var. *seminuda*, Hantken.
Rhabdogonium tricarinatum (d'Orbigny).
Marginulina costata (Batsch).
" *glabra*, d'Orbigny.
Cristellaria aculeata, d'Orbigny.
" *calcar* (Linné).
" *cultrata* (Montfort).
" *gibba*, d'Orbigny.
" *italica* (Defrance).
" *obtusata*, Reuss, var. *subalata*, Brady.
" *orbicularis* (d'Orbigny).
" *reniformis*, d'Orbigny.
" *rotulata* (Lamarck).
" *variabilis*, Reuss.
Polymorphina sp. (?).
Uvigerina pygmæa, d'Orbigny.
Ramulina globulifera, Brady.
× *Globigerina æquilateralis*, Brady.
× " *bulloides*, d'Orbigny, var. *triloba*, Reuss.
× " *conglobata*, Brady.
× " *dubia*, Egger.
× " *rubra*, d'Orbigny.

STATION 23.

× *Globigerina sacculifera*, Brady.
× *Orbulina universa*, d'Orbigny.
× *Pullenia obliquiloculata*, Parker and Jones.
,, *quinqueloba*, Reuss.
,, *sphæroides* (d'Orbigny).
× *Sphæroidina dehiscens*, Parker and Jones.
,, *bulloides*, d'Orbigny.
× *Candeina nitida*, d'Orbigny.
Truncatulina lobatula (Walker and Jacob).
,, *reticulata* (Czjzek).
,, *robertsoniana*, Brady.
,, *rosea* (d'Orbigny).
,, *tenuimargo*, Brady.
,, *ungeriana* (d'Orbigny).
,, *wuellerstorfi* (Schwager).
Anomalina ammonoides, Reuss.
,, *ariminensis* (d'Orbigny).
,, *coronata*, Parker and Jones.
,, *grosserugosa* (Gümbel).
,, *polymorpha*, Costa.
Pulvinulina elegans (d'Orbigny).
× ,, *menardii* (d'Orbigny).
× ,, ,, var. *fimbriata*, Brady.
× ,, *michcliniana* (d'Orbigny).
,, *pauperata*, Parker and Jones.
× ,, *tumida*, Brady.
Gypsina inhærens (Schultze).
Polytrema miniaceum (Linné).
Amphistegina lessonii, d'Orbigny.

Radiolaria (Haeckel, Zool. pt. 40).—The following list has been compiled by Professor Haeckel, with the assistance of Dr. F. Dreyer :—

I. Spumellaria.
a. Sphæroidea.
Cenosphæra antiqua, Haeckel.
,, *hexagonalis*, Haeckel.
Carposphæra belladonna, Haeckel.
Cromyosphæra quadruplex, Haeckel.
,, *scorodonium*, Haeckel.
Collosphæra huxleyi, Müller,
Acrosphæra erinacea, Haeckel.
Siphonosphæra patinaria, Haeckel.
Amphistylus hippocampus, Haeckel.
Hexalonche castanella, Haeckel.
b. Prunoidea.
Druppula cocos, Haeckel.
Spongocore velata, Haeckel.
Panartus tetrathalamus, Haeckel.
c. Discoidea.
Astrophacus phacodiscus, Haeckel.
Perichlamydium antillarum, n.sp. (MS.).
Rhopalastrum malleus, Haeckel.
Hymeniastrum leydigii, Haeckel.
Hexapyle hexacantha, Haeckel.
Spongodiscus cycloides, Haeckel.
,, *favus*, Ehrenberg.
,, *resurgens*, Ehrenberg.
Rhopalodictyum abyssorum, Ehrenberg.
,, *curvatum*, Haeckel.
Spongasteriscus clavatus, Haeckel.
Spongaster pentacyclus, Haeckel.
,, *tetras*, Ehrenberg.
d. Larcoidea.
Tetrapyle quadriloba, Haeckel.
II. Nassellaria.
a. Stephoidea.
Archicircus primordialis, Haeckel.
Lithocircus quadricornis, Haeckel.
Lygocircus productus, Bütschli.
,, *triquetrus*, Haeckel.
Eucoronis nephrospyris, Haeckel.
b. Cyrtoidea.
Tripodiscium furcatum, Haeckel.
Pterocanium gravidum, Haeckel.
Clathrocyclas basilea, Haeckel.
Theocalyptra veneris, Haeckel.
Theoconus campanulatus, Haeckel.
Dictyomitra articulata (Ehrenberg).
Lithocampe nereidum (Ehrenberg).
III. Phæodaria.
Dictyocha stapedia, Haeckel.
Distephanus speculum (Ehrenberg).

Organisms from Surface-Nets.

Surface Organisms.—The following species are recorded from the surface on this date :—

Brachyura (Miers, Zool. pt. 49).
Nautilograpsus minutus (Linné).

Fishes (Günther, Zool. pt. 78).
Echeneis remora, Linné.

STATION 23.

While dredging, two sharks (*Carcharias brachyurus*) were caught. One had the greater portion of one of its pectoral fins bitten off, apparently by some other shark, there being a clean semicircular cut where the jaws had closed and bitten through the tough cartilage and muscle. Three specimens of *Echeneis remora* were attached to the one fish and two to the other, and four of these were hauled on board still maintaining their hold. While the sharks were struggling in the water at the end of the line, they frequently shifted their position on the fish. The belly of *Echeneis* is dark, and at first sight it is difficult to persuade one's self that the back is not uppermost, and the sucker on the ventral surface. The fish adheres so tightly to a table that it is impossible to pull it off by exerting a vertical strain.

AT ST. THOMAS.

The Challenger remained at anchor at St. Thomas from 1.30 P.M. on March 16 till 4 P.M. on March 24, 1873. The following species are recorded in the Zoological Reports as having been obtained during the stay by dredging in the steam-pinnace near the Island of St. Thomas in shallow water, or by collecting on shore :—

ANIMALS FROM ST. THOMAS.

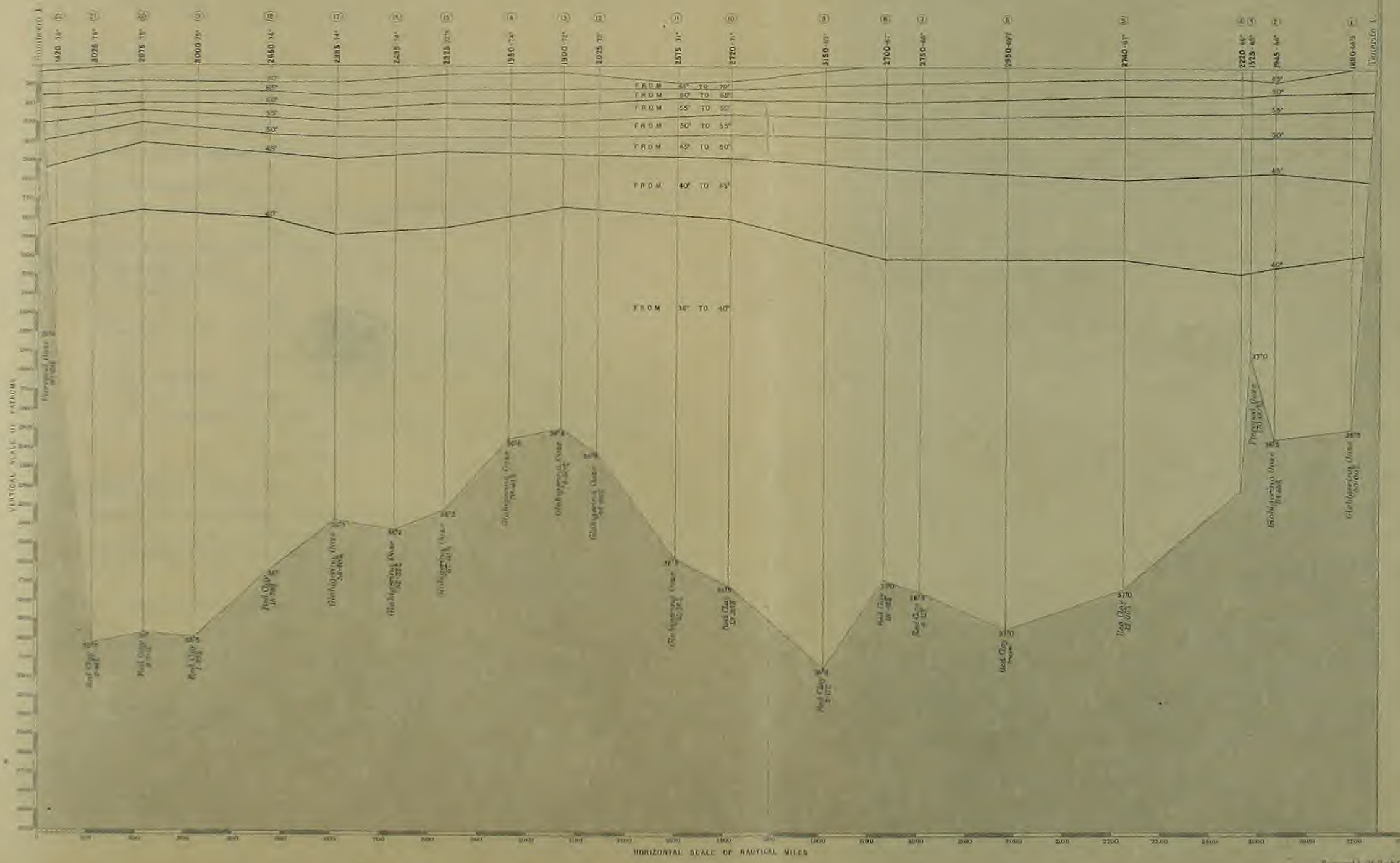
REEF CORALS (Quelch, Zool. pt. 46).

Oculina diffusa, Lamarck. One specimen (shallow water); obtained also at Bermuda.
,, *varicosa*, Lesueur. Obtained also at Bermuda.
,, *recta*, n.sp. Two specimens; obtained at no other locality.
Cladocora arbuscula (Lesueur). One specimen (shallow water); obtained also in Simon's Bay, Cape.
Pectinia profunda (Dana). One specimen (reefs); obtained at no other locality by the Challenger.
Isophyllia aspera (Duchassaing and Michelotti). One specimen; obtained at no other locality by the Challenger.
Manicina areolata (Linné). One specimen (reefs, shallow water); obtained also in Simon's Bay, Cape.
Agaricia fragilis (Dana). Two specimens; obtained also at Bermuda.
,, *frondosa* (Duchassaing). One specimen; obtained at no other locality by the Challenger.
Madrepora palmata (Lamarck). Several specimens; obtained at no other locality by the Challenger. Recorded from Florida Reefs.
,, *prolifera* (Lamarck). One specimen; obtained at no other locality by the Challenger. Recorded from Florida Reefs.
,, *cervicornis* (Lamarck). One specimen; obtained at no other locality by the Challenger. Recorded from Florida Reefs.
Porites astraeoides, Lamarck. One specimen; obtained at no other locality by the Challenger. Recorded from West Indies and Florida Reefs.


SOUNDINGS AND STATIONS
in the vicinity of the
CANARY ISLANDS
For explanation of abbreviations &c. see Appendix 1
Palma
1125
volcanic mud
Ferro
Gomera
TENERIFE
Gran Canaria
VIIk
1975
globigerina ooze
1750 volcanic mud
1340
volcanic mud
620
volcanic mud
1620
volcanic mud
1390
640 volcanic mud
179 hard ground
78 volcanic sand
560
volcanic mud
975
630
278 volcanic mud
volcanic mud
1890
18° Long West from Greenwich
Engraved by Malby & Sons

ATLANTIC OCEAN. Longitudinal Temperature Section. Teneriffe I. to Sombrero I.

For Explanation of Symbols see Appendix I.



Engraved by Malby & Sons.

Millepora alcicornis, Linné. One specimen; obtained also at Bermuda. Recorded from Florida Reefs. St. Thomas.

„ *carthaginiensis*, Duchassaing and Michelotti. One specimen; obtained at no other locality by the Challenger.

Ophiuroidea (Lyman, Zool. pt. 14).

Ophiura cinerea (Müller and Troschel). Obtained also at Bahia.

Ophiocoma echinata (Agassiz). Obtained at no other locality by the Challenger.

Echinoidea (Agassiz, Zool. pt. 9).

Diadema setosum (Gray). Obtained also at Cape Verdes, Philippines, and Tahiti.

Annelida (M'Intosh, Zool. pt. 34).

Hermodice caruncidata (Pallas). Two specimens; obtained also at Bermuda and Cape Verdes.

Hesione (?) sp. Fragment (shallow water).

Nereis antillensis, n.sp. One specimen; obtained at no other locality.

Marphysa goodsiri, n.sp. One specimen (shallow water); obtained at no other locality.

Sabella bipunctata, Baird. One specimen (between tide-marks); obtained at no other locality by the Challenger.

Dasychone wyvillei, n.sp. One specimen (between tide-marks); obtained at no other locality.

„ *nigro-maculata* (Baird). One specimen (between tide-marks); obtained at no other locality by the Challenger. Recorded from West Indies.

Stomatopoda (Brooks, Zool. pt. 45).

Pseudosquilla ciliata, Miers. Two specimens (2 fathoms); obtained also at Sandwich Islands. Recorded from Cuba.

Gonodactylus chiragra, Latreille. Many specimens; obtained also at Station 36, Bermuda, near Cape St. Roque, and Philippines.

Isopoda.—One specimen, genus and species undetermined.

Macrura (Spence Bate, Zool. pt. 52).

Sicyonia carinata (Olivier). One specimen (shallow water); obtained also at Bahia. Recorded from Rio Janeiro and Australia.

Alpheus bermudensis, n.sp. One specimen; obtained also at Bermuda.

Leptochela serratorbita, n.sp. One specimen (shallow water); obtained at no other locality.

St. Thomas.

Anomura (Henderson, Zool. pt. 69).

Hypoconcha sabulosa (Herbst). Two specimens (shallow water); obtained at no other locality by the Challenger. Recorded from West Indies.

Porcellana sayana (Leach). Several specimens (shallow water); obtained at no other locality by the Challenger. Recorded from West Indies and United States.

Lamellibranchiata (Smith, Zool. pt. 35).

Amussium cancellatum, n.sp. Obtained also at Stations 24, 33, and 56, 390 to 1075 fathoms.

Cephalopoda (Hoyle, Zool. pt. 44).

Octopus tehuelchus, d'Orbigny. One specimen (8 fathoms); obtained at no other locality by the Challenger. Recorded from Central and South America.

Fishes (Günther, Zool. pts. 6 and 78).

Serranus apua, Bl. Obtained at no other locality by the Challenger.
Mesoprion chrysurus, Bl. Obtained at no other locality by the Challenger.
Pomacanthus para, Bl. Obtained at no other locality by the Challenger.
Scorpæna plumieri, Bl. Obtained at no other locality by the Challenger.
Holocentrum longipinne, C.V. Obtained also at Ascension.
Echeneis naucrates, Linné. Obtained also at Fiji.

In the foregoing list 40 species are enumerated from the shore and shallow water at St. Thomas, including 7 new to science, 5 of which were not obtained elsewhere.

Station 24.

Station 24 (Sounding 70), St. Thomas to Bermuda (see Chart 7 and Diagram 2).

March 25, 1873; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.
Temperature of air at noon, 77°·8; mean for the day, 76°·5.
Temperature of water at surface, 76°·0.
Density at 60° F. at surface, 1·02704.
Depth, 390 fathoms; deposit, Pteropod Ooze, containing 73·88 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.15 a.m. shortened and furled sails and got up steam to sound and dredge. At 7 a.m. sounded in 390 fathoms. At 7.30 a.m. put large dredge with tangles over, veering 800 fathoms. At 10.15 a.m. hauled in dredge, containing many specimens.


SOUNDINGS AND STATIONS
in the vicinity of the
VIRGIN ISLANDS
For explanation of abbreviations &c. see Appendix 1
25 3875
red clay
24 625
pteropod ooze
24 390
pteropod ooze
22 1420
pteropod ooze
Sombrero I.
590
23 pteropod ooze
460
23 pteropod ooze
23 450
pteropod ooze
Anegada I.
VIRGIN ISLANDS
Tortola
St. Thomas
1550 ft.
Virgin Gorda
1370 ft.
St. John
Culebra
PUERTO RICO
Crab I.
Santa Cruz
Anguilla I.
St. Martin I.
1360 ft.
Saba I.
2820 ft.
Dog I.
19°
18°
66°
65°
64°
63°
65° Long. West from Greenwich

At 11.10 A.M. sounded in 625 fathoms, deposit Pteropod Ooze, containing 68·88 per cent. of carbonate of lime (Station 24A). Put over dredge and veered 1100 fathoms. Dredge became fast at the bottom, but when freed a considerable quantity of mud was brought up. While hauling in the dredge, a block hook of the dredging apparatus gave way, and a boy was killed by being struck with the block. STATION 24.

The position of this dredging-ground is about 15 miles north of Culebra Island, the whole group of the Virgin Islands being in sight. At 8 P.M. made all plain sail.

The following species are recorded in the Zoological Reports from the dredge at this Station, the only species from the greater depth (625 fathoms) being *Rhizocrinus lofotensis* :— ANIMALS FROM DREDGE.

MONAXONIDA (Ridley and Dendy, Zool. pt. 59).

Desmacella annexa, Schmidt. Small fragment; obtained at no other locality by the Challenger. Recorded from Florida and English Channel.

TETRACTINELLIDA (Sollas, Zool. pt. 63).

Craniella schmidtii, n.sp. Three (?) specimens; obtained at no other locality.

Thenea schmidtii, n.n. One specimen; for distribution see Station IV.

HEXACTINELLIDA (Schulze, Zool. pt. 53).

Hyalonema toxeres, Wyville Thomson, n.sp. Three specimens; obtained at no other locality.

Farrea occa (Bowerbank), Carter. One specimen; obtained also at Stations 170 and 207, 630 and 700 fathoms. Recorded from Japan.

Aphrocallistes bocagei, Wright. One specimen; for distribution see Station 23.

Myliusia callocyathus, Gray. One specimen; obtained also at Stations 192 and 194, 140 and 360 fathoms. Recorded from West Indies.

CORALS (Moseley, Zool. pt. 7).

Cryptohelia pudica, M.-Edwards and Haime. For distribution see Station 3.

Caryophyllia paucipalata, n.sp. Two specimens; obtained at no other locality.

Deltocyathus italicus, M.-Edwards and Haime. Several specimens; obtained also at Stations 56, 78, 120, 191 (?), 285, and off Bermuda (var.), 200 to 2375 fathoms. Recorded from North Atlantic (American expeditions, &c.).

Odontocyathus coronatus (Pourtalès). Five specimens; obtained at no other locality by the Challenger. Recorded from Florida.

Desmophyllum cailleti, Duchassaing and Michelotti. One dead specimen; obtained at no other locality by the Challenger.

Station 24.

Lophohelia prolifera, M.-Edwards and Haime. Small fragment; for distribution see Station 23.

Bathyactis symmetrica (Pourtalès). Very widely distributed, both geographically and bathymetrically; obtained at Stations 24, 36, 56, 73, 78, 133, 147, 157, 181, 194, 195, 196, 218, 224, 241, 244, 299, 325, and 332, 32 to 2900 fathoms.

Hydroida (Allman, Zool. pt. 70).

Cryptolaria flabellum, n.sp. Obtained at no other locality.

Sertularia catena, n.sp. One specimen; obtained at no other locality.

Crinoidea (Carpenter, Zool. pt. 32).

Rhizocrinus lofotensis, Sars. Two specimens from 625 fathoms; obtained also at Stations 122 and 323, 400 and 1900 fathoms. Recorded from both sides of the North Atlantic ("Porcupine," "Lightning," "Knight Errant," and various American expeditions).

Asteroidea (Sladen, Zool. pt. 51).

Brisinga cricophora, n.sp. Obtained at no other locality.

Ophiuroidea (Lyman, Zool. pt. 14).

Ophiozona nivea, Lyman. Obtained at no other locality by the Challenger.

Ophioglypha falcifera, Lyman. Obtained at no other locality by the Challenger.

" *variabilis*, n.sp. (young?). Obtained also at Station 195, 1425 fathoms.

Ophiomusium validum, Ljungman. Obtained also at Station 23.

Ophiopyren longispinus, n.g., n.sp. Obtained also at Stations 23 and 33.

Ophiomitra dipsacos, n.sp. Obtained at no other locality.

Ophioscolex tropicus, n.sp. Obtained at no other locality.

Echinoidea (Agassiz, Zool. pt. 9).

Dorocidaris (*Cidaris*) *papillata* (Leske). Obtained also at Stations 204, 210, 320, Canaries, and St. Paul's Rocks, 70 to 600 fathoms.

Salenia varispina, Agassiz. For distribution see Station 23.

Podocidaris sculpta, Agassiz. Obtained at no other locality by the Challenger.

Annelida (M'Intosh, Zool. pt. 34).

Aphrodita intermedia, n.sp. Obtained also at Station 23.

Nothria tenuisetis, n.sp. One fragmentary specimen (either from this Station or Station 23); obtained also at Station 169.

OSTRACODA (Brady, Zool. pt. 3). STATION 24.

Macrocypris tenuicauda, n.sp. Many specimens ; obtained also at Station 122, 350 fathoms.

,, *decora*, Brady. Obtained also at Stations 122, 149, and Admiralty Islands, 16 to 350 fathoms. Recorded from Australia and Batavia.

Bythocypris reniformis, n.g., n.sp. Several specimens ; obtained also at Stations 120, 122, 145 and 162, 38 to 675 fathoms.

Bairdia victrix, Brady. Obtained also at Stations 75, 76, 120, 122, 149, 164B (?), and 335 (?), 120 to 1425 fathoms. Recorded from Colon-Aspinwall and Cuba.

Cythere (?) *serratula*, n.sp. A few separate valves ; obtained also at Stations 85 and 335, 1125 and 1425 fathoms.

,, *dictyon*, n.sp. Very widely distributed ; obtained at Stations 24, 64, 70, 73, 75, 76, 78, 120, 122, 146, 150, 164, 191, 218, 224, 246, 280, 296, 300, 302, 305, 308, 332, 335, and Humboldt Bay, Papua, 37 to 2750 fathoms.

Cytherella lata, n.sp. A few detached valves ; obtained also at Stations 75, 120, 185 and 191, 155 to 675 fathoms.

CIRRIPEDIA (Hoek, Zool. pt. 25).

Pœcilasma carinatum, n.sp. One small specimen ; obtained also at Station 344, 420 fathoms.

AMPHIPODA (Stebbing, Zool. pt. 67).

Syrrhoë papyracea, n.sp. One specimen ; obtained at no other locality.

Ampelisca abyssicola, n.sp. One specimen ; obtained at no other locality.

MACRURA (Spence Bate, Zool. pt. 52).

Platybema rugosum, n.g., n.sp. One specimen ; obtained at no other locality.

ANOMURA (Henderson, Zool. pt. 69).

Porcellana robertsoni, n.sp. One specimen ; obtained at no other locality.

Munida microphthalma, M.-Edwards. One specimen ; obtained also at Stations 171 and 343, 600 and 425 fathoms. Recorded from West Indies ("Blake").

Elasmonotus armatus, M.-Edwards. Three specimens ; obtained also at Station 23.

Uroptychus nitidus (M.-Edwards). One specimen ; obtained also at Station 23.

STATION 24. LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Neæra consociata, n.sp. Obtained also at Station 33, 435 fathoms.
,, sp. (?). A single valve.
Verticordia woodii, n.sp. Obtained also at Station 122, 350 fathoms.
Cryptodon incrassatus (Jeffreys), var. (?). A few odd valves; obtained at no other locality by the Challenger.
Montacuta occidentalis, n.sp. One specimen; obtained at no other locality.
Crassatella parva (Adams). Obtained at no other locality by the Challenger.
Nucula culebrensis, n.sp. Obtained at no other locality.
Leda decipiens, n.sp. Obtained at no other locality.
,, *inaudax*, n.sp. Obtained at no other locality.
,, *hebes*, n.sp. Obtained at no other locality.
,, *despecta*, n.sp. Obtained at no other locality.
Malletia veneriformis, n.sp. Obtained also at Station 33, 435 fathoms.
,, *cuneata*, n.sp. Obtained at no other locality.
Glomus jeffreysi, n.sp. Obtained at no other locality.
,, *simplex*, n.sp. Obtained at no other locality.
,, *inæquilateralis*, n.sp. Obtained at no other locality.
,, sp. (?). A single valve.
Limopsis minuta (Philippi). Obtained also at Stations II., VIIIP., VIII., and 75.
Arca (*Barbatia*) *pteroessa*, n.sp. Obtained also at Stations 16, 71, 73, 237, and 246.
,, (*Scapharca*) *inæquisculpta*, n.sp. Obtained also at Station 5.
,, (,, ?) *culebrensis*, n.sp. Obtained at no other locality.
Idas dalli, n.sp. Obtained at no other locality.
Dacrydium occidentale, n.sp. Obtained at no other locality.
Lima (*Limatula*) *laminifera*, n.sp. Obtained also at Station 23.
Pecten culebrensis, n.sp. Obtained at no other locality.
,, sp. (?). A few odd valves.
,, sp. (?). A single valve.
Amussium squamigerum, n.sp. A few detached valves; obtained also at Station 33, 435 fathoms.
,, *obliquum*, n.sp. A single valve; obtained at no other locality.
,, *cancellatum*, n.sp. Obtained also at Stations 33, 56, and off St. Thomas.

SCAPHOPODA and GASTEROPODA (Watson, Zool. pt. 42).

Dentalium capillosum, Jeffreys (?). One fragmentary specimen; for distribution see Station II.
,, *compressum*, n.sp. One specimen; obtained at no other locality.

Dentalium didymum, n.sp. Six fragmentary specimens; obtained at no other locality. STATION 24.

Siphodentalium platamodes, n.sp. Obtained at no other locality.

,, *tytthum*, n.sp. Obtained at no other locality.

Cadulus vulpidens, n.sp. Obtained at no other locality.

,, *rastridens*, n.sp. Obtained at no other locality.

,, *sauridens*, n.sp. Obtained at no other locality.

,, *curtus*, n.sp. Obtained at no other locality.

,, ,, var. *congruens*, nov. Obtained at no other locality.

,, *obesus*, n.sp. Obtained at no other locality.

,, *exiguus*, n.sp. Obtained at no other locality.

,, *ampullaceus*, n.sp. Obtained at no other locality.

Lepeta cæca (Müller). Obtained at no other locality by the Challenger. Recorded from the Arctic, North Atlantic, and North Pacific. Fossil—Post-Pliocene of Scandinavia, and Red and Coralline Crags of England.

Zeidora naufraga, n.sp. Obtained at no other locality.

Puncturella clathrata, Jeffreys. Obtained at no other locality by the Challenger. Recorded from North Atlantic.

,, *agger*, n.sp. Obtained at no other locality.

,, *oxia*, n.sp. Obtained at no other locality.

,, *sportella*, n.sp. Obtained at no other locality.

,, (*Cranopsis*) *asturiana* (Fischer). Obtained at no other locality by the Challenger. Recorded from Bay of Biscay.

,, (,,) *granulata* (Seguenza). Obtained at no other locality by the Challenger. Fossil—Miocene Marls of Sicily.

,, (,,) *profundi*, Jeffreys. Obtained at no other locality by the Challenger. Recorded from North Atlantic.

,, (*Fissurisepta*) *rostrata* (Seguenza). One specimen; obtained at no other locality by the Challenger. Fossil—Upper Miocene of Sicily.

Trochus (*Ziziphinus*) *stirophorus*, n.sp. Obtained at no other locality.

,, (,,) *tiara*, n.sp. Obtained also at Station 56, 1075 fathoms. Recorded subsequently from off Havana.

,, (*Oxystele*) *euspira* (Dall). Obtained at no other locality by the Challenger. Recorded from North Atlantic and Gulf of Mexico.

,, (*Margarita*) *pompholugotus*, n.sp. Obtained at no other locality.

,, (,,) *æglees*, n.sp. Obtained at no other locality by the Challenger. Recorded subsequently from Gulf of Mexico.

STATION 24. *Trochus* (*Margarita*) *elevatus*, n.sp. Obtained also at Station 120 (?), 675 fathoms.

,, (,,) *scintillans*, n.sp. Obtained also at Station 56, 1075 fathoms.

,, (,,) *cancellatus*, Jeffreys. Obtained at no other locality by the Challenger. Recorded from North Atlantic ("Porcupine").

,, , two other species undetermined.

Basilissa alta, n.g., n.sp. Obtained also at Station 120, 675 fathoms (var. *oxytoma*, nov.). Recorded subsequently from Gulf of Mexico.

,, *costulata*, n.g., n.sp. Obtained at no other locality by the Challenger. Recorded from North Atlantic ("Porcupine"), and Gulf of Mexico.

Seguenzia monocingulata, Seguenza. Obtained also at Station 56, 1075 fathoms; and var. *lineata*, nov., at Stations 120 and 122, 675 and 350 fathoms. Recorded from North Atlantic and Gulf of Mexico. Fossil—Upper Miocene of Calabria, and Middle Pliocene of Sicily.

,, *ionica*, n.sp. Obtained also at Station 73, 1000 fathoms. Recorded subsequently from Gulf of Mexico.

Stomatella (*Gena*) *caliginosa*, Adams. Obtained at no other locality by the Challenger. Original locality unknown.

Scissurella crispata, Fleming. Obtained also at Station 145, 140 fathoms. Recorded from Arctic, North Atlantic, and Mediterranean. Fossil—Later glacial beds of Norway, Middle and Upper Pliocene of Calabria, and Coralline Crag of England.

,, *alta*, n.sp. Obtained also at Station 75, 450 fathoms.

Schismope tabulata, n.sp. Obtained at no other locality.

,, *lacuniformis*, n.sp. Obtained at no other locality.

,, (?) sp.

Homalogyra densicostata, Jeffreys (?). Obtained at no other locality by the Challenger. Recorded from North Atlantic ("Bulldog" and "Porcupine").

Cyclostrema excavatum, n.sp. Obtained at no other locality.

,, sp. (?).

Turbo (*Collonia*) *indutus*, n.sp. Obtained at no other locality.

Nerita tessellata, Gmelin. Obtained at no other locality by the Challenger. Recorded from West Indies.

Solarium sp. (?).

Scalaria tortilis, n.sp. Obtained at no other locality.

,, *acus*, n.sp. Obtained also at Station 73, 1000 fathoms. Recorded from North Atlantic.

Scalaria (*Acirsa*) *pyrrhias*, n.sp. Obtained at no other locality. STATION 24.
Oliva (*Olivella*) *vitilia*, n.sp. Obtained at no other locality.
,, sp. (?)
Columbella (*Pyrene*) *strix*, n.sp., var. *subacta*, nov. Obtained also at Stations 23 and 122.
,, (,,) *stricta*, n.sp. Obtained at no other locality.
Marginella (*Glabella*) *elata*, n.sp. Obtained at no other locality.
,, (*Granula*) *agger*, n.sp. Obtained at no other locality.
,, , two other species undetermined.
Pleurotoma (*Surcula*) *syngenes*, n.sp. Obtained also at Station 23.
,, (*Drillia*) *incilis*, n.sp. Obtained at no other locality.
,, (*Typhlomangelia*) *lincta*, n.sp. Obtained at no other locality.
,, (*Mangelia*) *corallina*, n.sp. Obtained at no other locality.
,, (,,) *tiara*, n.sp. Obtained also at Station 56, 1075 fathoms.
Clathurella formosa (Jeffreys). Obtained also at Stations 73, 78, and 85, 1000 to 1125 fathoms. Recorded from North Atlantic ("Triton" and "Travailleur").
,, *hormophora*, n.sp. Obtained also at Stations 23 and 122.
,, *chariessa*, n.sp. Obtained also at Stations 73, 78, 85, and 122, 350 to 1125 fathoms.
,, *pachia*, n.sp. Obtained at no other locality.
,, *pudens*, n.sp. Obtained at no other locality.
,, *araneosa*, n.sp. Obtained at no other locality.
,, *circumvoluta*, n.sp. Obtained at no other locality.
,, *perpauxilla*, n.sp. Obtained at no other locality.
,, , two other species undetermined.
Borsonia ceroplasta, n.sp. Obtained at no other locality.
Clionella exsculpta, n.sp. Obtained at no other locality.
,, *amblia*, n.sp. Obtained at no other locality.
,, *aglaophanes*, n.sp. Obtained at no other locality.
Cassis (?), two species (fry).
Natica sp. α. Obtained also at Station 23.
,, sp. β. Obtained also at Stations 85, 120, and 122. Recorded from St. Helena.
,, sp. γ.
Odostomia (*Obeliscus*) *nitidula* (Adams). Obtained also at Station 75, 450 fathoms. Recorded from Bay of Biscay, Mediterranean, Japan, and Corea.
,, (*Turbonilla*) *densicostata* (Philippi). Obtained at no other locality by the Challenger. Recorded from Mediterranean. Fossil—Post-Pliocene of Italy.

STATION 24. *Odostomia* (*Turbonilla*) *paucistriata*, Jeffreys. Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean.

„ („) *rhabdota*, n.sp. Obtained at no other locality.

„ („) *kymatoëssa*, n.sp. Obtained at no other locality.

„ („) *phrikalea*, n.sp. One specimen; obtained at no other locality.

„ („) sp. *a*, and fragments of other species.

Mathilda sp. (?).

Eulima piriformis, Brugnone. Obtained at no other locality by the Challenger. Recorded from Sicily. Fossil—Pleistocene of Sicily.

„ *psila*, n.sp. Obtained at no other locality.

„ *fasciata*, n.sp. Obtained at no other locality.

„ *chaskanon*, n.sp. Obtained at no other locality.

„ *hians*, n.sp. Obtained at no other locality.

„ *chydæa*, n.sp. Obtained at no other locality.

„ *cylindrata*, n.sp. Obtained at no other locality.

„ *gomphus*, n.sp. Eight specimens; obtained at no other locality.

„ *hyalina*, n.sp. Obtained at no other locality.

„ , five other species undetermined.

Cerithiopsis pulchella (Adams). Obtained at no other locality by the Challenger. Recorded from Jamaica.

Bittium, fragments of various species.

Triforis bigemma, n.sp. Obtained at no other locality by the Challenger. Recorded subsequently from Yukatan Strait ("Blake").

„ *inflata*, n.sp. Obtained at no other locality by the Challenger. Recorded subsequently from Yukatan Strait ("Blake").

Litiopa melanostoma, Rang. Obtained also at the surface near Station 64. Universally distributed in warm seas, especially Sargasso Sea, on floating seaweed.

Iphitus tuberculatus, n.sp. Obtained at no other locality.

Rissoa pyrrhias, n.sp. Obtained at no other locality.

„ *xanthias*, n.sp. Obtained also at Station 122, 350 fathoms.

„ *microstoma*, n.sp. Obtained at no other locality.

„ (*Alvania*) *didyma*, n.sp. Obtained at no other locality.

„ (*Onoba*) *brachia*, n.sp. Obtained at no other locality.

„ (*Cingula*) *alvearium*, n.sp. Obtained at no other locality.

„ (*Setia*) *tenuisculpta*, Watson. Obtained also at Station 344, 420 fathoms. Recorded from North Atlantic and Mediterranean.

Rissoa, five other species undetermined. STATION 24.

Rissoina chesnelii (Michaud). Obtained at no other locality by the Challenger. Recorded from West and East Indies, Mauritius, Ceylon, and Nicobars.

,, sp. (?).

Fenella elongata, n.sp. Obtained also at Station 78, 1000 fathoms.

Actæon turritus, n.sp. One specimen; obtained at no other locality.

Ringicula peracuta, n.sp. Obtained also at Stations 56 and 122, 1075 and 350 fathoms.

Scaphander punctostriatus (Mighels). Obtained also at Stations 73 and 78, 1000 fathoms. Recorded from Arctic, North Atlantic, and Mediterranean.

Utriculus spatha, n.sp. Obtained at no other locality.

,, , two other species undetermined.

Cylichna ovata, Jeffreys (?). Obtained also at Stations 73, 75 (?), 78 (?), and 122, 350 to 1000 fathoms. Recorded from North-East Atlantic ("Porcupine," "Travailleur," and "Washington"). Fossil —Middle Pliocene of Italy.

,, *discus*, n.sp. Obtained at no other locality.

,, (*Volvula*) *paupercula*, n.sp. Obtained at no other locality.

Cæcum lineicinctum, de Folin, n.sp. One specimen; obtained at no other locality.

POLYZOA (Busk, Zool. pt. 30).

Pasythea eburnea (Smitt). Obtained also at Stations 23 and 122.

Farciminaria atlantica, n.sp. Obtained also at Station 23.

BRACHIOPODA (Davidson, Zool. pt. 1).

Terebratula vitrea (Born), var. *minor*, Philippi. One specimen; obtained also at Stations 73 and 142, 1000 and 150 fathoms. Recorded from Arctic, North Atlantic, and Mediterranean. Fossil—Pliocene of Sicily.

Terebratulina wyvillii, n.sp. One specimen; obtained at no other locality. Another specimen said to be in Amsterdam Museum without name or derivation.

Magasella incerta, n.sp. Twelve small specimens, probably immature; obtained at no other locality.

In addition to the foregoing, the following are recorded in the Station-book :—Alcyonarian, *Archaster* sp. (?), *Myriotrochus*, several Annelids (only one reported), *Echiurus*, *Chætoderma* (?), Brachyuran.

STATION 24.

Excluding Protozoa, over 350 specimens of invertebrates were obtained at this Station, belonging to about 245 species, of which 129 are new to science, including representatives of 4 new genera; 95 of the new species were not obtained elsewhere.

Willemoes-Suhm writes:—"Among the worms got to-day were a fragment of an *Echiurus* (?) and an animal probably belonging to the genus *Chætoderma*. The latter is 52 mm. long and 2 mm. broad; the pharyngeal part with the proboscis is smooth, while all the rest of the body is covered with small spines, as remarked by Lovén in specimens from the North Sea. At the posterior extremity the two feathered appendages described by Lovén could not be found, the posterior end of the body being abruptly flattened. But perhaps these parts have been retracted, as they can be according to Lovén. The mouth was here also 'in antico fine inflato, angustum,' and this soft part was expanded by a liquid of a red colour, in which Moseley saw hæmoglobin. This species is probably very nearly allied to *Chætoderma nitidulum*, Lovén, which I have seen in Copenhagen; it was taken by Lovén on the west coast of Sweden, and by Lütken near Hellebäk at the entrance of the Oeresund (Keferstein, Beiträge zur systematischen und anatomischen Kenntniss der Sipunculiden, *Zeitschr. f. wiss. Zool.*, Bd. xv. p. 442). Being the only one got from the deep sea, I did not dissect the specimen."

The following species of Pteropoda, Heteropoda, and Foraminifera were observed in the deposit from this Station (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.)

ORGANISMS FROM THE DEPOSIT.

PTEROPODA (Pelseneer, Zool. pt. 65).

Limacina inflata (d'Orbigny).
,, *triacantha* (Fischer).
,, *lesueuri* (d'Orbigny).
,, *bulimoides* (d'Orbigny).
Peraclis reticulata (d'Orbigny).
Clio (*Creseis*) *virgula* (Rang).
,, (,,) *acicula* (Rang).
,, (*Hyalocylix*) *striata* (Rang).
,, (*Styliola*) *subula* (Quoy and Gaimard).
Clio pyramidata, Linné.
Cuvierina columnella (Rang).
Cavolinia trispinosa (Lesueur).
,, *quadridentata* (Lesueur).
,, *longirostris* (Lesueur).
,, *gibbosa* (Rang).
,, *uncinata* (Rang).
,, *inflexa* (Lesueur).

HETEROPODA (Smith, Zool. pt. 72).

Carinaria sp. (?), fry.
Atlanta peronii, Lesueur.
,, *souleyeti*, Smith.
Atlanta fusca, Eydoux and Souleyet.
,, *inclinata*, Eydoux and Souleyet.

FORAMINIFERA (Brady, Zool. pt. 22).—The pelagic species, which make up about 40 per cent. of the carbonate of lime present in the deposit, are marked thus ×:—

Nodobacularia tibia, Jones and Parker.
Biloculina comata, Brady.
,, *depressa*, d'Orbigny.
Biloculina elongata, d'Orbigny.
,, *irregularis*, d'Orbigny.
,, *lævis* (Defrance).

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Biloculina ringens (Lamarck).
,, *sphæra*, d'Orbigny.
,, *tubulosa*, Costa.
Spiroloculina crenata, Karrer.
,, *limbata*, d'Orbigny.
,, *planulata* (Lamarck).
,, *robusta*, Brady.
Miliolina auberiana (d'Orbigny).
,, *bucculenta*, Brady.
,, ,, var. *placentiformis*, Brady.
,, *ferussacii* (d'Orbigny).
,, *insignis*, Brady.
,, *linnæana* (d'Orbigny).
,, *oblonga* (Montagu).
,, *reticulata* (d'Orbigny).
,, *tricarinata* (d'Orbigny).
,, *trigonula* (Lamarck).
Articulina conico-articulata (Batsch).
,, *sagra*, d'Orbigny.
,, *sulcata*, Reuss.
Vertebralina insignis, Brady.
,, *turmidium*, Brady (?).
Ophthalmidium inconstans, Brady.
,, *tumidulum*, Brady.
Planispirina celata (Costa).
,, *sigmoidea*, Brady.
Cornuspira carinata (Costa).
,, *foliacea* (Philippi).
,, *involvens*, Reuss.
Peneroplis lævigatus, Karrer.
,, *pertusus* (Forskål).
Orbiculina adunca (Fichtel and Moll).
Orbitolites marginalis (Lamarck).
Pelosina (?) sp.
Psammosphæra fusca, Schulze.
Hyperammina arborescens (Norman).
,, *elongata*, Brady.
,, *friabilis*, Brady.
,, *ramosa*, Brady.
,, *subnodosa*, Brady.
,, *vagans*, Brady.
Marsipella elongata, Norman.
Rhabdammina discreta, Brady.
,, *linearis*, Brady.
Aschemonella catenata (Norman).
Reophax dentaliniformis, Brady.
,, *pilulifera*, Brady.
,, *scorpiurus*, Montfort.
Haplophragmium anceps, Brady.
,, *calcareum*, Brady.
Haplophragmium emaciatum, Brady.
,, *globigeriniforme* (Parker and Jones).
,, *latidorsatum* (Bornemann).
,, *scitulum*, Brady.
,, *tenuimargo*, Brady.
Placopsilina cenomana (d'Orbigny).
Haplostiche soldanii (Jones and Parker).
Bdelloidina aggregata, Carter.
Thurammina papillata, Brady.
Hormosina carpenteri, Brady.
,, *globulifera*, Brady.
,, *ovicula*, Brady.
Ammodiscus gordialis (Jones and Parker).
,, *incertus* (d'Orbigny).
Trochammina coronata, Brady.
,, *galeata*, Brady.
,, *lituiformis*, Brady.
,, *pauciloculata*, Brady.
,, *proteus*, Karrer.
,, *squamata*, Jones and Parker.
,, *trullissata*, Brady.
Webbina clavata, Jones and Parker.
Cyclammina cancellata, Brady.
,, *pusilla*, Brady.
Textularia agglutinans, d'Orbigny.
,, *aspera*, Brady.
,, *barrettii*, Jones and Parker.
,, *concava* (Karrer).
,, *gramen*, d'Orbigny (?).
,, *luculenta*, Brady.
,, *trochus*, d'Orbigny.
,, *turris*, d'Orbigny.
Verneuilina propinqua, Brady.
,, *pygmæa* (Egger).
,, *spinulosa*, Reuss.
,, *triquetra* (Münster).
,, *variabilis*, Brady.
Tritaxia caperata, Brady.
Bigenerina capreolus (d'Orbigny).
,, *pennatula* (Batsch).
,, *robusta*, Brady.
Pavonina flabelliformis, d'Orbigny.
Gaudryina filiformis, Berthelin.
,, *pupoides*, d'Orbigny.
,, ,, var. *chilostoma*, Reuss.
,, *scabra*, Brady.
,, *siphonella*, Reuss.
,, *subrotundata*, Schwager.
Valvulina fusca (Williamson).
Clavulina angularis, d'Orbigny (?).

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Clavulina communis, d'Orbigny.
,, *parisiensis*, d'Orbigny.
,, ,, var. *humilis*, Brady.
Bulimina aculeata, d'Orbigny.
,, *affinis*, d'Orbigny.
,, *buchiana*, d'Orbigny.
,, *elegantissima*, d'Orbigny.
,, *inflata*, Seguenza.
,, *pyrula*, d'Orbigny.
,, *subteres*, Brady.
Virgulina squamosa, d'Orbigny.
Bolivina decussata, Brady (?).
,, *porrecta*, Brady.
,, *punctata*, d'Orbigny.
Cassidulina calabra (Seguenza).
,, *crassa*, d'Orbigny.
,, *lævigata*, d'Orbigny.
,, *subglobosa*, Brady.
Chilostomella ovoidea, Reuss.
Lagena gracillima (Seguenza).
,, *hispida*, Reuss.
,, *interrupta*, Williamson.
,, *lævis* (Montagu).
,, *lagenoides* (Williamson).
,, *marginata* (Walker and Boys).
,, *orbignyana* (Seguenza).
,, *squamosa* (Montagu).
,, *striatopunctata*, Parker and Jones.
,, *sulcata* (Walker and Jacob).
Nodosaria (*Glandulina*) *æqualis*, Reuss.
,, *comata* (Batsch).
,, *communis*, d'Orbigny.
,, *consobrina*, d'Orbigny, var. *emaciata*, Reuss.
,, *costulata*, Reuss.
,, *farcimen*, Soldani.
,, *filiformis*, d'Orbigny.
,, *hispida*, d'Orbigny.
,, *intercellularis*, Brady.
,, (*Glandulina*) *lævigata*, d'Orbigny.
,, *obliqua* (Linné).
,, *raphanus* (Linné).
,, *roemeri* (Neugeboren).
,, *soluta*, Reuss.
,, *vertebralis* (Batsch).
Lingulina carinata, d'Orbigny.
,, ,, var. *seminuda*, Hantken.
Frondicularia alata, d'Orbigny.
Rhabdogonium tricarinatum (d'Orbigny).
Marginulina costata (Batsch).
Vaginulina legumen (Linné), var. *arquata*, Brady.
,, *linearis* (Montagu).
Cristellaria aculeata, d'Orbigny.
,, *acutauricularis* (Fichtel and Moll).
,, *articulata*, Reuss.
,, *calcar* (Linné).
,, *compressa*, d'Orbigny.
,, *convergens*, Bornemann.
,, *crepidula* (Fichtel and Moll).
,, *cultrata* (Montfort).
,, *echinata* (d'Orbigny).
,, *gibba*, d'Orbigny.
,, *italica* (Defrance).
,, *latifrons*, Brady.
,, *orbicularis* (d'Orbigny).
,, *papillosa* (Fichtel and Moll).
,, *reniformis*, d'Orbigny.
,, *rotulata* (Lamarck).
,, *schloenbachi*, Reuss.
,, *variabilis*, Reuss.
Polymorphina angusta, Egger (?).
,, *compressa*, d'Orbigny.
,, *ovata*, d'Orbigny.
,, *rotundata* (Bornemann) (?).
Uvigerina asperula, Czjzek.
,, ,, var. *ampullacea*, Brady.
,, *pygmæa*, d'Orbigny.
Sagrina columellaris, Brady.
,, *dimorpha*, Parker and Jones.
× *Globigerina æquilateralis*, Brady.
× ,, *bulloides*, d'Orbigny.
× ,, *conglobata*, Brady.
× ,, *dubia*, Egger.
× ,, *rubra*, d'Orbigny.
× ,, *sacculifera*, Brady.
Orbulina porosa, Terquem.
× ,, *universa*, d'Orbigny.
× *Pullenia obliquiloculata*, Parker and Jones.
,, *quinqueloba*, Reuss.
,, *sphæroides* (d'Orbigny).
Sphæroidina bulloides, d'Orbigny.
× ,, *dehiscens*, Parker and Jones.
× *Candeina nitida*, d'Orbigny.
Spirillina decorata, Brady.
,, *vivipara*, Ehrenberg.
× *Cymbalopora* (*Tretomphalus*) *bulloides* (d'Orbigny).
,, *poeyi* (d'Orbigny).
Discorbina orbicularis (Terquem).
Planorbulina mediterranensis, d'Orbigny.
Truncatulina haidingerii (d'Orbigny).

Station 24.

Truncatulina lobatula (Walker and Jacob).
„ *reticulata* (Czjzek).
„ *robertsoniana*, Brady.
„ *rosea* (d'Orbigny).
„ *soluta*, Brady.
„ *ungeriana* (d'Orbigny).
Anomalina ammonoides (Reuss).
„ *ariminensis* (d'Orbigny).
„ *coronata*, Parker and Jones.
„ *foveolata*, Brady (?).
„ *polymorpha*, Costa.
Carpenteria proteiformis, Goës.
„ *utricularis*, Carter.
„ sp. (?).
Pulvinulina auricula (Fichtel and Moll).
„ *dispansa*, Brady.
„ *elegans* (d'Orbigny).
× „ *menardii* (d'Orbigny).
× *Pulvinulina menardii*, var. *fimbriata*, Brady.
× „ *micheliniana* (d'Orbigny).
„ *pauperata*, Parker and Jones.
„ *punctulata* (d'Orbigny).
„ *repanda* (Fichtel and Moll).
„ *schreibersii* (d'Orbigny).
× „ *tumida*, Brady.
„ *vermiculata* (d'Orbigny).
Rotalia soldanii, d'Orbigny.
Gypsina globulus (Reuss).
„ *inhærens* (Schultze).
„ *vesicularis* (Parker and Jones).
Polytrema miniaceum (Linné).
Nonionina scapha (Fichtel and Moll).
„ *turgida* (Williamson).
„ *umbilicatula* (Montagu).
Polystomella striatopunctata (Fichtel and Moll).
Amphistegina lessonii, d'Orbigny.

Cannartidium amphisiphon was also observed in the deposit among other Radiolaria.

Station 25 (Sounding 72), St. Thomas to Bermuda (see Charts 6 and 7, and Diagram 2). Station 25.

March 26, 1873; lat. 19° 41′ N., long. 65° 7′ W.

Temperature of air at noon, 76°·8; mean for the day, 76°·3.

Temperature of water:—

	°		°
Surface, ...	76·0	800 fathoms, . . .	39·0
100 fathoms, . . .	68·8	900 „ . . .	38·7
200 „ . .	61·5	1000 „ . . .	38·5
300 „ . . .	54·0	1100 „ . . .	38·3
400 „ . . .	47·4	1200 „ . . .	38·1
500 „ . . .	43·8	1300 „ . . .	37·9
600 „ . . .	41·5	1400 „ . . .	37·7
700 „ . . .	40·0	1500 „ . . .	37·5

Density at 60° F. at surface, 1·02692; bottom, 1·02631.

Depth, 3875 fathoms; deposit, Red Clay, containing 7·15 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 5.20 A.M. shortened and furled sails, and got up steam to sound. At 8 A.M. sounded in 3875 fathoms. No bottom temperature was obtained, both thermometer bulbs being broken by the pressure. At 10.30 A.M. lowered small dredge, with one of the Hydra disengaging rods and a weight of 4 cwts. 2 fathoms behind the dredge. Two weights of 1 cwt. each were run down to the toggle 500 fathoms from the dredge. At

STATION 25. 1.30 P.M. commenced heaving in the dredge. The toggle came up with only one weight, and at 5 P.M. the dredge came up with a considerable quantity of Red Clay. In the course of the afternoon temperatures at intervals of 100 fathoms down to 1500 fathoms were obtained. The carbonic acid was determined in the bottom water, and amounted to 57·0 milligrammes per litre. At 7.30 P.M. made all plain sail.

Distance from Bermuda at noon, 754 miles. Made good 58 miles. Amount of current 14 miles, direction N. 37° W.

STATION 26.

Station 26 (Sounding 73), St. Thomas to Bermuda (see Chart 6 and Diagram 2).

March 27, 1873; lat. 21° 26′ N., long. 65° 16′ W.
Temperature of air at noon, 73°·8; mean for the day, 75°·0.
Temperature of water at surface, 76°·0.
Density at 60° F. at surface, 1·02704; bottom, 1·02594.
Depth, 2800 fathoms; deposit, Red Clay, containing 6·00 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 1.15 P.M. shortened and furled sails, and got up steam to sound. At 2.30 P.M. sounded in 2800 fathoms. The thermometer at the bottom registered several degrees below the freezing point, but it was believed to be faulty. Buchanan sent down some small glass hermetically-sealed tubes enclosed in a copper cylinder open at both ends. The glass in the case of one of the tubes was shattered into the finest powder, like snow. The copper cylinder was compressed and crumpled together opposite the spot where the tube had been. The inference was that, the glass tube giving way very suddenly and leaving a comparative vacuum, there was not sufficient time for the production of equilibrium by the transmission of water through the ends of the cylinder, but this was partly brought about by the more direct action of the pressure, the cylinder wall being driven in. The experiment was, indeed, a kind of reversal of the explosion of gases or gunpowder. Obtained sample of bottom water. The carbonic acid was determined in the surface water, and amounted to 46·0 milligrammes per litre. Jolly-boat away collecting surface specimens. At 5.10 P.M. completed heaving in sounding line.

Distance from Bermuda at noon, 654 miles. Made good 100 miles. Amount of current 14 miles, direction N. 55° W.

ORGANISMS FROM SURFACE-NETS. **Surface Organisms.**—Murray was away in jolly-boat picking up Crustacea, *Antennarius*, pipe-fish, &c., from numerous patches of gulf-weed.

Station 27 (Sounding 74), St. Thomas to Bermuda (see Chart 6 and Diagram 2). STATION 27.

March 28, 1873; lat. 22° 49′ N., long. 65° 19′ W.

Temperature of air at noon, 76°·3; mean for the day, 75°·6.

Temperature of water:—

	°		°
Surface,*. . . .	75·5	900 fathoms, ...	39·1
100 fathoms, . . .	72·5	1000 „	39·0
200 „ . . .	64·7	1100 „	38·7
300 „ . . .	57·0	1200 „	38·4
400 „ . . .	49·7	1300 „	38·1
500 „ . . .	45·0	1400 „	37·8
600 „ . . .	42·2	1500 „	37·5
700 „ . . .	40·8	Bottom, ...	36·2
800 „ . . .	40·0		

Density at 60° F. at surface, 1·02710; bottom, 1·02601.

Depth, 2960 fathoms; deposit, Red Clay, containing 3·25 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.15 A.M. shortened and furled sails, and got up steam to sound. At 8 A.M. sounded in 2960 fathoms. At noon took a series of temperatures at intervals of 100 fathoms down to 1500 fathoms. The carbonic acid was determined in the bottom water, and amounted to 53·0 milligrammes per litre. Completed sounding at 2 P.M., and made all plain sail. Two sharks with white fins, about 5 or 6 feet long, swam backwards and forwards near the ship for a long time while sounding; the sailors called them shovel-nosed sharks.

Distance from Bermuda at noon, 566 miles. Made good 89 miles. Amount of current 24 miles, direction N. 44° W.

Station 28 (Sounding 75), St. Thomas to Bermuda (see Chart 6 and Diagram 2). STATION 28.

March 29, 1873; lat. 24° 39′ N., long. 65° 25′ W.

Temperature of air at noon, 77°·8; mean for the day, 74°·8.

Temperature of water:—

	°		°
Surface, ...	75·0	800 fathoms, ...	40·0
50 fathoms, . . .	74·0	900 „	39·5
100 „ . . .	67·2	1000 „	39·1
150 „ . . .	64·6	1100 „	38·7
200 „ . . .	63·5	1200 „	38·4
300 „ . . .	58·3	1300 „	38·1
400 „ . . .	51·8	1400 „	37·8
500 „ . . .	45·2	1500 „	37·5
600 „ . . .	42·3	Bottom „ . . .	36·3
700 „ . . .	41·0		

STATION 28.

Density at 60° F. at surface, 1·02710; bottom, 1·02608.

Depth, 2850 fathoms; deposit, Red Clay, containing 18·79 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 7.30 A.M. shortened and furled sails, and got up steam to sound and dredge. At 9 A.M. sounded in 2850 fathoms. At 11 A.M. lowered dredge. At 1 P.M. took a series of temperatures at intervals of 100 fathoms down to 1500 fathoms. At 5.30 P.M. dredge came up empty, rope, weights, tangles, and dredge twisted round each other in almost inextricable confusion. Took a second series of temperatures at intervals of 50 fathoms down to 200 fathoms, in order to confirm temperatures obtained earlier in the day. The carbonic acid was determined in the bottom water, and amounted to 52·0 milligrammes per litre.

Distance from Bermuda at noon, 458 miles. Made good 110 miles. Amount of current 20 miles, direction N. 47° W.

ORGANISMS FROM SURFACE.

Surface Organisms.—Moseley writes: "Murray and I went out in the jolly-boat. The gulf-weed was in much greater abundance than we have seen it before. There were patches about the ship in the morning several square yards in extent. *Antennarius* is to be found clinging even to very small isolated pieces, as are also the Crustacea, the animals not being by any means confined to the larger pieces. I obtained several Planarians."

STATION 29.

Station 29 (Sounding 76), St. Thomas to Bermuda (see Chart 6 and Diagram 2).

March 31, 1873; lat. 27° 49′ N., long. 64° 59′ W.

Temperature of air at noon, 74°·3; mean for the day, 72°·7.

Temperature of water:—

	°		°
Surface,	72·0	350 fathoms,	54·5
10 fathoms,	73·0	400 „	50·9
20 „	72·5	450 „	47·4
30 „	71·4	500 „	44·7
40 „	70·3	600 „	41·7
50 „	69·4	700 „	40·5
60 „	68·4	800 „	39·8
70 „	67·4	900 „	39·3
80 „	66·4	1000 „	38·9
90 „	65·5	1100 „	38·6
100 „	64·5	1200 „	38·3
150 „	63·8	1300 „	38·0
200 „	62·8	1400 „	37·7
250 „	61·2	1500 „	37·4
300 „	58·0	Bottom,	36·4

Density at 60° F. :— STATION 29.

Surface,	1·02739	400 fathoms,	1·02640
100 fathoms,	1·02782	500 „	1·02612
200 „	1·02708	Bottom,	1·02607
300 „	1·02672		

Depth, 2700 fathoms; deposit, Red Clay, containing 21·84 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.35 A.M. put dredge over. Shortened and furled sails, and got up steam to sound and dredge. At 9 A.M. sounded in 2700 fathoms. At 10 A.M. obtained serial temperatures. At 1 P.M. obtained specimens of water at different depths to ascertain the specific gravity. The carbonic acid was determined in surface water, and amounted to 48·0 milligrammes per litre. At 2.45 P.M. commenced heaving in dredge, which came up at 5 P.M. with a large quantity of Red Clay. On sifting the deposit the only animal of the higher groups obtained was a small bright scarlet Caridid shrimp, along with some large bottom-living Foraminifera. Numerous patches of gulf-weed passed the ship during the day.

Distance from Bermuda at noon, 266 miles. Made good 85 miles. Amount of current 14 miles, direction N. 55° E.

ORGANISMS FROM SURFACE-NETS.

Surface Organisms.—After leaving St. Thomas, the tow-net was constantly put out, and yielded Oscillatoriaceæ and a few gulf-weed animals, but it was not till March 31 that the weed appeared in large patches, and the Crustacea, &c., inhabiting it were obtained in abundance. Several small, apparently young, flying fish, a *Syngnathus*, and two rather large specimens of *Antennarius* were caught, and Radiolaria were in enormous abundance.

Station 30 (Sounding 77), St. Thomas to Bermuda (see Chart 6 and Diagram 2). STATION 30.

April 1, 1873; lat. 29° 5′ N., long. 65° 1′ W.

Temperature of air at noon, 76°·3; mean for the day, 73°·5.

Temperature of water at surface, 72°·0; bottom, 36°·5.

Density at 60° F. at surface, 1·02735; bottom, 1·02774.

Depth, 2600 fathoms; deposit, Red Clay, containing 28·88 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 10.30 A.M. shortened and furled sails. Lowered jolly-boat and second gig for collecting surface animals and gulf-weed, of which large quantities were seen in the course of the day. At 1 P.M. sounded in 2600 fathoms.

Distance from Bermuda at noon, 191 miles. Made good 76 miles. Amount of current 4 miles, direction N. 61° E.

Station 0. Organisms from the Surface.

Surface Organisms.—The following species are recorded in the Zoological Reports from the North Atlantic, April 1873, and from the gulf-weed, south of Bermuda:—

CIRRIPEDIA (Hoek, Zool. pt. 25).

Lepas anserifera, Linné. From gulf-weed.

MACRURA (Spence Bate, Zool. pt. 52).

Sergestes edwardsii, Kröyer.
Latreutes ensiferus (M.-Edwards). From gulf-weed.
Hippolyte bidentatus, n.sp. From gulf-weed.
Palæmon natator, M.-Edwards. From gulf-weed.

BRACHYURA (Miers, Zool. pt. 49).

Neptunus (Neptunus) sayi, M.-Edwards. From gulf-weed.
Nautilograpsus minutus (Linné). From gulf-weed.

CEPHALOPODA (Hoyle, Zool. pt. 44).

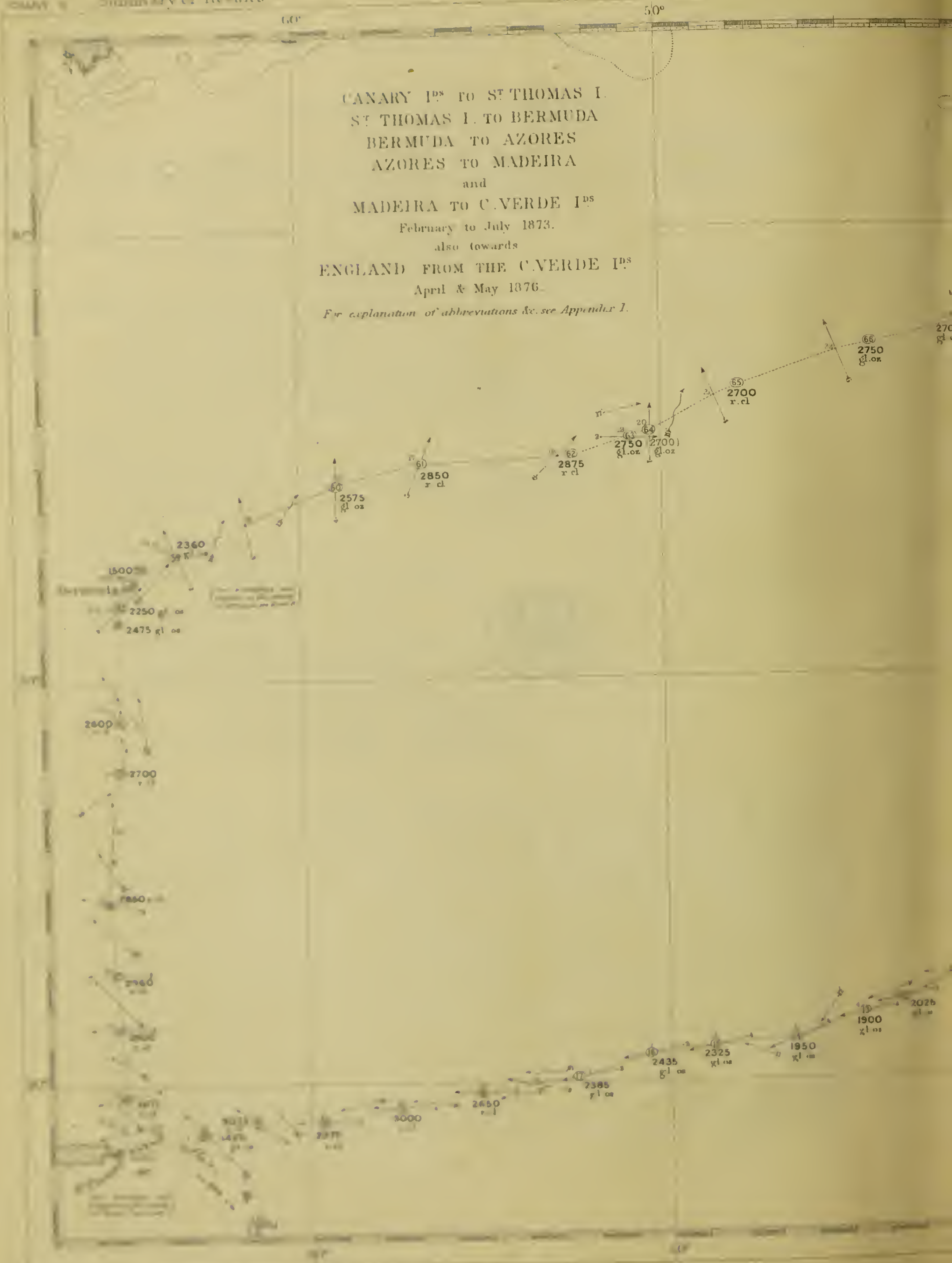
Teleoteuthis caribbæa (Lesueur), Verrill.

FISHES (Günther, Zool. pts. 6 and 78).

Psenes cyanophrys, C.V. From gulf-weed.
Antennarius marmoratus, Günther. From gulf-weed.
Exocoetus spilurus, Günther. From gulf-weed.
„ *affinis*, Günther (?). From gulf-weed.
Syngnathus pelagicus, Osbeck. From gulf-weed.

Moseley writes: "We are at last amongst large patches of the gulf-weed. From the deck at noon patches, some nearly half an acre in extent, were to be seen on the surface in every direction. The bright yellow of the weed contrasts most beautifully with the deep blue of the sea. The sea was perfectly filled with Oscillatoriaceæ of the usual two forms, fasciculate and globular. These little bodies reflect light strongly, and from the deck the water appeared as if full of small particles of mica in suspension. Separated floats of *Sargassum*, covered with white *Membranipora*, were floating about on the surface in considerable quantities, and were puzzling to make out from a distance.

"I went with Murray to overhaul some of the weed-beds. We got plenty of shrimps and crabs, of which the weed is full, also two small Cephalopods and some small (young) flying fish. The whole of the animals in the gulf-weed have acquired in their colouring a most remarkable protective resemblance to it. The crabs and shrimps are of a yellow colour exactly like that of the weed, and have markings of white which represent the *Membranipora* constantly present upon its surface. The largest shrimp has a dark


50°
CANARY I^DS TO S^T THOMAS I.
S^T THOMAS I. TO BERMUDA
BERMUDA TO AZORES
AZORES TO MADEIRA
and
MADEIRA TO C. VERDE I^DS
February to July 1873.
also towards
ENGLAND FROM THE C. VERDE I^DS
April & May 1876.
For explanation of abbreviations &c. see Appendix I.
2750
gl.oz
2700
r.cl
2750
gl.oz
2700
gl.oz
2875
r cl
2850
r cl
2575
gl oz
2360
2250
2475
2600
2700
1900
2325
1950
2435
2385
2650
3000


30°
20°
40°
30°
20°
AZORES OR WESTERN Ids
Fayal
S. Miguel
{For soundings and stations in the vicinity of the Azores see sheet 10.}
Madeira
{For soundings and stations in the vicinity of Madeira see sheet 4.}
Tenerife
CANARY ISLANDS
St. Vincent
CAPE VERDE Ids
1675 gl.oz
1675 gl.oz
2200
1240 Pt.oz
1000 pt.oz
1350 pt.oz
2025 gl.oz
2660 gl.oz
2675 gl.oz
2400 gl.oz
1650 gl.oz
1675 gl.oz
1125 volc.m
1890 gl.oz
2300 gl.oz
1525 pt.oz
1945 gl.oz
2220
2965 r.cl
2740 r.cl
2300 gl.oz
3150 r.cl
2700 r.cl
2750 r.cl
2950 r.cl
2400 gl.oz
2400 gl.oz
2075 gl.oz
1975 gl.oz
30°
20°

brown colour, with brilliant white, sharply defined, areas, and thus closely resembles the older darker pieces of *Sargassum*, which also are thickest covered with *Membranipora*. *Antennarius* is of the weed colour, and the peculiar white spots on the body evidently have a like signification. Even one of the Planarians living in the weed is yellow marked with brown. STATION 30.

"In the morning when I was out in a boat Radiolarians had been scarce, but in the forenoon it fell almost a dead calm, and Murray, going out in the afternoon after it had been calm some time, found them on the surface in enormous abundance."

April 2, 1873. APRIL 2, 1873.

Temperature of water :—

Surface, ...	69°·5	160 fathoms, ...	64°·2
20 fathoms, . . .	67·0	180 "	63·9
40 " . . .	67·0	200 "	62·1
60 " . . .	66·8	225 "	63·3
80 " . . .	66·0	250 "	62·3
100 " . . .	66·3	275 "	61·8
120 " . . .	65·6	300 "	60·6
140 " . . .	63·8		

At daylight a spar of pitch pine was picked up and hauled on board. At 9.30 A.M. obtained serial temperatures down to 300 fathoms. Cutter was lowered to try the current, and jolly-boat for surface collecting.

Surface Organisms.—Moseley writes: "The spar of pitch pine was covered with a *Lepas* [*Lepas anatifera*, Linné, see Hoek, Zool. pt. 25] in abundance, and numbers of the small gulf-weed crab [*Nautilograpsus minutus* (Linné), see Miers, Zool. pt. 49]. The colour of the crabs here matched admirably with the dark coloured wood and white *Lepas*-shells showing out in relief upon it. But I suspect that they are merely casual visitors to such a log, and that their real home is the gulf-weed, the white patches being imitative of the *Flustra* and not *Lepas*-shells, perhaps of both since a few *Lepas*-shells are to be met with on the weed. A small brown Nudibranch (*Æolis*) was abundant on the log, and there were plenty of its eggs disposed in small rounded white patches amongst the bases of the *Lepas*-stems. These ova contained embryos in an advanced stage of development; they seemed closely to resemble the embryos of *Tergipes* figured by Selenka. Some Campanularians were the only other animals on the log, but there were a few small Diatoms growing on it. ORGANISMS FROM SURFACE.

"The tow-net, which for some time past has been almost barren, produced some very fine specimens of *Phyllosoma*, a male *Lucifer* with spermatophores, larvæ of *Squilla*, *Nymphon*, the yellow coloured gulf-weed Planarian, and several Leptocephali. A dolphin was speared with the 'grains.'"

April 2, 1873

Willemoes-Suhm writes: "Larvæ of Annelids, 3 mm. in length, were found for the first time at sea. As we were in very deep water, it is probable that the adults live in the gulf-weed."

Stations 31 to 32A.

Stations 31 to 32A (Soundings 78 to 80), St. Thomas to Bermuda (see Charts 6 and 8, and Diagram 2).

April 3, 1873; lat. 31° 24′ N., long. 65° 0′ W.
Temperature of air at noon, 69°·8; mean for the day, 68°·5.
Temperature of water at surface, 69°·5.

At 6 A.M. stopped and sounded in 2475 fathoms, deposit Globigerina Ooze, containing 54·70 per cent. of carbonate of lime, bottom temperature 36°·5 (Station 31). At 8 A.M. proceeded under steam. At 11.30 A.M. stopped and sounded in 2250 fathoms, deposit Globigerina Ooze, containing 69·61 per cent. of carbonate of lime, bottom temperature 36°·7 (Station 32). At 1 P.M. proceeded under steam. At 3 P.M. sounded in 1820 fathoms, deposit Coral Mud, containing 81·86 per cent. of carbonate of lime (Station 32A).

Station 32B.

Station 32B.

At 6 P.M. stopped and sounded in 950 fathoms, deposit Coral Mud, containing 89·36 per cent. of carbonate of lime (Station 32B).

Distance at noon from Bermuda, 26 miles. Made good 128 miles. Amount of current 5 miles, direction N. 11° W.

Organisms from the Deposit.

The following species of Pteropoda, Foraminifera, and Diatoms were observed in the deposit from this Station (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.):—

PTEROPODA (Pelseneer, Zool. pt. 65).

Limacina bulimoides (d'Orbigny).

FORAMINIFERA (Brady, Zool. pt. 22).—The pelagic species, which make up about 30 per cent. of the carbonate of lime present in the deposit, are marked thus ×:—

Biloculina depressa, d'Orbigny.	*Articulina funalis*, Brady.
„ *ringens* (Lamarck).	*Haplophragmium glomeratum*, Brady.
Spiroloculina acutimargo, Brady.	*Textularia agglutinans*, d'Orbigny.
„ [illegible], Karrer.	*Bulimina inflata*, Seguenza.
Miliolina [illegible], Brady.	*Bolivina dilatata*, Reuss.
„ *seminulum* (Linné).	„ *robusta*, Brady.

Cassidulina subglobosa, Brady.
× *Globigerina bulloides*, d'Orbigny.
× ,, *conglobata*, Brady.
× ,, *dubia*, Egger.
× ,, *inflata*, d'Orbigny.
× ,, *rubra*, d'Orbigny.
× ,, *sacculifera*, Brady.
× *Orbulina universa*, d'Orbigny.
× *Pullenia obliquiloculata*, Parker and Jones.
,, *quinqueloba*, Reuss.
,, *sphæroides* (d'Orbigny).
Sphæroidina bulloides, d'Orbigny.
Spirillina decorata, Brady.
,, sp. (?).
Discorbina orbicularis (Terquem).
,, *vilardeboana* (d'Orbigny).
Planorbulina mediterranensis, d'Orbigny.
Truncatulina tenera, Brady.
,, *ungeriana* (d'Orbigny).
,, sp. (?).
× *Pulvinulina canariensis* (d'Orbigny).
× ,, *menardii* (d'Orbigny).
× ,, *micheliniana* (d'Orbigny).
× ,, *tumida*, Brady.
Rotalia soldanii, d'Orbigny.
Polytrema miniaceum (Linné).
Nonionina umbilicatula (Montagu).
Polystomella subnodosa (Münster).
Amphistegina lessonii, d'Orbigny.

DIATOMACEÆ.—The following species of Diatoms were observed by Mr. Comber:—

Amphora gigantea, Grunow.
,, *crassa*, Gregory.
,, *oblonga*, Gregory.
Navicula lyra, Ehrenberg.
,, *clavata*, Gregory.
,, *gregoriana*, Greville.
,, *prætexta*, Ehrenberg.
,, *brasiliensis*, Grunow.
,, *notabilis*, Greville.
,, *græffii*, A. Schmidt.
,, *campylodiscus*, Grunow.
,, *coffeæformis*, A. Schmidt.
,, *lacrimans*, A. Schmidt.
,, *didyma*, Kutzing.
,, *multicostata*, Grunow.
,, *splendida*, Gregory.
,, *aspera*, Ehrenberg.
,, *consors*, A. Schmidt.
,, *janischii*, Castracane.
,, *strangulata*, Greville.
Cocconeis scutellum, Ehrenberg.
,, *moorei* (= *Rhaphoneis*, O'Meara).
,, *pseudomarginata*, Gregory.
Orthoneis splendida, Grunow.
Nitzschia panduriformis, Gregory.
,, *plana*, W. Smith.
,, *circumsuta*, Grunow.
Synedra gaillionii, Ehrenberg.
Euphyllodium spathulatum, Shadbolt.
Surirella fastuosa, Ehrenberg.
Campylodiscus imperialis, Greville.
,, *latus*, Shadbolt.
,, *biangulatus*, Greville.
,, *ecclesianus*, Greville.
Grammatophora epsilon, Grunow.
Fragilaria mutabilis, Grunow.
,, *schwartzii*, Grunow.
Glyphodesmis williamsonii, Grunow.
,, sp. (?).
Dimeregramma nanum, Ralfs.
Plagiogramma lyratum, Greville.
Coscinodiscus concavus, Ehrenberg.
,, *excentricus*, Ehrenberg.
,, *nitidus*, Gregory.
,, *nitidulus*, Grunow.
,, *subtilis*, Ehrenberg.
,, *radiatus*, Ehrenberg.
,, *nodulifer*, Janisch.
,, *africanus*, Janisch.
Ethmodiscus sp. (?).
Paralia sulcata, Cleve.
Hemidiscus cuneiformis, Wallich.
Biddulphia pulchella, Gray.
,, *tuomeyii*, Roper.
Triceratium balearicum, Cleve and Grunow, forma *tetragona*.
,, *pentacrinus*, Wallich, forma *pentagona*.

Cladocora arbuscula, M.-Edwards and Haime. Dead fragment; obtained also in Simon's Bay, Cape, 10 to 20 fathoms. STATION 33.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophiomusium cancellatum, n.sp. (?). Obtained also at Station 236, 420 to 775 fathoms.

Ophiopyren longispinus, n.g., n.sp. Obtained also at Stations 23 and 24.

Amphilepis norvegica, Ljungman (?). Obtained also at Stations 45 and 46, 1240 and 1350 fathoms.

Ophiacantha troscheli, n.sp. Obtained at no other locality by the Challenger. Recorded subsequently from North Atlantic ("Blake").

Ophiomitra chelys (Wyville Thomson), n.sp. (var. ?). For distribution see Station 3.

Astroschema brachiatum, n.sp. Obtained at no other locality.

ANNELIDA (M'Intosh, Zool. pt. 34).

Eulepis wyvillei, n.sp. One specimen; obtained at no other locality.

Eunotomastus grubei, n.g., n.sp. One fragmentary specimen; obtained at no other locality. Only species of the genus.

Placostegus assimilis, n.sp. One specimen; obtained at no other locality.

Spirobranchus occidentalis, n.sp. One specimen, attached to tube of *Placostegus assimilis*; obtained at no other locality.

OSTRACODA (Brady, Zool. pt. 3).

Pontocypris trigonella, Sars. Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil—Post-Tertiary of Scotland.

Bairdia foveolata, Brady (?). Obtained also at Stations 93, 94, 162, 187, 189, 279, Hong Kong Harbour, and Admiralty Islands, 6 to 1150 fathoms.

Cythere bermudæ, Brady. Obtained at no other locality by the Challenger. Recorded from Colon-Aspinwall.

,, *fungoides* (Brady). Obtained also at Stations 187 and 189, 6 to 8 and 28 fathoms. Recorded from Australia.

Xestoleberis curta, Brady. Obtained also at Stations 149, 187, 300, Port Jackson, and Sandwich Islands, 2 to 1375 fathoms. Recorded from West Indies.

Asterope sp. (?). A few imperfect specimens.

Cytherella pulchra, Brady. Obtained also at Stations 167, 344, and Port Jackson, 2 to 420 fathoms. Recorded from Australia.

,, *irregularis*, n.sp. A few detached valves; obtained at no other locality.

Station 33 BRACHYURA (Miers, Zool. pt. 49).

Geryon (?) *incertus*, n.sp. One injured specimen; obtained at no other locality.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Corbula philippii, n.sp. Obtained at no other locality by the Challenger. Recorded from Hayti.

Neæra consociata, n.sp. Obtained also at Station 24.

„ *curta*, Jeffreys. Single valve; obtained also at Station 75, 450 fathoms. Recorded from North Atlantic ("Porcupine").

„ *claviculata*, Dall. Obtained at no other locality by the Challenger. Recorded from North Atlantic ("Blake").

„ *congenita*, n.sp. Single valve, afterwards unfortunately destroyed; obtained at no other locality.

Ervilia subcancellata, n.sp. Obtained also at Stations 113A and 120, 25 and 675 fathoms. Recorded from West Indies.

Circe bermudensis, n.sp. Obtained at no other locality.

Verticordia ornata (d'Orbigny), var. Three valves; obtained at no other locality by the Challenger. Recorded from West Atlantic, California, and China Seas.

Lucina (*Codakia*) *pecten*, Lamarck. A few small valves; obtained also at Station 113A, 25 fathoms. Recorded from North Atlantic and Mediterranean.

Cryptodon barbatus (Reeve) (?). Single valve; obtained at no other locality by the Challenger.

„ *croulinensis* (Jeffreys). Several valves; for distribution see Station VIII.

Malletia veneriformis, n.sp. Obtained also at Station 24.

Amussium dalli, n.sp. Obtained at no other locality.

„ *squamigerum*, n.sp. Obtained also at Station 24.

„ *cancellatum*, n.sp. Obtained also at Stations 24, 56, and St. Thomas.

GASTEROPODA (Watson, Zool. pt. 42).

Fissurella (*Lucapina*) *cayenensis*, Lamarck. One specimen; obtained also at Station 122, 350 fathoms. Recorded from North-West Atlantic.

Natica radiata, n.sp. Obtained also in North Atlantic, over 1000 fathoms (?).

BRACHIOPODA (Davidson, Zool. pt. 1).

Crania sp. (?). One imperfect valve.

In addition to the foregoing, the following are recorded in the Station-book :—

three Sponges (only two given above), Gorgonoid, Antipathid, Clypeastrid, and fragments of an unknown Sea-urchin. Station 33.

Excluding Protozoa, over 80 specimens of invertebrates were obtained at this Station, belonging to about 70 species, of which 22 are new to science, including representatives of 3 new genera; 12 of the new species and 1 new genus were not obtained elsewhere.

Willemoes-Suhm writes: "In the dredge were obtained two forms of *Serpula*, one of them in pellucid tubes, and fragments, 2 inches long, of a worm apparently belonging to the genus *Lumbrinereis*; this, however, could not be made out, as the head was wanting in both specimens. A Brachyurous Decapod has the last joint of the fifth pair of legs enlarged, and two spines on the carapace; it is apparently closely allied to the crab always got in the gulf-weed."

Organisms from the Deposit.

The following species of Pteropoda, Heteropoda, Foraminifera, and Diatoms were observed in the deposit from this Station (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.):—

Pteropoda (Pelseneer, Zool. pt. 65).

Limacina inflata (d'Orbigny).
,, *triacantha* (Fischer).
,, *lesueuri* (d'Orbigny).
,, *bulimoides* (d'Orbigny).
Peraclis reticulata (d'Orbigny).
,, *bispinosa*, n.sp.
Clio (*Creseis*) *virgula* (Rang).
,, (,,) *acicula* (Rang).
Clio (*Hyalocylix*) *striata* (Rang).
,, (*Styliola*) *subula* (Quoy and Gaimard).
,, *pyramidata*, Linné.
Cuvierina columnella (Rang).
Cavolinia trispinosa (Lesueur).
,, *quadridentata* (Lesueur).
,, *longirostris* (Lesueur).
,, *inflexa* (Lesueur).

Heteropoda (Smith, Zool. pt. 72).

Atlanta peronii, Lesueur.
,, *inflata*, Eydoux and Souleyet.
,, *lesueuri*, Eydoux and Souleyet.
Atlanta souleyeti, Smith.
,, *fusca*, Eydoux and Souleyet.
,, *inclinata*, Eydoux and Souleyet.

Foraminifera (Brady, Zool. pt. 22).—The pelagic species are marked thus ×:—

Nubecularia lucifuga, Defrance.
Biloculina ringens (Lamarck).
,, ,, var. *denticulata*, Brady.
,, *sphæra*, d'Orbigny.
Spiroloculina acutimargo, Brady.
,, *crenata*, Karrer.
,, *excavata*, d'Orbigny.
Miliolina circularis (Bornemann).
,, *ferussacii* (d'Orbigny).
,, *gracilis* (d'Orbigny).
,, *insignis*, Brady.
Miliolina linnæana (d'Orbigny).
,, *oblonga* (Montagu).
,, *pulchella* (d'Orbigny).
,, *reticulata* (d'Orbigny).
,, *trigonula* (Lamarck).
Articulina conico-articulata (Batsch).
,, *funalis*, Brady.
,, *lineata*, Brady.
,, *sagra*, d'Orbigny.
,, *sulcata*, Reuss.
Cornuspira foliacea (Philippi).

STATION 33 *Peneroplis pertusus* (Forskål).
Orbiculina adunca (Fichtel and Moll).
Orbitolites complanata, Lamarck.
,, *marginalis* (Lamarck).
Pelosina sp. (?).
Hyperammina sp. (?).
Haplophragmium agglutinans (d'Orbigny) (?).
Placopsilina cenomana, d'Orbigny.
Haplostiche soldanii (Jones and Parker).
Bdelloidina aggregata, Carter.
Textularia agglutinans, d'Orbigny.
,, *concava* (Karrer).
,, *conica*, d'Orbigny (?).
,, *luculenta*, Brady.
,, *sagittula*, Defrance, var. *fistulosa*, Brady.
,, *trochus*, d'Orbigny.
,, *turris*, d'Orbigny.
,, sp. (?).
Verneuilina spinulosa, Reuss.
Bigenerina capreolus (d'Orbigny).
Gaudryina pupoides, d'Orbigny.
,, ,, var. *chilostoma*, Reuss.
Clavulina angularis, d'Orbigny.
,, *communis*, d'Orbigny.
,, *parisiensis*, d'Orbigny.
Bulimina elegans, d'Orbigny, var. *exilis*, Brady.
,, *inflata*, Seguenza.
,, *ovata*, d'Orbigny.
,, *subteres*, Brady.
Virgulina subsquamosa, Egger.
Bolivina dilatata, Reuss.
,, *karreriana*, Brady.
,, *punctata*, d'Orbigny.
,, *textilarioides*, Reuss.
,, *tortuosa*, Brady.
Cassidulina bradyi, Norman.
,, *parkeriana*, Brady (?).
Ehrenbergina sp. (?).
Chilostomella ovoidea, Reuss.
Lagena favoso-punctata, Brady.
,, *hispida*, Reuss.
,, *laevis* (Montagu).
Nodosaria scalaris (Batsch).
,, *communis*, d'Orbigny.
,, *consobrina*, d'Orbigny, var. *emaciata*, Reuss.
,, *calomorpha*, Reuss.
,, *farcimen*, d'Orbigny.
,, *hispida*, d'Orbigny.
,, ,, var. *sublineata*, Brady.
Nodosaria intercellularis, Brady.
,, *mucronata* (Neugeboren).
,, *perversa*, Schwager (?).
,, *roemeri* (Neugeboren) (?).
,, *soluta*, Reuss (?).
,, ,, var. *striata*, Brady (?).
,, *vertebralis* (Batsch).
,, sp. (?).
Lingulina carinata, d'Orbigny, var. *seminuda*, Hantken.
Frondicularia alata, d'Orbigny.
Rhabdogonium tricarinatum (d'Orbigny).
Marginulina costata (Batsch).
Cristellaria articulata, Reuss.
,, *crepidula* (Fichtel and Moll).
,, *cultrata* (Montfort).
,, *gibba*, d'Orbigny.
,, *italica* (Defrance).
,, *orbicularis* (d'Orbigny).
,, *rotulata* (Lamarck).
,, *schloenbachi*, Reuss.
,, *tenuis* (Bornemann).
,, *tricarinata*, Reuss.
,, sp. (?).
Polymorphina compressa, d'Orbigny.
,, *lactea* (Walker and Jacob) (?).
Uvigerina angulosa, Williamson.
,, *canariensis*, d'Orbigny.
Ramulina globulifera, Brady.
× *Globigerina æquilateralis*, Brady.
× ,, *bulloides*, d'Orbigny.
× ,, *conglobata*, Brady.
× ,, *dubia*, Egger.
× ,, *inflata*, d'Orbigny.
× ,, *rubra*, d'Orbigny.
× ,, *sacculifera*, Brady.
× *Orbulina universa*, d'Orbigny.
× *Pullenia obliquiloculata*, Parker and Jones.
,, *quinqueloba*, Reuss.
,, *sphæroides* (d'Orbigny).
Spirillina inæqualis, Brady.
,, *vivipara*, Ehrenberg.
,, sp. (?).
× *Cymbalopora* (*Tretomphalus*) *bulloides* (d'Orbigny).
,, *poeyi* (d'Orbigny).
Discorbina globularis (d'Orbigny).
,, *orbicularis* (Terquem).
Planorbulina acervalis, Brady.
,, *mediterranensis*, d'Orbigny.
Truncatulina lobatula, Walker and Jacob.

STATION 33.

Truncatulina ungeriana (d'Orbigny).
,, *wuellerstorfi* (Schwager).
,, sp. (?).
Anomalina ariminensis (d'Orbigny).
,, *grosserugosa*, Gümbel.
,, *polymorpha*, Costa.
Carpenteria monticularis, Carter.
,, *proteiformis*, Goës.
,, *utricularis*, Carter.
,, sp. (?).
Rupertia stabilis, Wallich.
Pulvinulina auricula (Fichtel and Moll).
× ,, *canariensis* (d'Orbigny).
,, *concentrica*, Parker and Jones.
× ,, *micheliniana* (d'Orbigny).
,, *oblonga* (Williamson).
Pulvinulina oblonga, var. *scabra*, Brady.
,, *repanda* (Fichtel and Moll).
,, *schreibersii* (d'Orbigny).
× ,, *tumida*, Brady.
,, *umbonata*, Reuss.
,, sp. (?).
Rotalia soldanii, d'Orbigny.
Gypsina globulus (Reuss).
,, *inhærens* (Schultze).
,, *vesicularis* (Parker and Jones).
,, sp. (?).
Polytrema miniaceum (Linné).
Nonionina scapha (Fichtel and Moll).
,, *umbilicatula* (Montagu).
Polystomella striatopunctata (Fichtel and Moll).
Amphistegina lessonii, d'Orbigny.

DIATOMACEÆ.—The following species of Diatoms were observed by Mr. Comber:—

Amphora gigantea, Grunow.
,, *proteus*, Gregory.
,, *lanceolata*, Cleve.
,, *cuneata*, Cleve.
,, *spectabilis*, Gregory.
,, *crassa*, Gregory, var. *punctata*, Grunow.
Navicula clavata, Gregory.
,, *lyra*, Ehrenberg.
,, *gregoriana*, Greville.
,, *hennedyii*, W. Smith, and var.
,, *prætexta*, Ehrenberg, var. *abundans*, A. Schmidt.
,, *bullata*, Norman.
,, *directa*, Ralfs.
,, *maxima*, Gregory.
,, *granulata*, Brebisson.
,, *mediterranea*, Grunow.
,, *smithii*, Brebisson.
,, *graeffii*, A. Schmidt.
,, *campylodiscus*, Grunow.
,, *lacrimans*, A. Schmidt.
,, *suborbicularis*, Ralfs.
,, *excemta*, A. Schmidt.
,, *pristiophora*, Janisch.
,, *multicostata*, Grunow.
,, *didyma*, Kutzing.
,, *apis*, Kutzing.
,, *splendida*, Gregory.
,, *bombus*, Kutzing.
,, *pandura*, Brebisson.
,, *strangulata*, Greville.
Navicula consors, A. Schmidt.
Alloioneis antillarum, Cleve and Grunow.
Cocconeis scutellum, Ehrenberg.
,, *moorei* (= *Rhaphoneis*, O'Meara).
,, sp. (?).
Synedra gaillionii, Ehrenberg.
,, *fulgens*, W. Smith.
,, *robustus*, Ralfs.
Euphyllodium spathulatum, Shadbolt.
Nitzschia marina, Grunow.
,, *panduriformis*, Gregory.
,, *plana*, W. Smith.
,, *bilobata*, W. Smith.
Perrya pulcherrima, Kitton.
Surirella fastuosa, Ehrenberg.
Campylodiscus imperialis, Greville.
,, *biangulatus*, Greville.
,, *ecclesianus*, Greville.
Grammatophora macilenta, W. Smith.
Fragilaria mutabilis, Grunow.
,, *schwartzii*, Grunow.
Dimeregramma nanum, Ralfs.
Glyphodesmis williamsonii, Grunow.
,, sp. (?).
Plagiogramma inæquale, Greville.
,, *lyratum*, Greville.
,, *obesum*, Greville.
,, *pygmæum*, Greville.
Coscinodiscus atlanticus, Castracane.
,, *excentricus*, Ehrenberg.
,, *concavus*, Ehrenberg.

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Coscinodiscus leptopus, Grunow.
,, *minutus*, Gregory.
,, *nitidulus*, Grunow.
,, *subtilis*, Ehrenberg.
,, *radiatus*, Ehrenberg.
,, ,, var. *minor*, Rattray.
,, *oculus-iridis*, Ehrenberg.
,, *nodulifer*, Janisch.
,, *apiculatus*, Ehrenberg.
,, *elegans*, Greville.
,, *obnubilus*, Rattray.
Ethmodiscus sp. (?).

Paralia sulcata, Cleve.
Hemidiscus cuneiformis, Wallich.
Biddulphia pulchella, Gray.
,, *tuomeyii*, Roper.
Triceratium serratum, Wallich.
,, *balearicum*, Cleve and Grunow, forma *tetragona*.
,, *pentacrinum*, Wallich, forma *pentagona*.
,, *cælatum*, Janisch.
,, *punctatum*, Brightwell.
,, *venulosum*, Greville.

At Bermuda

The Challenger remained at Bermuda from 5 P.M. on April 4, till 7 A.M. on April 21.

April 17, 1873.

Sounding taken from boat, about a mile from the reef at Bermuda.

Depth, 200 fathoms; deposit, Coral Sand, containing 93·34 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

FORAMINIFERA (Brady, Zool. pt. 22).—The following species of Foraminifera were observed in the deposit at this place; the pelagic species, which make up over 5 per cent. of the carbonate of lime present in the deposit, are marked thus × :—

Biloculina elongata, d'Orbigny.
,, *ringens* (Lamarck).
Spiroloculina robusta, Brady.
,, sp. (?).
Miliolina [illegible] (d'Orbigny).
,, *circularis* (Bornemann).
,, [illegible]*riana* (d'Orbigny).
,, [illegible] (Montagu).
Articulina [illegible]*ata*, Reuss.
Peneroplis [illegible] (Costa).
,, [illegible], Brady.
[illegible], Montfort.
[illegible], d'Orbigny.
[illegible] (Jones and Parker).
Textularia [illegible], d'Orbigny.
,, [illegible], d'Orbigny.
,, [illegible], Defrance, var. *fistulosa*, Brady.
,, [illegible], d'Orbigny.
[illegible], Reuss.
[illegible], d'Orbigny (?).
,, sp. (?).
[illegible], d'Orbigny.
,, [illegible], d'Orbigny.
[illegible].

Bolivina dilatata, Reuss.
Cassidulina calabra (Seguenza).
Nodosaria comata (Batsch).
,, *obliqua* (Linné).
,, *scalaris* (Batsch).
Lingulina carinata, d'Orbigny, var. *seminuda*, Hantken.
Marginulina costata (Batsch).
,, sp. (?).
Cristellaria acutauricularis (Fichtel and Moll).
,, *articulata*, Reuss.
,, *costata* (Fichtel and Moll).
,, *cultrata* (Montfort).
,, *gibba*, d'Orbigny.
,, *orbicularis* (d'Orbigny).
,, sp. (?).
Uvigerina angulosa, Williamson.
,, *tenuistriata*, Reuss.
× *Globigerina aequilateralis*, Brady.
× ,, *bulloides*, d'Orbigny.
× ,, *conglobata*, Brady.
× ,, *dubia*, Egger.
× ,, *inflata*, d'Orbigny.
× ,, *rubra*, d'Orbigny.

Bermuda.

× *Globigerina sacculifera*, Brady.
× *Orbulina universa*, d'Orbigny.
× *Pullenia obliquiloculata*, Parker and Jones.
Sphæroidina bulloides, d'Orbigny.
Discorbina globularis (d'Orbigny).
" *orbicularis* (Terquem).
Planorbulina mediterranensis, d'Orbigny.
Truncatulina lobatula (Walker and Jacob)
" *ungeriana* (d'Orbigny).
Anomalina ariminensis (d'Orbigny).
" *foveolata*, Brady.
" *grosserugosa* (Gümbel).
Carpenteria balaniformis, Gray (?).
Carpenteria utricularis, Carter.
Pulvinulina auricula (Fichtel and Moll).
× " *canariensis* (d'Orbigny).
× " *menardii* (d'Orbigny).
× " *micheliniana* (d'Orbigny).
" *procera*, Brady.
" *repanda* (Fichtel and Moll).
Gypsina globulus (Reuss).
" *vesicularis* (Parker and Jones).
Polytrema miniaceum (Linné).
Nonionina umbilicatula (Montagu).
Amphistegina lessonii, d'Orbigny.

Stations 33A to 34. **Stations 33A to 34** (Soundings 88 to 90), off Bermuda (see Chart 8).

April 21, 1873.
Temperature of air at noon, 68°·8 ; mean for the day, 67°·3.
Temperature of water at surface, 67°·2.

At 10.20 A.M. took a series of soundings in shallow water, sounding out the bank to the north-east of Bermuda. Afterwards soundings were taken in 175 fathoms, deposit Coral Sand (Station 33A), then in 640 fathoms, deposit Coral Mud (Station 33B), and at 5.40 P.M. in 1370 fathoms, deposit Coral Mud (Station 34).

Stations 35A to 35C. **Stations 35A to 35C** (Soundings 91 to 93), off Bermuda (see Chart 8).

April 22, 1873.
Temperature of air at noon, 69°·5 ; mean for the day, 67°·9.
Temperature of water at surface, 67°·8.

At 6 A.M. shortened sail, and got up steam to sound. At 7 A.M. sounded in 2450 fathoms, deposit Globigerina Ooze, containing 66 per cent. of carbonate of lime, bottom temperature 36°·5 (Station 35A). At 8.15 A.M. proceeded under steam. At 10.30 A.M. sounded in 2100 fathoms, deposit Globigerina Ooze, containing 77·13 per cent. of carbonate of lime, bottom temperature 36°·5 (Station 35B). At 2 P.M. stopped and sounded in 1950 fathoms, deposit Globigerina Ooze, containing 81·31 per cent. of carbonate of lime (Station 35C). A landrail alighted on the ship, and was caught. At 5.30 P.M. stopped and anchored in 32 fathoms.

Challenger Bank. This shoal, which was well known to the Bermudian fishermen, was entered in Captain Maury's charts, but not in those of the Admiralty. It is said to have been discovered from the abundance of fish seen near the surface. The bottom consists of large rounded

Challenger Bank.

pebbles and stones of the material of the Bermuda Serpuline reefs, and seems to be covered with a growth of small Corals, chiefly *Madracis asperula*. The bank, which has been called the Challenger Bank, is about five miles in diameter; it seems to be nearly level, but its outline was not exactly determined.

Station 35c.

The following species of Pteropoda and Foraminifera were observed in the deposit from Station 35c, 1950 fathoms :—

Organisms from the Deposit.

Pteropoda (Pelseneer Zool. pt. 65).

Clio (Creseis) acicula (Rang).
„ *(Styliola) subula* (Quoy and Gaimard).
Clio pyramidata, Linné.
Cavolinia trispinosa (Lesueur).

Foraminifera (Brady, Zool. pt. 22).—The pelagic species, which make up about 65 per cent. of the carbonate of lime present in the deposit, are marked thus × :—

Biloculina depressa, d'Orbigny.
„ *ringens* (Lamarck).
Miliolina auberiana (d'Orbigny).
„ *oblonga* (Montagu).
Cornuspira involvens, Reuss.
Hyperammina elongata, Brady.
„ *ramosa*, Brady.
Reophax difflugiformis, Brady (?).
Haplophragmium glomeratum, Brady.
„ *nanum*, Brady.
„ *rotulatum*, Brady.
Trochammina lituiformis, Brady.
„ *pauciloculata*, Brady.
Gaudryina baccata, Schwager.
„ *pupoides*, d'Orbigny.
Bulimina subteres, Brady.
Virgulina subdepressa, Brady.
Bolivina porrecta, Brady.
Pleurostomella alternans, Schwager.
Lagena marginata (Walker and Boys).
„ „ var. *semimarginata*, Reuss.
Nodosaria sp. (?)
Cristellaria crepidula (Fichtel and Moll) (?).
„ *latifrons*, Brady.
× *Globigerina aequilateralis*, Brady.
× *Globigerina bulloides*, d'Orbigny.
× „ *conglobata*, Brady.
× „ *dubia*, Egger.
× „ *inflata*, d'Orbigny.
× „ *rubra*, d'Orbigny.
× „ *sacculifera*, Brady.
× *Orbulina universa*, d'Orbigny.
× *Hastigerina pelagica* (d'Orbigny).
× *Pullenia obliquiloculata*, Parker and Jones.
× *Sphaeroidina dehiscens*, Parker and Jones.
Discorbina rosacea (d'Orbigny).
Truncatulina tenera, Brady.
„ *ungeriana* (d'Orbigny).
„ *wuellerstorfi* (Schwager).
× *Pulvinulina canariensis* (d'Orbigny).
„ *elegans* (d'Orbigny).
× „ *menardii* (d'Orbigny).
× „ „ var. *fimbriata*, Brady.
× „ *micheliniana* (d'Orbigny).
× „ *tumida*, Brady.
Rotalia orbicularis, d'Orbigny.
„ *soldanii*, d'Orbigny.
Nonionina boucana, d'Orbigny.
„ sp. (?).
Amphistegina lessonii, d'Orbigny.

Station 36 (Sounding 94), off Bermuda (see Chart 8). STATION 36.

April 23, 1873; lat. 32° 7′ 25″ N., long. 65° 4′ W.
Temperature of air at noon, 69°·5; mean for the day, 67°·9.
Temperature of water at surface, 67°·5.
Depth, 32 fathoms; deposit, Coral Mud.

At 8 A.M. the surveying boats left the ship to sound out the Challenger Bank in charge of the surveying officers, and remained out till the afternoon. The jolly-boat was sent out three times from the ship with the dredge, which was slowly hauled into the ship by the donkey-engine. In that way large numbers of specimens were secured. At 1.30 P.M. surveying boats returned. At 3.45 P.M. weighed anchor, and proceeded S.S.W. under steam. At 4 P.M. dredged in somewhat deeper water, the dredge bringing up a large quantity of Algæ, some pebbles, stones, and specimens.

The following species are recorded in the Zoological Reports from the dredge at this Station:— ANIMALS FROM DREDGE.

CALCAREA (Poléjaeff, Zool. pt. 24).

Sycon arcticum (Haeckel), var. *maximum*, Haeckel. One specimen; obtained also at Station 209, 95 to 100 fathoms. Recorded from the Arctic.
Heteropegma nodus gordii, n.g., n.sp. One specimen; obtained also at Station 186, 8 fathoms.
Leucilla uter, n.sp. One specimen; obtained also at Station 209, 95 to 100 fathoms.
Leuconia multiformis, n.sp., var. *amorpha*, nov. Several specimens.
,, ,, n.sp., var. *goliath*, nov. Several specimens; the species obtained also at Station 209, 95 to 100 fathoms (var. *capillata*).
,, *typica*, n.sp., var. *tuba*, nov. Two specimens; obtained at no other locality.
,, ,, n.sp., var. *massa*, nov. One specimen; obtained at no other locality.
,, *rudifera*, n.sp. Fragments of two specimens; obtained at no other locality.
,, *dura*, n.sp. Many specimens (colonial and solitary); obtained also at Station 186, 8 fathoms.

CORALS (Moseley, Zool. pt. 7).

Madracis asperula, M.-Edwards and Haime. Large quantities; obtained also at Cape Verdes and Fernando Noronha.
Bathyactis symmetrica (Pourtalès). For distribution see Station 24.

STATION 36.

HYDROIDA (Allman, Zool. pt. 70).

Campanularia insignis, n.sp. Obtained at no other locality.

Desmoscyphus gracilis, n.sp. Obtained at no other locality.

ASTEROIDEA (Sladen, Zool. pt. 51).

Chætaster longipes (Retzius), Sars. Numerous specimens; obtained also at Station 75, 450 fathoms. Recorded from Mediterranean, and taken by "Porcupine," locality not known.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophiothrix angulata, Ayres. Obtained also at Fernando Noronha and Bahia, shallow water to 20 fathoms.

,, *suensonii*, Lütken. Obtained at no other locality by the Challenger.

Ophiomyxa flaccida, Lütken. Obtained also at Bahia, 7 to 20 fathoms.

ANNELIDA (M'Intosh, Zool. pt. 34).

Notopygos megalops, n.sp. One specimen; obtained at no other locality.

STOMATOPODA (Brooks, Zool. pt. 45).

Gonodactylus chiragra, Latreille. One specimen (surface?); obtained also at St. Thomas, Bermuda, Philippines, and off Cape St. Roque (var. *minutus*, nov.).

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Arca noæ, Linné. Obtained at no other locality by the Challenger. Recorded from Mediterranean and West Indies.

,, (*Acar*) *domingensis*, Lamarck. Obtained at no other locality by the Challenger.

Avicula (*Meleagrina*) *squamulosa*, Lamarck. Obtained at no other locality by the Challenger. Recorded from Brazil and Caribbean Sea.

Lima (*Mantellum*) *hians*, Gmelin. Obtained at no other locality by the Challenger.

POLYPLACOPHORA (Haddon, Zool. pt 43).

Chiton squamosus Linné. Two specimens; obtained at no other locality by the Challenger.

POLYZOA (Busk, Zool. pts. 30 and 50).

Ætea anguina (Linné). Obtained also at Stations 135, 161, 162, and 304, 33 to 110 fathoms.

Bugula neritina (Linné). Obtained at no other locality by the Challenger. Recorded from Mediterranean, North and South Atlantic, and Australian Seas. STATION 36.

Crisia denticulata (Lamarck), var. *patagonica*, d'Orbigny (?). Obtained at no other locality by the Challenger. Recorded from Patagonia.

Amathia lendigera (Linné). Obtained at no other locality by the Challenger. Recorded from European Seas.

In addition to the foregoing, the following are recorded in the Station-Book :—*Anthea*, elongate Actinian with leathery cuticle, Star-fishes, *Pagurus*, *Galathea*, *Stenorhynchus*, *Maia* (?), large specimen of *Pinna*, small fish, many Foraminifera (*Cristellaria*), Diatoms, about fourteen species of Algæ, and a calcareous Alga.

Excluding Protozoa, about 35 species of invertebrates and fishes were obtained in these dredgings on the Challenger Bank, of which 11 are new to science, including representative of 1 new genus ; 6 of the new species were not obtained elsewhere.

Station 37 (Sounding 95), Bermuda to Halifax (see Charts 8 and 9, and Diagram 2). STATION 37.

April 24, 1873 ; lat. 32° 18′ N., long. 65° 38′ 8″ W.

Temperature of air at noon, 70°·0 ; mean for the day, 68°·8.

Temperature of water :—

Surface,	68°·0	500 fathoms,	50°·4
20 fathoms,	67·2	550 ,,	46·8
40 ,,	66·2	600 ,,	43·9
60 ,,	65·7	650 ,,	42·0
80 ,,	65·5	700 ,,	41·0
100 ,,	65·3	800 ,,	39·8
120 ,,	65·1	900 ,,	39·3
140 ,,	64·9	1000 ,,	39·0
150 ,,	64·8	1100 ,,	38·7
200 ,,	64·3	1200 ,,	38·4
250 ,,	63·8	1300 ,,	38·1
300 ,,	63·2	1400 ,,	37·8
350 ,,	61·0	1500 ,,	37·5
400 ,,	57·7	Bottom,	36·5
450 ,,	54·3		

Depth, 2650 fathoms ; deposit, Globigerina Ooze, containing 62·47 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

Station 37. At 6.20 A.M. shortened and furled sails, and got up steam to sound. At 7.30 A.M. sounded in 2650 fathoms. At 9 A.M. completed a series of temperatures down to 1500 fathoms. At 10.45 A.M. put the dredge over, and veered 3400 fathoms. At 2.30 P.M. sent second cutter away to try current. At 3 P.M. commenced heaving in dredge, which came up at 4.50 P.M. with a small quantity of Globigerina Ooze. Many petrels (*Thalassidroma wilsoni*) and numerous patches of sea-weed were seen.

Distance at noon from Gibb's Hill Lighthouse, Bermuda, 43 miles. Amount of current 9 miles, direction S. 13° E.

Station 38.

Station 38 (Sounding 96), Bermuda to Halifax (see Chart 9 and Diagram 2).

April 25, 1873; lat. 33° 3′ N., long. 66° 32′ W.

Temperature of air at noon, 73°·3; mean for the day, 70°·5.

Temperature of water:—

Surface,	70°·0	450 fathoms,	54°·7
20 fathoms,	69·0	500 „	50·0
40 „	68·0	550 „	46·0
60 „	67·1	600 „	43·6
80 „	66·2	650 „	42·0
100 „	66·0	700 „	41·1
120 „	66·0	800 „	40·0
140 „	65·4	900 „	39·6
160 „	64·8	1000 „	39·2
180 „	64·2	1100 „	38·8
200 „	63·7	1200 „	38·4
250 „	63·5	1300 „	38·0
300 „	63·0	1400 „	37·7
350 „	61·3	1500 „	37·4
400 „	58·5	Bottom,	36·5

Density at 60° F. at surface, 1·02723.

Depth, 2600 fathoms; deposit, Globigerina Ooze, containing 50·84 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 9.15 A.M. shortened and furled sails, and proceeded under steam to sound. Sounded in 2600 fathoms. The water-bottle was sent down, but owing to the stopcock having opened a good deal of the water was lost. At 10 A.M. serial temperatures were taken down to 1500 fathoms. During the day the force of the wind had been gradually increasing, terminating in half a gale towards nightfall, accompanied by sheet lightning at the northern horizon, and a steadily falling barometer. A flock of petrels (*Thalassidroma wilsoni*) was hovering astern all day, and porpoises were seen playing under the bows. The sea was brilliantly phosphorescent at night.

Distance from Sandy Hook at noon, 568 miles. Made good 64 miles. Amount of current 9 miles, direction N. 35° E. STATION 38.

Station 39 (Sounding 97), Bermuda to Halifax (see Chart 9 and Diagram 2). STATION 39.

April 27, 1873 ; lat. 34° 3′ N., long. 67° 32′ W.

Temperature of air at noon, 58°·8 ; mean for the day, 59°·6.

Temperature of water :—

Surface,	65°·0	175 fathoms,	63°·8
10 fathoms,	66·5	200 ,,	63·7
20 ,,	67·0	225 ,,	63·5
30 ,,	66·2	250 ,,	63·3
40 ,,	65·2	300 ,,	62·5
50 ,,	64·7	350 ,,	60·0
60 ,,	64·2	400 ,,	56·5
70 ,,	64·1	450 ,,	52·5
80 ,,	64·0	500 ,,	48·7
90 ,,	63·9	550 ,,	45·2
100 ,,	63·8	600 ,,	42·2
125 ,,	63·8	650 ,,	41·0
150 ,,	63·8	Bottom,	36·5

Density at 60° F. at surface, 1·02701.

Depth, 2850 fathoms ; deposit, Red Clay, containing 28·31 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 11.20 A.M. shortened and furled sails, and got up steam to sound. At 1 P.M. sounded in 2850 fathoms. At 2 P.M. took serial temperatures down to 650 fathoms. Sea still running high. Two black threads, over 100 feet in length, were put over the stern of the ship; in a short time one of Wilson's petrels became entangled, and was hauled on board.

Distance at noon from Sandy Hook, 490 miles. Distance run through the water 74 miles; made good 9 miles. Amount of current 5 miles, direction S. 19° E.

Station 40 (Sounding 98), Bermuda to Halifax (see Chart 9 and Diagram 2). STATION 40.

April 28, 1873 ; lat. 34° 51′ N., long. 68° 30′ W.

Temperature of air at noon, 65°·8 ; mean for the day, 63°·4.

Temperature of water at surface, 69°·5.

Density at 60° F. at surface, 1·02698.

STATION 40.

Depth, 2675 fathoms; deposit, Globigerina Ooze, containing 45·83 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 9.30 A.M. stopped to put over dredge. The small dredge was used with a bread-bag lining to the net; a 28 lb. weight was slung to the tangle bar and four tangles. At 2 P.M. sounded in 2675 fathoms. The weights had apparently not been detached, as in hauling in there was a great strain, and the line finally parted, water-bottle and thermometer being lost. Sent cutter away to try current. At 3.20 P.M. commenced heaving in dredge. At 4.30 P.M. cutter returned. At 5.45 P.M. dredge came up with a small quantity of ooze, two red shrimps, and a few fishes. Many stormy petrels were seen about the ship.

Distance from Sandy Hook at noon, 420 miles. Made good 68 miles. Amount of current 6 miles, direction N. 63° W.

ANIMALS FROM DREDGE.

The following species are recorded in the Zoological Reports from the dredge at this Station:—

MACRURA (Spence Bate, Zool. pt. 52).

Acanthephyra purpurea, M.-Edwards. One specimen; obtained also at Stations 87 and 354, 1675 fathoms. Recorded from North Atlantic.

,, *sica*, n.sp. One specimen; obtained also at Stations 159, 168, 169, 170, 181, 194, 230, 235, and 318, 200 to 2675 fathoms.

FISHES (Günther, Zool. pt. 57).

Nealotus tripes, Johnson. One specimen (probably from near the surface); obtained at no other locality by the Challenger. Recorded from Madeira.

Gonostoma microdon, n.sp. Two specimens; for distribution see Station 23.

Two jelly-like masses came up in the dredge, but could not be made out. Murray picked up from a boat part of a huge Cephalopod, which seemed swollen as if it had been dead in water some considerable time.

STATION 41.

Station 41, Bermuda to Halifax (see Chart 9).

April 29, 1873; lat. 36° 7′ N., long. 69° 54′ W.

Temperature of air at noon, 67°·3; mean for the day, 64°·2.

Temperature of water :— STATION 41.

Surface,	65·0	250 fathoms,	62·6
25 fathoms,	64·9	300 ,,	61·2
50 ,,	64·8	350 ,,	59·3
75 ,,	64·7	400 ,,	56·2
100 ,,	64·5	450 ,,	52·2
125 ,,	64·3	500 ,,	48·0
150 ,,	64·1	550 ,,	45·0
175 ,,	63·8	600 ,,	42·0
200 ,,	63·5	650 ,,	40·8
225 ,,	63·1		

Density at 60° F. at surface, 1·02703.

At 7 A.M. proceeded under steam to sound. Blowing hard, with a heavy swell. Attempted to take a series of temperatures, but could not succeed. At 7.50 A.M. the starboard wheel-rope was carried away, and the necessary repairs caused some delay. Later in the day swell moderated, and at 3.40 P.M. proceeded to obtain serial temperatures down to 650 fathoms.

Distance from Sandy Hook at noon, 324 miles. Made good 101 miles. Amount of current 12 miles, direction N. 40° W.

Station 42 (Sounding 100), Bermuda to Halifax (see Chart 9 and Diagram 2). STATION 42.

April 30, 1873 ; lat. 35° 58′ N., long. 70° 35′ W.

Temperature of air at noon, 61°·5 ; mean for the day, 61°·8.

Temperature of water :—

Surface,	65·0	1300 fathoms,	38·2
900 fathoms,	40·2	1400 ,,	37·9
1000 ,,	39·2	1500 ,,	37·6
1100 ,,	38·8	Bottom,	36·8
1200 ,,	38·5		

Density at 60° F. at surface, 1·02695 ; bottom, 1·02668.

Depth, 2425 fathoms ; deposit, Blue Mud, containing 24·34 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.30 A.M. shortened sail, and got up steam to sound. At 8 A.M. sounded in 2425 fathoms. Sent down water-bottle and two thermometers. The water-bottle seemed to have fallen on its side into the mud before closing, as it contained a considerable quantity of the upper layer of mud. The swell was still heavy, and sounding operations were carried on with some difficulty. Serial temperatures were, however, obtained from 900

Station 42

to 1500 fathoms, at intervals of 100 fathoms, to complete the series of the previous evening. At 2 P.M. the temperature of the sea-surface suddenly rose from 65°·5 to 71°·5, showing that the ship had slipped over the eastern edge of the Gulf Stream. Owing to the cloudy and somewhat boisterous weather, little difference was observed in the appearance of the water. At 8 P.M. the surface temperature reached 73°, while the thermometer in the air stood at 64°. A flock of water-rails alighted on the rigging of the ship, and several were caught by the sailors; numerous stormy petrels were about the ship.

Distance from Sandy Hook at noon, 308 miles. Made good 37 miles. Amount of current 17 miles, direction N. 65° W.

Organisms from Surface-Nets.

Surface Organisms.—The following species is recorded from this Station, evidently from the surface:—

MACRURA (Spence Bate, Zool. pt. 52).

Sergestes atlanticus, M.-Edwards.

Station 43

Station 43 (Sounding 101), Bermuda to Halifax (see Chart 9 and Diagram 2).

May 1, 1873; lat. 36° 23′ N., long. 71° 46′ W.

Temperature of air at noon, 60°·0; mean for the day, 62°·5.

Temperature of water:—

	°		°
Surface,	75·0	225 fathoms,	51·0
20 fathoms,	71·2	250 "	49·7
40 "	71·0	300 "	47·7
60 "	71·0	350 "	46·2
80 "	68·0	400 "	44·8
100 "	64·0	450 "	43·8
125 "	59·5	500 "	42·9
150 "	56·4	550 "	42·0
175 "	54·0	600 "	41·0
200 "	52·2	2600 "	36·8

Density at 60° F. at surface, 1·02674.

Depth, 2600 fathoms.

At 6.30 A.M. shortened and furled sails, and got up steam to sound. At 7 A.M. commenced sounding. A considerable swell made the various operations somewhat difficult. The line parted, and two thermometers, the hydra, and water-bottle were lost. In the second sounding no bottom was found at a depth exceeding 2600 fathoms. At 1 P.M. tried current at different depths, and obtained serial temperatures. During the ten hours occupied in sounding and obtaining temperatures, the current ran uniformly at the rate of $3\frac{1}{4}$ miles per hour in a N. 60° E. direction. Stormy petrels still follow the ship, and a large gull (*Skua*) was seen. At about 11 P.M. the surface temperature suddenly fell from 67°·5 to 56°·5. STATION 43.

Sandy Hook distant at noon, 262 miles. Made good 66 miles. Amount of current 14 miles, direction S. 78° E.

Station 44 (Sounding 102), Bermuda to Halifax (see Chart 9 and Diagram 2). STATION 44.

May 2, 1873; lat. 37° 25′ N., long. 71° 40′ W.

Temperature of air at noon, 59°·3; mean for the day, 58°·6.

Temperature of water:—

	°		°
Surface,	56·5	500 fathoms,	38·7
25 fathoms,	54·8	550 ,,	38·5
50 ,,	52·5	600 ,,	38·4
75 ,,	50·4	700 ,,	38·2
100 ,,	48·2	800 ,,	38·0
125 ,,	46·0	900 ,,	37·8
150 ,,	44·5	1000 ,,	37·6
175 ,,	43·2	1100 ,,	37·4
200 ,,	42·0	1200 ,,	37·2
250 ,,	40·3	1300 ,,	37·0
300 ,,	39·5	1400 ,,	36·8
350 ,,	39·2	1500 ,,	36·6
400 ,,	39·0	Bottom,	36·2
450 ,,	38·8		

Density at 60° F. at surface, 1·02541.

Depth, 1700 fathoms; deposit, Blue Mud, containing 24·61 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.30 A.M. shortened and furled sails, and proceeded under steam to sound. At 8 A.M. sounded in 1700 fathoms. At noon obtained a series of temperatures down to 1500 fathoms. At 12.10 P.M. put over dredge, and veered 2500 fathoms. At 5.20 P.M. dredge came up with a considerable quantity of mud and a number of organisms. A great many porpoises were about the ship.

Distance at noon from Sandy Hook, 209 miles. Made good 62 miles.

The following species are recorded in the Zoological Reports from the dredge at this Station:—

Station 44.

Animals from Dredge

PENNATULIDA (Kölliker, Zool. pt. 2).

Protoptilum aberrans, n.sp. One specimen; obtained also at Stations 45 and 46, 1240 and 1350 fathoms.

ASTEROIDEA (Sladen, Zool. pt. 51).

Pararchaster semisquamatus, n.g., n.sp., var. *occidentalis*, nov. One specimen (either from this Station or Station 45). The species was obtained at Stations 235 and 237, 565 and 1875 fathoms. Recorded subsequently from Indian Ocean ("Investigator").

Pontaster forcipatus, n.g., n.sp. A few specimens; obtained also at Stations 45, 46, 50, and 146 (var. *echinata*), 1240 to 1375 fathoms.

Dytaster exilis, n.g., n.sp., var. *carinata*, nov. The species was obtained at Station 300, 1375 fathoms; and var. *gracilis* at Station 133, 1900 fathoms. Recorded subsequently from Indian Ocean ("Investigator").

,, *madreporifer*, n.g., n.sp. Obtained also at Station 45, 1240 fathoms.

Plutonaster rigidus, n.g., n.sp. One specimen (either from this Station or Station 45); var. *semiarmata* was obtained at Station 46 or 47.

Phoxaster pumilus, n.g., n.sp. One specimen (either from this Station or Station 45); obtained also at Station 46, 1350 fathoms. Only species of the genus.

GEPHYREA (Selenka, Zool. pt. 36).

Phascolosoma flagriferum, n.sp. One specimen; obtained also at Station 241, 2300 fathoms.

ANNELIDA (M'Intosh, Zool. pt. 34).

Melinnopsis atlantica, n.g., n.sp. One fragmentary specimen; obtained at no other locality. Only species of the genus.

POLYZOA (Busk, Zool. pt. 30).

Canda simplex, n.sp. (?). One or two small fragments; obtained at no other locality by the Challenger. Recorded from Gulf of Mexico.

TUNICATA (Herdman, Zool. pt. 17).

Culeolus perlatus (Willemoes-Suhm), n.g., n.sp. One specimen; obtained at no other locality.

In addition to the foregoing, the following are recorded in the Station-book:—two

Ophiurids, two specimens of *Brissus* (?), Sipunculid, three species of Annelids (one only given above), two Isopods, shrimp, and *Squilla*. STATION 44.

Excluding Protozoa, about 30 specimens of invertebrates were obtained at this Station, belonging to about 19 species, of which 11 are new to science, including representatives of 7 new genera; 2 of the new species and 1 new genus were not obtained elsewhere.

Willemoes-Suhm writes: "The dredge brought up a shrimp belonging to the Peneidæ, two Isopods belonging to the genus *Tanais*, a Sipunculid (*Sternaspis*), which was afterwards unfortunately lost, and a *Polynoë*."

ORGANISMS FROM THE DEPOSIT.

FORAMINIFERA (Brady, Zool. pt. 22).—The following species of Foraminifera were observed in the deposit from this Station; the pelagic species, which make up about 73 per cent. of the carbonate of lime present in the deposit, are marked thus × :—

Biloculina bulloides, d'Orbigny.
,, *depressa*, d'Orbigny.
,, ,, var. *murrhyna*, Schwager.
,, *ringens* (Lamarck).
Miliolina circularis (Bornemann).
,, *seminulum* (Linné).
,, *valvularis* (Reuss) (?).
,, sp. (?).
Planispirina celata (Costa).
Orbitolites tenuissima, Carpenter.
Astrorhiza angulosa, Brady.
,, *granulosa*, Brady.
Pelosina cylindrica, Brady.
Storthosphæra sp. (?).
Dendrophrya sp. (?).
Bathysiphon filiformis, Sars.
Psammosphæra fusca, Schulze.
Hyperammina elongata, Brady.
,, *ramosa*, Brady.
,, *vagans*, Brady.
,, sp. (?).
Rhabdammina abyssorum, Sars.
,, *linearis*, Brady.
,, sp. (?).
Aschemonella ramuliformis, Brady.
Reophax bacillaris, Brady.
,, *dentaliniformis*, Brady.
,, *difflugiformis*, Brady.
,, *pilulifera*, Brady (?).
Haplophragmium agglutinans (d'Orbigny).
,, *foliaceum*, Brady.
,, *globigeriniforme* (Parker and Jones).
Haplophragmium latidorsatum (Bornemann).
Placopsilina bulla, Brady.
Thurammina papillata, Brady.
Hormosina globulifera, Brady.
Ammodiscus charoides (Jones and Parker).
,, *tenuis*, Brady.
Trochammina ringens, Brady.
,, *trullissata*, Brady.
Textularia agglutinans, d'Orbigny.
Verneuilina pygmæa (Egger).
Gaudryina baccata, Schwager.
,, *pupoides*, d'Orbigny.
Bulimina ovata, d'Orbigny.
,, *pyrula*, d'Orbigny.
Virgulina schreibersiana, Czjzek.
Lagena acuticosta, Reuss (?).
,, *apiculata*, Reuss.
,, *distoma*, Parker and Jones.
,, *globosa* (Montagu).
,, *gracillima* (Seguenza).
,, *hexagona* (Williamson).
,, *lævis* (Montagu).
,, sp. (?).
Nodosaria communis, d'Orbigny.
,, *mucronata* (Neugeboren).
,, *simplex*, Silvestri.
Cristellaria crassa, d'Orbigny.
,, *crepidula* (Fichtel and Moll).
,, *reniformis*, d'Orbigny.
Uvigerina tenuistriata, Reuss.
× *Globigerina æquilateralis*, Brady.
× ,, *bulloides*, d'Orbigny.

STATION 44.

× *Globigerina conglobata*, Brady.
× ,, *dubia*, Egger.
× ,, *dutertrei*, d'Orbigny.
× ,, *inflata*, d'Orbigny.
× ,, *rubra*, d'Orbigny.
× ,, *sacculifera*, Brady.
× *Orbulina universa*, d'Orbigny.
× *Pullenia obliquiloculata*, Parker and Jones.
,, *quinqueloba*, Reuss.
,, *sphæroides* (d'Orbigny).
× *Sphæroidina dehiscens*, Parker and Jones.
Discorbina bertheloti (d'Orbigny).
Truncatulina ungeriana (d'Orbigny).
Truncatulina wuellerstorfi (Schwager).
× *Pulvinulina canariensis* (d'Orbigny).
× ,, *crassa* (d'Orbigny).
,, *elegans* (d'Orbigny).
× ,, *menardii* (d'Orbigny).
× ,, *micheliniana* (d'Orbigny).
× ,, *patagonica* (d'Orbigny).
× ,, *tumida*, Brady.
Rotalia soldanii, d'Orbigny.
,, sp. (?).
Nonionina pompilioides (Fichtel and Moll).
,, *scapha* (Fichtel and Moll).
,, *umbilicatula* (Montagu).

STATION 45.

Station 45 (Sounding 103), Bermuda to Halifax (see Chart 9 and Diagram 2).

May 3, 1873; lat. 38° 34′ N., long. 72° 10′ W.

Temperature of air at noon, 47°·8; mean for the day, 49°·2.

Temperature of water :—

	°		°
Surface, ...	49·5	500 fathoms, . .	38·4
100 fathoms, . . .	51·1	600 ,, . . .	38·1
200 ,, . . .	43·5	700 ,, . . .	38·0
300 ,, . . .	40·2	Bottom, . . .	37·2
400 ,, . . .	39·0		

Density at 60° F. at surface, 1·02504.

Depth, 1240 fathoms; deposit, Blue Mud, containing 14·59 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.30 A.M. shortened and furled sails, and proceeded under steam to sound. At 8 A.M. sounded in 1240 fathoms. Soon after lowered dredge, which came up at 12.10 P.M. with some mud and many specimens. At 2 P.M. took serial temperatures down to 700 fathoms. Two small birds (finches) alighted on the ship in an exhausted condition.

Distance from Sandy Hook at noon, 139 miles. Made good 73 miles.

ANIMALS FROM DREDGE.

The following species are recorded in the Zoological Reports from the dredge at this Station :—

PENNATULIDA (Kölliker, Zool. pt. 2).

Protoptilum aberrans, n.sp. (var. ?). Fragment; obtained also at Stations 44 and 46.

CORALS (Moseley, Zool. pt. 7).

Caryophyllia communis (Seguenza). One broken specimen; obtained also at Stations 50, 57, 78, and 142, 150 to 1250 fathoms. Fossil—Tertiary of Sicily.

ASTEROIDEA (Sladen, Zool. pt. 51).

Pararchaster semisquamatus, n.g., n.sp., var. *occidentalis*, nov. One specimen (either from this Station or Station 44); see Station 44.

Pontaster forcipatus, n.g., n.sp. A few specimens; obtained also at Stations 44, 46, 50, and 146.

Dytaster madreporifer, n.g., n.sp. Obtained also at Station 44.

Plutonaster rigidus, n.g., n.sp. One specimen (either from this Station or Station 44); see Station 44.

Porcellanaster cæruleus, Wyville Thomson, n.g., n.sp. Obtained also at Stations 46 and 47, 1350 and 1340 fathoms. Recorded subsequently from Indian Ocean ("Investigator") (?).

Phoxaster pumilus, n.g., n.sp. One specimen (either from this Station or Station 44); see Station 44.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophioglypha lepida, n.sp. Obtained also at Stations 46, 76, 343, and Bermuda, 420 to 1350 fathoms.

,, *bullata*, Wyville Thomson, n.sp. (young). Obtained also at Stations 54, 61, and 133, 1900 to 2850 fathoms.

Ophiomusium lymani, Wyville Thomson. Obtained also at Stations 50, 76, 135, 169, 191, 235, and 296, 565 to 1825 fathoms.

Amphiura otteri, Ljungman. Obtained also at Stations 50, 76, and 78, 900 to 1250 fathoms.

Amphilepis norvegica, Ljungman. Obtained also at Stations 33 (?) and 46.

Ophiacantha bidentata (Retzius), Ljungman. Obtained also at Stations 46 and 49, 1350 and 85 fathoms.

HOLOTHURIOIDEA (Théel, Zool. pt. 39).

Trochostoma albicans, n.sp. Four specimens; obtained also at Station 169, 700 fathoms (var. *glabra*).

Fragments of a pedate Holothurid.

NEMERTEA (Hubrecht, Zool. pt. 54).

Carinina grata, n.g., n.sp. One specimen; obtained also at Station 47, 1340 fathoms. Only species of the genus.

Station 45

ANNELIDA (M'Intosh, Zool. pt. 34).

Harmothoë benthaliana, n.sp. Two specimens; obtained at no other locality.

Nephthys phyllobranchia, n.sp. One fragmentary specimen; obtained at no other locality.

Lumbriconereis punctata, n.sp. One fragmentary specimen; obtained at no other locality.

Eunice œrstedi, Stimpson (?). One specimen; obtained also at Stations 49 and 144A, 85 and 69 fathoms.

Spiochætopterus (?) sp. A few empty tubes.

Praxilla occidentalis, n.sp. One fragmentary specimen; obtained at no other locality.

COPEPODA (Brady, Zool. pt. 23).

Calanus princeps, n.sp. One specimen; obtained also at Station 50, 1250 fathoms.

ISOPODA (Beddard, Zool. pt. 48).

Neotanais americanus, n.g., n.sp. One specimen; obtained also at Station 323, 1900 fathoms. Only species of the genus.

CUMACEA (Sars, Zool. pt. 55).

Eudorella abyssi, n.sp. One specimen; obtained at no other locality.

MACRURA (Spence Bate, Zool. pt. 52).

Gennadas parvus, n.g., n.sp. One specimen; obtained also at Stations 101, 120, 159, 206, 220, 230, 232, 235, 237, 250, 267, and 289, 345 to 3050 fathoms. Recorded subsequently from Indian Ocean ("Investigator").

Orphania tenuimana, n.g., n.sp. One specimen; obtained at no other locality. Only species of the genus.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Malletia obtusa, Sars. Obtained also at Station 47, 1340 fathoms. Recorded from Atlantic.

In addition to the foregoing, the following are recorded in the Station-book :—Actinia, many specimens of an unknown Urchin, very large specimen of *Sipunculus*.

Excluding Protozoa, over 50 specimens of invertebrates were obtained at this Station, belonging to about 33 species, of which 17 are new to science, including representatives of 7 new genera; 6 of the new species and 1 new genus were not obtained elsewhere.

Willemoes-Suhm writes: "The dredge brought up an enormous Copepod, 13 mm. in length, belonging to the Calanidæ family, the largest of which hitherto known was only 6 mm. in length. It was hanging in the swabs, by which it had probably been caught in their passage through the surface water. Also a very long *Sipunculus* and several Annelids, most of which were only in fragments." Station 45.

Foraminifera (Brady, Zool. pt. 22).—The following species of Foraminifera were observed in the deposit from this Station; the pelagic species, which make up about 68 per cent. of the carbonate of lime present in the deposit, are marked thus ×:— Organisms from the Deposit.

Biloculina depressa, d'Orbigny.
„ „ var. *serrata*, Brady.
„ *ringens* (Lamarck).
„ *tubulosa*, Costa.
Spiroloculina tenuis (Czjzek).
Miliolina seminulum (Linné).
„ *tricarinata* (d'Orbigny).
Planispirina celata (Costa).
Astrorhiza arenaria, Norman.
Psammosphæra fusca, Schulze.
Hyperammina friabilis, Brady.
„ *vagans*, Brady (?).
Rhabdammina abyssorum, Sars.
Reophax scorpiurus, Montfort.
Haplophragmium globigeriniforme (Parker and Jones).
„ *glomeratum*, Brady.
„ *scitulum*, Brady.
„ *turbinatum*, Brady.
Hormosina globulifera, Brady.
Trochammina pauciloculata, Brady.
Tritaxia lepida, Brady.
Gaudryina baccata, Schwager.
„ *pupoides*, d'Orbigny.
Clavulina parisiensis, d'Orbigny.
Bulimina aculeata, d'Orbigny.
„ *affinis*, d'Orbigny.
„ *elegans*, d'Orbigny, var. *exilis*, Brady.
„ *inflata*, Seguenza.
„ *marginata*, d'Orbigny.
„ *ovata*, d'Orbigny.
„ *pupoides*, d'Orbigny.
„ *pyrula*, d'Orbigny.
Virgulina schreibersiana, Czjzek.
Bolivina pygmæa, Brady.
Pleurostomella subnodosa, Reuss.
Cassidulina lævigata, d'Orbigny.
Lagena apiculata, Reuss.
„ *distoma*, Parker and Jones.
Lagena fimbriata, Brady.
„ *globosa* (Montagu).
„ *gracilis*, Williamson.
„ *lævis* (Montagu).
„ *marginata* (Walker and Boys).
„ *sulcata* (Walker and Jacob).
Nodosaria communis, d'Orbigny.
„ *obliqua* (Linné).
„ *raphanus* (Linné).
„ *soluta*, Reuss.
Frondicularia alata, d'Orbigny.
„ *inæqualis*, Costa.
Marginulina costata (Batsch).
„ *glabra*, d'Orbigny.
Vaginulina legumen (Linné).
Cristellaria crassa, d'Orbigny.
„ *lata* (Cornuel).
„ *reniformis*, d'Orbigny.
„ *rotulata* (Lamarck).
„ *variabilis*, Reuss.
Polymorphina lactea (Walker and Jacob).
„ *sororia*, Reuss.
Uvigerina angulosa, Williamson.
„ *pygmæa*, d'Orbigny.
„ *tenuistriata*, Reuss.
× *Globigerina bulloides*, d'Orbigny.
× „ *conglobata*, Brady.
× „ *dubia*, Egger.
× „ *dutertrei*, d'Orbigny.
× „ *inflata*, d'Orbigny.
× „ *pachyderma* (Ehrenberg).
× „ *rubra*, d'Orbigny.
× „ *sacculifera*, Brady.
× *Orbulina universa*, d'Orbigny.
× *Pullenia obliquiloculata*, Parker and Jones.
„ *quinqueloba*, Reuss.
„ *sphæroides* (d'Orbigny).
Sphæroidina bulloides, d'Orbigny.

Station 45.

× *Sphaeroidina dehiscens*, Parker and Jones.
Truncatulina lobatula (Walker and Jacob).
,, *tenera*, Brady.
,, *ungeriana* (d'Orbigny).
Anomalina ammonoides (Reuss).
× *Pulvinulina canariensis* (d'Orbigny).
× ,, *crassa* (d'Orbigny).
,, *elegans* (d'Orbigny).
× *Pulvinulina menardii* (d'Orbigny).
× ,, *micheliniana* (d'Orbigny).
× ,, *tumida*, Brady.
Rotalia calcar, d'Orbigny (?).
,, *soldanii*, d'Orbigny.
Nonionina pompilioides (Fichtel and Moll).
,, *scapha* (Fichtel and Moll).
Polystomella striatopunctata (Fichtel and Moll).

On May 4, the water was observed to be of a peculiar bottle-green colour.

Station 46.

Station 46 (Sounding 104), Bermuda to Halifax (see Chart 9).

May 6, 1873; lat. 40° 17′ N., long. 66° 48′ W.
Temperature of air at noon, 47°·2; mean for the day, 45°·0.
Temperature of water at surface, 40°·0; bottom, 37°·2.
Density at 60° F. at surface, 1·02403.
Depth, 1350 fathoms; deposit, Blue Mud, containing 15·40 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 8 A.M. proceeded under steam to sound. At 9 A.M. sounded in 1350 fathoms. At 11 A.M. put over dredge, which came up at 4 P.M. with a small quantity of mud and several specimens. The dredge was sent down again about 4 P.M., and brought up about 6.30 P.M., but it did not seem to have reached the bottom, the ship having possibly drifted into deeper water. There was a brilliant halo round the sun during a part of the day, showing prismatic colours. Many petrels and flocks of other birds were observed from the ship.

Distance from Sambro Island at noon, 288 miles. Made good 115 miles. Amount of current 17 miles, direction S. 65° E.

Animals from Dredge.

The following species are recorded in the Zoological Reports from the dredge at this Station :—

PENNATULIDA (Kölliker, Zool. pt. 2).

Protoptilum aberrans, n.sp. (?). Fragment; obtained also at Stations 44 and 45.

ACTINIARIA (Hertwig, Zool. pt. 15).

Stephanactis abyssicola (Moseley), n.g., n.sp. Two specimens; obtained at no other locality.

ASTEROIDEA (Sladen, Zool. pt. 51).

Pararchaster armatus, n.g., n.sp. Obtained also at Station 50, 1250 fathoms; and off coast of Portugal.

Pontaster forcipatus, n.g., n.sp. Many specimens; obtained also at Stations 44, 45, 50, and 146. STATION 46.

Plutonaster rigidus, n.g., n.sp., var. *semiarmata*, nov. One specimen (either from this Station or Station 47); the species obtained also at Station 44 or 45.

Porcellanaster cæruleus, Wyville Thomson, n.g., n.sp. Obtained also at Stations 45 and 47.

Leptoptychaster arcticus (Sars), var. *elongata*, nov. Obtained also at Station 49, 85 fathoms. The species recorded from North Atlantic ("Porcupine").

Phoxaster pumilus, n.g., n.sp. One young specimen; obtained also at Station 44 or 45. Only species of the genus.

Zoroaster fulgens, Wyville Thomson. Obtained also at Stations 50 and 120, 1250 and 675 fathoms. Recorded from North Atlantic ("Porcupine" and "Triton").

Cribrella oculata (Linck), Forbes. Obtained also at Stations 48 and 49, 51 and 85 fathoms. Recorded from Arctic, and North Atlantic ("Porcupine," "Knight Errant," and "Triton").

Brisinga verticillata, n.sp. Obtained at no other locality.

Freyella bracteata, n.sp. Obtained also at Stations 47 and 50, 1340 and 1250 fathoms.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophioglypha lepida, n.sp. Obtained also at Stations 45, 76, 343, and Bermuda.

Amphilepis norvegica, Ljungman. Obtained also at Stations 33 (?) and 45.

Ophiacantha bidentata (Retzius), Ljungman. Obtained also at Stations 45 and 49.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Echinus acutus, Lamarck. Obtained also at Stations 170 and 343, 630 and 425 fathoms.

,, *elegans* (Düben and Koren). Obtained also at Stations 135 and 219, 1100 and 150 fathoms.

,, *norvegicus*, Düben and Koren. Obtained also at Stations 47, 232, 235, and 308, 175 to 1340 fathoms.

In addition to the foregoing, the Station-book records a Gorgonoid.

Excluding Protozoa, over 40 specimens of invertebrates were obtained at this Station, belonging to about 19 species, of which 11 are new to science, including representatives of 6 new genera; 2 of the new species were not obtained elsewhere.

Station 46. Organisms from Surface Nets.

Surface Organisms.—The following species are recorded from the surface near this Station :—

Amphipoda (Stebbing, Zool. pt. 67).

Euthemisto bispinosa (Boeck).

Heteropoda (Smith, Zool. pt. 72).

Pterotrachea sp. (?). [off Boston, U.S.].

Murray was away in a boat, and picked up some specimens of Ctenophoræ.

Station 47.

Station 47 (Sounding 105), Bermuda to Halifax (see Chart 9).

May 7, 1873; lat. 41° 14′ N., long. 65° 45′ W.
Temperature of air at noon, 45°·8 ; mean for the day, 42°·1.
Temperature of water at surface, 42°·0.
Density at 60° F. at surface, 1·02419.
Depth, 1340 fathoms ; deposit, Blue Mud, containing 6·68 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6 A.M. stopped to sound, and at 6.30 A.M. sounded in 1340 fathoms. At 8 A.M. put over dredge, which came up at 1.45 P.M. half full of mud, and with many specimens, while jammed between the mouth of the dredge and the arms was a large block of syenite, weighing about 5 cwts.

Distance at noon from Sambro Island, 214 miles. Made good 75 miles. Amount of current 6 miles, direction S. 20° W.

Animals from Dredge.

The following species are recorded in the Zoological Reports from the dredge at this Station :—

Asteroidea (Sladen, Zool. pt. 51).

Plutonaster bifrons (Wyville Thomson). One small specimen ; obtained also at Station V.

" *rigidus*, n.g., n.sp., var. *semiarmata*, nov. One specimen (either from this Station or Station 46) ; see Station 46.

Porcellanaster cæruleus, Wyville Thomson, n.g., n.sp. Obtained also at Stations 45 and 46.

Freyella bracteata, n.sp. Five specimens ; obtained also at Stations 46 and 50.

Echinoidea (Agassiz, Zool. pt. 9).

Echinus norvegicus, Düben and Koren. Many specimens ; obtained also at Stations 46, 232, 235, and 308.

Nemertea (Hubrecht, Zool. pt. 54).

Carinina grata, n.g., n.sp. One specimen; obtained also at Station 45. Only species of the genus.

Gephyrea (Selenka, Zool. pt. 36).

Bonellia suhmii, n.sp. One specimen; obtained at no other locality.

Annelida (M'Intosh, Zool. pt. 34).

Laranda longa (Webster). One specimen; obtained at no other locality by the Challenger. Recorded from coast of Virginia.

Lumbriconereis ehlersii, n.sp., var. *tenuisetis*, nov. One fragmentary specimen; obtained at no other locality by the Challenger. The species recorded from Europe, and Greenland ("Valorous").

Aricia norvegica, Sars, var. (?). One fragmentary specimen; obtained also at Station 125, 1200 fathoms (var.?). The species recorded from North Atlantic.

Aricidea fragilis, Webster. One fragmentary specimen; obtained at no other locality by the Challenger.

Notomastus agassizii, n.sp. Several specimens; obtained also by sounding line off San Antonio, Cape Verdes.

Maldane sp. (?).

Myriochele heeri, Malmgren, var. (?). One fragmentary specimen; obtained also at Stations 20 and 325.

Thelepus (?) sp. One injured specimen.

Terebellides strœmi, Sars, var. (?). One specimen; obtained also at Station 149, 110 and 127 fathoms (var. *kerguelensis*, nov.). The species ranges from European to American shores.

Cumacea (Sars, Zool. pt. 55).

Diastylis stygia, Sars. Eight specimens; obtained at no other locality by the Challenger. Recorded from North Atlantic and Arctic.

Lamellibranchiata (Smith, Zool. pt. 35).

Malletia obtusa, Sars. Obtained also at Station 45.

Gasteropoda (Watson, Zool. pt. 42).

Puncturella brychia, n.sp. Obtained at no other locality.

Fusus (*Sipho*), n.sp. (?). Four injured specimens.

Brachiopoda (Davidson, Zool. pt. 1).

Terebratella frielii, n.sp. Two specimens; obtained also at Station 201, 82 to 102 fathoms.

Station 47

In addition to the foregoing, the following are recorded in the Station-book:—Gorgonoid, many Ophiurids, several specimens of *Pourtalesia* (?), *Caudina*, and *Discina*.

Excluding Protozoa, over 80 specimens of invertebrates were obtained at this Station, belonging to about 26 species, of which 9 are new to science, including representatives of 3 new genera; 3 of the new species were not obtained elsewhere.

Organisms from the Deposit.

Diatomaceæ.—The following species of Diatoms were observed by Mr. Comber in the deposit from this Station:—

Navicula lyra, Ehrenberg, var. *elliptica*, A. Schmidt.	*Coscinodiscus concavus*, Ehrenberg.
,, *clavata*, Gregory.	,, *curvatulus*, Grunow.
,, *smithii*, Brebisson.	,, *kutzingii*, A. Schmidt.
,, *fusca*, Ralfs.	,, *fasciculatus*, O'Meara.
,, *didyma*, Kutzing.	,, *subtilis*, Ehrenberg.
,, *distans*, Ralfs.	,, *denarius*, A. Schmidt.
Pleurosigma directum, Grunow.	,, *normanii*, Gregory.
Cocconeis scutellum, Ehrenberg.	,, *concinnus*, W. Smith.
Nitzschia marina, Grunow.	,, *robustus*, Greville.
Biddulphia aurita, Brebisson.	,, *marginatus*, Ehrenberg.
Triceratium punctatum, Brightwell.	,, *borealis*, Bailey.
,, *alternans*, Bailey.	,, *centralis*, Ehrenberg.
Hemidiscus cuneiformis, Wallich.	,, *oculus-iridis*, Ehrenberg.
Actinoptychus undulatus, Ehrenberg.	,, *asteromphalus*, Ehrenberg.
,, *areolatus*, A. Schmidt.	,, *radiatus*, Ehrenberg.
,, *splendens*, Ralfs.	,, *obscurus*, A. Schmidt.
Actinocyclus sparsus (= *Eupodiscus*, Gregory).	,, *nodulifer*, Janisch.
,, *ralfsii*, Ralfs.	,, *decrescens*, Grunow.
Asteromphalus brookei, Bailey.	,, *crassus*, Bailey.
Eupodiscus radiatus, Bailey.	,, *elegans*, Greville.
Coscinodiscus excentricus, Ehrenberg.	*Paralia sulcata*, Cleve.
,, *lineatus*, Ehrenberg.	*Hyalodiscus scoticus*, Grunow.
,, *auguste-lineatus*, A. Schmidt.	

Station 48.

Station 48 (Sounding 106), Bermuda to Halifax (see Chart 9).

May 8, 1873; lat. 43° 4′ N., long. 64° 5′ W.

Temperature of air at noon, 44°·3; mean for the day, 41°·5.

Temperature of water at surface, 38·0.

Depth, 51 fathoms; deposit, rock, gravel, stones, &c.

At 5.5 A.M. stopped and sounded in 51 fathoms. At 7 A.M. put over dredge, which came up about noon. The dredge-bag was torn, and contained nothing, but the tangles were loaded with animals. In the afternoon most of the ship's company were occupied in fishing, and probably about 100 cod were taken, which proved a welcome addition to the

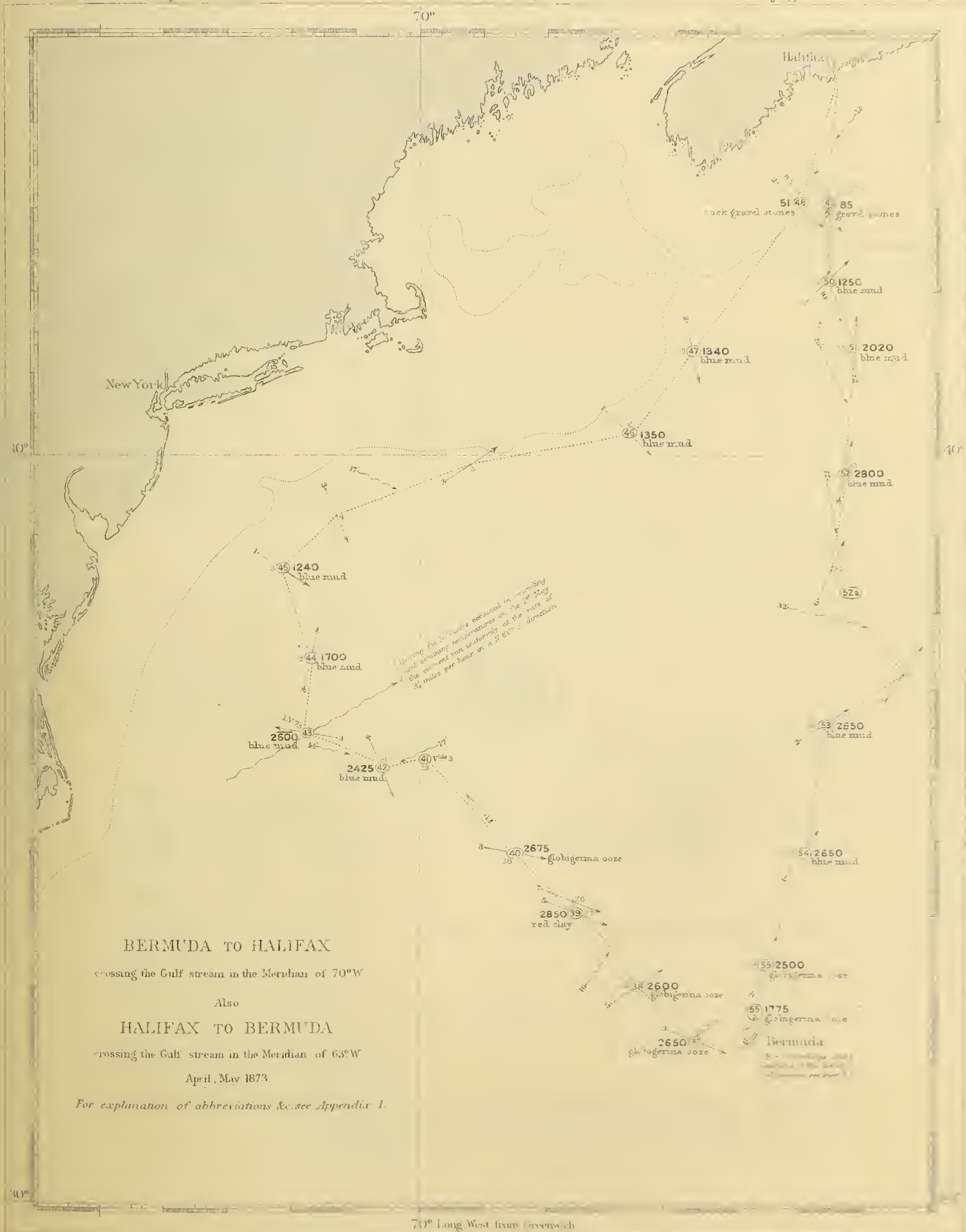

70°
Halifax
New York
40°
30°
51 48 rock gravel stones
85 gravel stones
50 1250 blue mud
47 1340 blue mud
51 2020 blue mud
46 1350 blue mud
52 2800 blue mud
45 1240 blue mud
44 1700 blue mud
43 2600 blue mud
2425 42 blue mud
41
53 2650 blue mud
40 2675 globigerina ooze
54 2650 blue mud
2850 39 red clay
55 2500
38 2600 globigerina ooze
56 1775 globigerina ooze
2650 globigerina ooze
Bermuda
BERMUDA TO HALIFAX
crossing the Gulf stream in the Meridian of 70°W
Also
HALIFAX TO BERMUDA
crossing the Gulf stream in the Meridian of 63°W
April, May 1873.
For explanation of abbreviations &c. see Appendix I.
70° Long. West from Greenwich

table. Petrels and gulls were seen about the ship. At 4.30 P.M. made all plain sail, and proceeded towards Halifax. Station 48.

Distance from Sambro Island Lighthouse at noon, 86 miles. Made good 131 miles. Amount of current 8 miles, direction N. 83° E.

The following species are recorded in the Zoological Reports from the dredge at this Station :— Animals from Dredge.

Hydroida (Allman, Zool. pt. 70).

Sertularia abietina, Linné. Several specimens; obtained at no other locality by the Challenger. Recorded from North Atlantic.

Thuiaria cupressina (Linné). One specimen; obtained at no other locality by the Challenger. Recorded from European coasts.

Crinoidea (Carpenter, Zool. pt. 60).

Antedon eschrichti (Müller). Several specimens; obtained at no other locality by the Challenger. Recorded from Arctic and North Atlantic ("Porcupine," "Valorous," "Alert," and "Triton").

„ *quadrata*, n.sp. Several specimens; obtained at no other locality by the Challenger. Recorded from Arctic and North Atlantic ("Valorous," "Alert," and "Triton").

Asteroidea (Sladen, Zool. pt. 51).

Crossaster papposus (Linck), Müller and Troschel. Obtained at no other locality by the Challenger. Recorded from Arctic, and North Atlantic ("Porcupine" and "Knight Errant").

Solaster endeca (Retzius), Forbes. Obtained at no other locality by the Challenger. Recorded from Arctic, Atlantic, and Pacific.

Cribrella oculata (Linck), Forbes. Obtained also at Stations 46 and 49.

Echinoidea (Agassiz, Zool. pt. 9).

Strongylocentrotus dröbachiensis (Müller). Obtained also at Station 49, 85 fathoms.

Nemertea (Hubrecht, Zool. pt. 54).

Cerebratulus truncatus, n.sp. One specimen; obtained also at Station 49, 85 fathoms, and off Bermuda.

Annelida (M'Intosh, Zool. pt. 34).

Eusyllis tubifex, Gosse. Several specimens; obtained at no other locality by the Challenger. Recorded from Britain and Madeira.

Station 48.

Thelepus cincinnatus (Fabricius), var. *canadensis*, nov. One specimen; obtained at no other locality by the Challenger. The species recorded from North Atlantic (" Knight Errant," &c.).

Myzostomida (Graff, Zool. pts. 27 and 61).

Myzostoma gigas, Lütken. On *Antedon eschrichti.*
,, *fimbriatum*, n.sp. On *Antedon quadrata.*

Brachyura (Miers, Zool. pt. 49).

Hyas aranea (Linné). One specimen; obtained at no other locality by the Challenger. Recorded from Arctic, North Atlantic, and North Pacific.
,, *coarctata*, Leach. One specimen; obtained also at Station 49, 85 fathoms.

Polyzoa (Busk, Zool. pt. 30).

Eschara elegantula, d'Orbigny. Obtained at no other locality by the Challenger. Recorded from North Atlantic and Arctic.
Cellepora canaliculata, n.sp. Obtained at no other locality.

Brachiopoda (Davidson, Zool. pt. 1).

Terebratulina caput-serpentis, Linné, var. *septentrionalis*, Couthouy. Many specimens; obtained also at Stations 49, 142, and 145, 85 to 150 fathoms. Recorded from North Atlantic.

Tunicata (Herdman, Zool. pts. 17 and 38).

Boltenia elegans, n.sp. Two specimens; obtained at no other locality.
Aplidium despectum, n.sp. One specimen; obtained at no other locality.

Excluding Protozoa, over 50 specimens of invertebrates were obtained at this Station, belonging to about 20 species, of which 7 are new to science; 5 of the new species were not obtained elsewhere.

Willemoes-Suhm states that on the cod that were caught a species of *Caligus* was found, to which was attached the ectoparasitical Trematode *Udonella caligorum*, known especially from Van Beneden's description of its ametabolous development.

Organisms from the Surface.

Surface Organisms.—Murray was away in a boat in the afternoon and caught some large Ctenophoræ. Diatoms and Coccospheres were very abundant on the surface during the past four days.

At Halifax.

The Challenger remained at Halifax, Nova Scotia, from 10.20 a.m. on May 9 till 5.10 p.m. on May 19, 1873.

On specimens of *Cottus* procured during the visit a parasitic Amphipod—*Lafystius sturionis*, Krøyer—was found (see Stebbing, Zool. pt. 67). HALIFAX.

Station 49 (Sounding 107), Halifax to Bermuda (see Chart 9 and Diagram 2). STATION 49.

May 20, 1873; lat. 43° 3′ N., long. 63° 39′ W.

Temperature of air at noon, 44°·3; mean for the day, 43°·0.

Temperature of water:—

Surface,	40°·5	60 fathoms,	35°·2
20 fathoms,	37·8	Bottom,	35·2
40 „	35·2		

Density at 60° F. at surface, 1·02354; bottom, 1·02400.

Depth, 85 fathoms; deposit, gravel, stones, &c.

At 9.15 A.M. shortened and furled sails, and got up steam to sound and dredge. Sounded in 83 [85] fathoms. At 10 A.M. put dredge over, and took four hauls in rapid succession, allowing the dredge to remain at the bottom about an hour on each occasion, a large number of specimens being procured. Serial temperature observations were taken at intervals of 20 fathoms from the surface.

Distance at noon from Gibb's Hill Lighthouse, Bermuda, 651 miles. Made good 86 miles. Amount of current 12 miles, direction S. 39° W.

The following species are recorded in the Zoological Reports from the dredge at this Station:—

KERATOSA (Poléjaeff, Zool. pt. 31). ANIMALS FROM DREDGE.

Psammopemma densum, Marshall. One specimen; obtained also at Port Jackson, 7 fathoms.

MONAXONIDA (Ridley and Dendy, Zool. pt. 59).

Artemisina suberitoides, Vosmaer. One specimen; obtained at no other locality by the Challenger. Recorded from Arctic.

Polymastia robusta, Bowerbank. One specimen; obtained at no other locality by the Challenger. Recorded from British seas ("Porcupine," &c.).

„ sp. (?) (*mammillaris?*). One small specimen.

Tentorium semisuberites (Schmidt). Ten specimens; obtained also at Stations 50 and 135, 60 to 90, and 1250 fathoms. Recorded from Arctic and North Atlantic.

STATION 49.

Stylocordyla stipitata (Carter). One specimen; obtained also at Stations 145 (var.), 147, 149 (var.), and Bahia, 7 to 1600 fathoms. Recorded from North Atlantic.

Quasillina brevis (Bowerbank). Fourteen specimens; obtained at no other locality by the Challenger. Recorded from Arctic, North Atlantic, and Mediterranean.

ACTINIARIA (Hertwig, Zool. pt. 73).

Epizoanthus cancrisocius, Studer. One specimen (on a Gasteropod shell tenanted by *Pagurus*); obtained at no other locality by the Challenger.

ASTEROIDEA (Sladen, Zool. pt. 51).

Pontaster hebitus, n.g., n.sp. Obtained at no other locality.

Pseudarchaster intermedius, n.g., n.sp. Obtained at no other locality.

Leptoptychaster arcticus (Sars), var. *elongata*, nov. Obtained also at Station 46.

Pentagonaster granularis (Retzius). Obtained at no other locality by the Challenger. Recorded from both sides of North Atlantic ("Porcupine," &c.).

Hippasteria plana (Linck), Gray. Numerous specimens; obtained at no other locality by the Challenger. Recorded from North Atlantic ("Porcupine" and "Triton," &c.).

Stichaster albulus (Stimpson), Verrill. Obtained at no other locality by the Challenger. Recorded from North Atlantic and Arctic.

Pteraster militaris, Müller and Troschel. Obtained at no other locality by the Challenger. Recorded from North Atlantic ("Triton"), and Arctic.

Cribrella oculata (Linck), Forbes. Obtained also at Stations 46 and 48.

Asterias (*Leptasterias*) *compta*, Stimpson. Obtained at no other locality by the Challenger. Recorded from North Atlantic.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophiopholis aculeata, Gray. Obtained at no other locality by the Challenger. Recorded from North Atlantic and Arctic.

Ophiacantha bidentata (Retzius), Ljungman. Obtained also at Stations 45 and 46.

Ophioglypha sarsii (Lütken), Lyman. Obtained at no other locality by the Challenger.

Astronyx loveni, Müller and Troschel. Obtained also at Station 232, 345 fathoms. Recorded from North European seas.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Strongylocentrotus dröbachiensis (Müller). Obtained also at Station 48.

Schizaster fragilis (Düben and Koren). Obtained also at Station 142, 150 fathoms. Recorded from Gulf of Maine.

HOLOTHURIOIDEA (Théel, Zool. pt. 39).

Psolus operculatus, Pourtalès. Numerous specimens; obtained also at Station 320 (?), 600 fathoms.

NEMERTEA (Hubrecht, Zool. pt. 54).

Drepanophorus lankesteri, n.sp. One specimen; obtained at no other locality.

Cerebratulus truncatus, n.sp. One specimen; obtained also at Station 48 and Bermuda.

GEPHYREA (Selenka, Zool. pt. 36).

Phascolion tubicola, Verrill. Obtained at no other locality by the Challenger. Recorded from New England.

ANNELIDA (M'Intosh, Zool. pt. 34).

Euphrosyne borealis, Œrsted. One specimen; obtained at no other locality by the Challenger. Recorded from Arctic and North Atlantic.

Lætmonice producta, Grube, var. *assimilis*, nov. Obtained at no other locality. A widely-distributed species.

Nereis (*Lycoris* ?) *pelagica*, Linné. One specimen; obtained at no other locality by the Challenger. A widely distributed species.

Eunice œrstedi, Stimpson (?). One specimen; obtained also at Stations 45 and 144A.

Nothria conchylega, Sars. Several specimens; obtained also at Station III.

Potamilla torelli, Malmgren. Several specimens; obtained at no other locality by the Challenger. Recorded from North Atlantic.

Protula americana, n.sp. One specimen; obtained at no other locality.

CIRRIPEDIA (Hoek, Zool. pt. 25).

Scalpellum stroemii, Sars. Numerous specimens; obtained at no other locality by the Challenger. Common throughout North Atlantic ("Triton," &c.).

Sylon challengeri, n.sp. (Hoek in Zool. pt. 52). Parasitic on *Spirontocaris spinus*.

AMPHIPODA (Stebbing, Zool. pt. 67).

Stegocephalus inflatus, Krøyer. Two specimens; obtained at no other locality by the Challenger. Recorded from Kara Sea.

STATION 49.

Œdiceros lynceus, Sars. One specimen; obtained at no other locality by the Challenger.

Pleustes panopla (Krøyer). One specimen; obtained at no other locality by the Challenger. Recorded from North Atlantic and Arctic.

Epimera loricata, Sars. Three specimens; obtained at no other locality by the Challenger. Recorded from North Atlantic.

Halirages fulvocinctus (Sars). Two specimens; obtained at no other locality by the Challenger.

Rhachotropis aculeatus (Lepechin). Thirteen specimens; obtained at no other locality by the Challenger.

Pardalisca abyssi, Boeck. One specimen; obtained at no other locality by the Challenger.

Unciola irrorata, Say. One specimen; obtained at no other locality by the Challenger.

MACRURA (Spence Bate, Zool. pt. 52).

Sabinea septemcarinata (Sabine). Twenty-two specimens; obtained at no other locality by the Challenger. Recorded from North Atlantic and Arctic.

Hippolyte projecta, n.sp. One specimen; obtained at no other locality.

Spirontocaris spinus (Sowerby), and varieties. Numerous specimens; obtained at no other locality by the Challenger. Recorded from North Atlantic and Arctic.

Hetairus gaimardii (M.-Edwards). One specimen; obtained at no other locality by the Challenger. Recorded from Iceland.

,, *tenuis*, n.g., n.sp. One specimen; obtained at no other locality.

,, *debilis*, n.g., n.sp. Fifteen specimens; obtained at no other locality.

Pandalus falcipes, n.sp. Two specimens; obtained at no other locality.

ANOMURA (Henderson, Zool. pt. 69).

Eupagurus pubescens (Krøyer), var. *kroyeri*, Stimpson. Two specimens in shells of *Natica affinis;* obtained at no other locality by the Challenger. Recorded from North Atlantic and North Pacific.

BRACHYURA (Miers, Zool. pt. 49).

Hyas coarctata, Leach. One specimen; obtained also at Station 48.

Neptunus (Neptunus) sayi, M.-Edwards. One specimen; obtained also on gulf-weed, North-West Atlantic, April 1873, and also May 1876.

PYCNOGONIDA (Hoek, Zool. pt. 10).

Nymphon grossipes (Fabricius). Three specimens; obtained at no other locality by the Challenger. Recorded from North Atlantic and Arctic.

„ *brevicollum*, n.sp. Eight specimens; obtained at no other locality.

SCAPHOPODA and GASTEROPODA (Watson, Zool. pt. 42).

Dentalium entalis, Linné, var. *striolatum*, Stimpson. For distribution see Station II.

Fusus sp. (?).

Natica affinis (Gmelin). Obtained at no other locality by the Challenger. Widely distributed in Northern Seas. Fossil—Pliocene onwards.

CEPHALOPODA (Hoyle, Zool. pt. 44).

Rossia (?) *tenera* (Verrill). One specimen; obtained at no other locality by the Challenger. Recorded from New England and St. Kitts.

POLYZOA (Busk, Zool. pt. 50; Waters, pt. 79).

Palmicellaria skenei (Ellis and Solander), var. *tridens*, Kirchenpauer. One specimen; obtained at no other locality by the Challenger.

Flustra separata, n.sp. One specimen; obtained at no other locality.

Idmonea atlantica, Forbes. Obtained also at Stations 135, 149, and Simon's Bay, Cape, 18 to 150 fathoms. Recorded from Arctic, North Atlantic, and Mediterranean. Fossil — Italian Miocene, Canadian Post-Pliocene.

BRACHIOPODA (Davidson, Zool. pt. 1).

Terebratulina caput-serpentis, Linné, var. *septentrionalis*, Couthouy. Many specimens; for distribution see Station 48.

TUNICATA (Herdman, Zool. pt. 17).

Ascidia falcigera, n.sp. Several specimens; obtained at no other locality.

FISHES (Günther, Zool. pt. 6).

Hippoglossoides dentatus, Mitch. Obtained at no other locality by the Challenger.

In addition to the foregoing, the following are recorded in the Station-book:—*Tripylus fragilis*, many Isopods, Squillids, *Astarte*, *Anomia*.

Excluding Protozoa, over 200 specimens of invertebrates and fishes were obtained at this Station, belonging to about 65 species, of which 15 are new to science, including representatives of 3 new genera; 10 of the new species were not obtained elsewhere.

Station 49.

Willemoes-Suhm writes: "Among great numbers of Crustacea, worms, &c., obtained in the dredge, some Squillids were remarkable for their *Bopyri*, and some specimens of *Anthura* were procured. *Nymphon* was in great abundance, and the various stages in its development could be followed; the larvæ just hatched had only three pairs of legs, the fourth being represented by two rudiments merely at each side of the tail." I may mention that I found the *Dentalia* inhabited by *Sipunculi* quite in the same way as they are on the Danish coasts.

Station 50.

Station 50 (Sounding 108), Halifax to Bermuda (see Chart 9 and Diagram 2).

May 21, 1873; lat. 42° 8′ N., long. 63° 39′ W.

Temperature of air at noon, 49°·3; mean for the day, 46°·9.

Temperature of water:—

	°		°
Surface, ...	45·0	700 fathoms, . . .	38·1
100 fathoms, . . .	45·2	800 ,, . . .	37·8
200 ,, . . .	41·3	900 ,, . . .	37·6
300 ,, . . .	39·5	1000 ,, . . .	37·4
400 ,, . . .	39·0	1100 ,, . . .	37·2
500 ,, . . .	38·7	1200 ,, . . .	37·0
600 ,, . . .	38·4		

Density at 60° F. at surface, 1·02451; bottom, 1·02546.

Depth, 1250 fathoms; deposit, Blue Mud, containing 16·25 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6 A.M. shortened sail, and got up steam to sound and dredge. At 6.40 A.M. sounded in 1250 fathoms. At 8 A.M. put over dredge and veered 2000 fathoms. At 1.15 P.M. hove up dredge, containing a mass of mud and a few specimens. At 2 P.M. the trawl was sent down with 1800 fathoms of rope. Obtained serial temperatures down to 1200 fathoms. At 6 P.M. sounded to obtain bottom water for analysis; a large *Pennatula* was brought up on the sounding-line, with a handsome *Euryale* attached. Hove up trawl, which contained a number of specimens.

Distance from Bermuda at noon, 596 miles. Made good 53 miles. Amount of current 26 miles, direction S.

Animals from Dredge and Trawl.

The following species are recorded in the Zoological Reports from the dredge and trawl at this Station:—

MONAXONIDA (Ridley and Dendy, Zool. pt. 59).

Tentorium semisuberites (Schmidt). One specimen; obtained also at Stations 49 and 135.

PENNATULIDA (Kölliker, Zool. pt. 2). STATION 50.

Anthoptilum murrayi, n.g., n.sp. One specimen; obtained at no other locality.

CORALS (Moseley, Zool. pt. 7).

Caryophyllia communis (Seguenza). Numerous specimens; obtained also at Stations 45, 57, 78, and 142.

Flabellum angulare, n.sp. One specimen; obtained at no other locality. Recorded subsequently from North Atlantic ("Blake").

DEEP-SEA MEDUSÆ (Haeckel, Zool. pt. 12).

Ptychogena pinnulata, Haeckel. One fragmentary specimen; obtained at no other locality by the Challenger. Recorded from North Atlantic.

Pectyllis arctica, Haeckel. One specimen; obtained at no other locality by the Challenger. Recorded from Greenland.

ASTEROIDEA (Sladen, Zool. pt. 51).

Pararchaster armatus, n.g., n.sp. Obtained also at Station 46, and off coast of Portugal.

Pontaster forcipatus, n.g., n.sp. Several specimens; obtained also at Stations 44, 45, 46, and 146.

Zoroaster fulgens, Wyville Thomson. Obtained also at Stations 46 and 120.

Asterias (*Hydrasterias*) *ophidion*, n.sp. Obtained at no other locality.

Freyella bracteata, n.sp. Obtained also at Stations 46 and 47.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophiomusium lymani, Wyville Thomson. Obtained also at Stations 45, 76, 135, 169, 191, 235, and 296.

Amphiura otteri, Ljungman. Obtained also at Stations 45, 76, and 78.

HOLOTHURIOIDEA (Théel, Zool. pt. 13).

Kolga nana, n.sp. Several specimens; obtained also at Station 152, 1260 fathoms.

ANNELIDA (M'Intosh, Zool. pt. 34).

Chætozone benthaliana, n.sp. One fragmentary specimen; obtained at no other locality.

COPEPODA (Brady, Zool. pt. 23).

Calanus princeps, n.sp. One specimen; obtained also at Station 45.

AMPHIPODA (Stebbing, Zool. pt. 67).

Lanceola suhmi, n.sp. One specimen; obtained at no other locality.

STATION 50.

SCHIZOPODA (Sars, Zool. pt. 37).

Eucopia australis, Dana. Obtained also at Stations 73, 92, 107, 146, 158, and 237, 1000 to 1975 fathoms. Recorded from Antarctic.

Boreomysis microps, n.sp. One specimen; obtained at no other locality.

PYCNOGONIDA (Hoek, Zool. pt. 10).

Colossendeis minuta, n.sp. One specimen; obtained at no other locality.

CEPHALOPODA (Hoyle, Zool. pt. 44).

Taonius hyperboreus, Steenstrup. One specimen (probably from the surface); obtained at no other locality by the Challenger. Recorded from North Atlantic ("Porcupine"), and Arctic.

In addition to the foregoing, the Station-book records:—*Euryale* and two young specimens of *Chætoderma*.

Excluding Protozoa, nearly 100 specimens of invertebrates were obtained at this Station, belonging to about 23 species, of which 12 are new to science, including representatives of 3 new genera; 7 of the new species were not obtained elsewhere.

Willemoes-Suhm writes: "Among the Crustacea was a Palæmonid with very thin and elongated legs. Two young specimens of *Chætoderma* were apparently not different from the one we got in the West Indies."

ORGANISMS FROM SURFACE NETS.

Surface Organisms.—The following species are recorded from the surface at this Station:—

RADIOLARIA (Haeckel, Zool. pt. 40).

Amphicraspedum maclaganium, Haeckel.

SCHIZOPODA (Sars, Zool. pt. 37).

Nematoscelis megalops, n.g., n.sp.

Willemoes-Suhm writes: "We made only 3 knots all night, and the tow-net, hauled in twice, was quite filled with a rather large species of *Hyperia*."

STATION 51.

Station 51 (Sounding 109), Halifax to Bermuda (see Chart 9 and Diagram 2).

May 22, 1873; lat. 41° 19′ N., long. 63° 12′ W.

Temperature of air at noon, 59°·8; mean for the day, 56°·3.

Temperature of water:— STATION 51.

Surface,	59·0°	900 fathoms,	38·0°
100 fathoms,	55·0	1000 „	37·8
200 „	47·0	1100 „	37·7
300 „	42·0	1200 „	37·5
400 „	39·8	1300 „	37·4
500 „	38·8	1400 „	37·3
600 „	38·4	1500 „	37·2
700 „	38·2	Bottom,	36·0
800 „	38·1		

Density at 60° F. at surface, 1·02625; bottom, 1·02595.

Depth, 2020 fathoms; deposit, Blue Mud, containing 27·75 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 7.30 A.M. stopped to sound and dredge. At 8 A.M. sounded in 2020 fathoms. At 9 A.M. sent jolly-boat to collect surface animals. At 10 A.M. put over dredge, and veered 2900 fathoms. At 1.55 P.M. commenced heaving in dredge, but the dredge rope parted at 1700 fathoms, the dredge being 300 fathoms from the bottom; at the time of the accident no undue strain on the rope was observed. Obtained a series of temperatures at intervals of 100 fathoms down to 1500 fathoms. Obtained samples of water from 250 and 500 fathoms for analysis.

Distance from Bermuda at noon, 550 miles. Made good 55 miles. Amount of current 10 miles, direction S. 33° E.

ORGANISMS FROM THE SURFACE.

Surface Organisms.—Willemoes-Suhm writes: "The iridescent *Saphirina*, found so often in the eastern part of the Atlantic, was, with some other species of the same genus, very abundant at the surface. *Salpæ* and Siphonophoræ also abound, and some Ctenophoræ, *Sagitta*, and Heteropods were also present."

Station 52 (Sounding 110), Halifax to Bermuda (see Chart 9 and Diagram 2). STATION 52.

May 23, 1873; lat. 39° 44′ N., long. 63° 22′ W.

Temperature of air at noon, 68°·2; mean for the day, 68°·3.

Temperature of water:—

Surface,	67·2°	700 fathoms,	39·8°
100 fathoms,	64·8	800 „	39·0
200 „	63·8	900 „	38·7
300 „	61·4	1100 „	38·1
400 „	53·5	1300 „	37·7
500 „	46·4	1500 „	37·3
600 „	42·0	Bottom,	36·2

Station 52

Density at 60° F. at surface, 1·02714 ; bottom, 1·02701.

Depth, 2800 fathoms ; deposit, Blue Mud, containing 25·02 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 10.10 A.M. stopped and sounded in 2800 fathoms. The sudden rise of temperature about 1.30 P.M. from 59°·5 to 64°·8, and as high as 71°·5, showed that the Gulf Stream had again been entered. At 4 P.M. took a series of temperatures down to 1500 fathoms. A heavy swell from the S.W. continued all day long, and prevented any attempt to dredge. On passing from the Arctic current to the Gulf Stream current the usual change of colour of the water from an inky green to a deep blue was observed.

Distance from Bermuda at noon, 456 miles. Made good 95 miles. Amount of current 25 miles, direction S. 25° E.

Station 52A.

Station 52A, Halifax to Bermuda.

May 24, 1873 ; lat. 38° 16′ N., long. 63° 17′ W.

Temperature of air at noon, 70°·8 ; mean for the day, 70°·5.

Temperature of water :—

Surface,	73·0°	100 fathoms,	65·5°
25 fathoms,	73·0	125 „	64·7
50 „	73·0	150 „	64·5
75 „	67·4		

Continued strong breeze from S.W., accompanied by heavy seas. At 3.45 P.M. shortened sail to obtain serial temperatures at intervals of 25 fathoms down to 150 fathoms ; also tried current.

Distance at noon from Bermuda, 382 miles. Made good 73 miles. Amount of current 21 miles, direction S. 8° E.

Station 53.

Station 53 (Sounding 112), Halifax to Bermuda (see Chart 9 and Diagram 2).

May 26, 1873 ; lat. 36° 30′ N., long. 63° 40′ W.

Temperature of air at noon, 74 ·8 ; mean for the day, 72°·7.

Temperature of water :—

Surface,	73·0	400 fathoms,	54·5°
25 fathoms,	69·5	500 „	45·2
50 „	66·2	600 „	41·2
75 „	64·0	700 „	39·8
100 „	64·0	800 „	39·2
150 „	64·0	1250 „	37·9
200 „	63·6	1500 „	37·3
300 „	60·2	Bottom,	36·3

Density at 60° F. at surface, 1·02708 ; bottom, 1·02700. STATION 53.

Depth, 2650 fathoms ; deposit, Blue Mud, containing 31·88 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 5.45 A.M. stopped to sound and obtain temperatures. At 7 A.M. sounded in 2650 fathoms. At 9 A.M., after commencing temperature operations, the line, with seven thermometers attached, carried away, having fouled the propeller. Continued taking serial temperatures down to 1500 fathoms. The carbonic acid was determined in bottom water, and amounted to 64·0 milligrammes per litre; the water was slightly turbid with calcium carbonate. The wind fell to a calm, and the ship proceeded under steam.

Distance from Bermuda at noon, 261 miles. Made good 69 miles. Amount of current 8 miles, direction N. 61° E.

Surface Organisms.—The following species is recorded from the surface at this Station :— ORGANISMS FROM SURFACE-NETS.

PTEROPODA (Pelseneer, Zool. pt. 65).

Clio pyramidata, Linné.

Willemoes-Suhm writes : "Among the surface things there was a Pteropod distinguished by two pairs of lateral appendages, one pair bearing thread cells. It was, as the ovary showed, a full-grown animal. It has been figured by Eschscholtz; Rang reproduces the figure, adding that he does not believe it to be a good species, but that Eschscholtz was deceived by some foreign bodies hanging out of the shell of a *Cleodora* [=*Clio*] *cuspidata*, among the synonyms of which he therefore places it. Our figure shows that *Cleodora pleuropus*, Rang, is a perfectly distinct and 'good' species. There was also a young, very transparent, *Sipunculus*, which shows that these worms, after having quitted the larval stage, continue to swim at the surface for a certain time, probably by the aid of their tentacles. There were, besides, shrimps belonging to *Euphausia* and *Thysanopoda*, and many specimens of *Lucifer*, of which I never could hitherto find the female ; males with ripening spermatophores were, however, frequently observed."

Station 54 (Sounding 113), Halifax to Bermuda (see Chart 9 and Diagram 2). STATION 54

May 27, 1873 ; lat. 34° 51′ N., long. 63° 59′ W.

Temperature of air at noon, 72°·0 ; mean for the day, 71°·3.

STATION 54.

Temperature of water :—

Surface,	70°·5	100 fathoms,	65°·0
10 fathoms,	69·8	200 ,,	63·9
20 ,,	68·2	300 ,,	61·8
30 ,,	66·2	350 ,,	59·5
40 ,,	65·8	400 ,,	49·8
50 ,,	65·2		

Density at 60° F. at surface, 1·02715.

Depth, 2650 fathoms; deposit, Blue Mud, containing 24·56 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 9.30 A.M. stopped and sounded in 2650 fathoms. At 12.10 P.M. put trawl over. Second gig away collecting surface animals. At 4.30 P.M. commenced heaving in trawl, which came up at 6.20 P.M. containing a few specimens. The carbonic acid was determined in water from the depth of 1 fathom, and amounted to 45·0 milligrammes per litre.

Distance from Bermuda at noon, 162 miles. Made good 100 miles. Amount of current 7 miles, direction N. 82° E.

ANIMALS FROM TRAWL.

The following species are recorded in the Zoological Reports from the trawl at this Station :—

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophioglypha bullata, Wyville Thomson, n.sp. Eight specimens; obtained also at Stations 45, 61, and 133.

Amphiura verrilli, n.sp. Obtained at no other locality.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Calymne relicta, Wyville Thomson, n.g., n.sp. Two specimens; obtained also near Tristan da Cunha (?).

The Station-book records also empty worm-tubes and a shrimp.

Willemoes-Suhm writes : "The trawl brought up a shrimp, which evidently does not belong to the group of deep-sea shrimps previously described, and some worm-tubes formed of very many Foraminifera."

ORGANISMS FROM SURFACE NETS.

Surface Organisms.—Fine brown Medusæ, *Tomopteris*, *Ianthina* with egg-capsules, and Heteropods, were taken on the surface.

Stations 55 and 55A (Soundings 114 and 115), Halifax to Bermuda (see Chart 9 and Diagram 2). Stations 55 and 55A

May 28, 1873; lat. 33° 20′ N., long. 64° 37′ W.

Temperature of air at noon, 74°·8; mean for the day, 72°·5.

Temperature of water:—

	°		°
Surface,	70·5	500 fathoms,	47·0
100 fathoms,	64·0	600 "	41·4
200 "	62·8	700 "	39·3
300 "	61·5	800 "	38·8
350 "	59·6	900 "	38·6
400 "	55·5	1000 "	38·5

Density at 60° F. at surface, 1·02711.

Depth, 2500 fathoms; deposit, Globigerina Ooze, containing 54·81 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6 A.M. stopped and lowered jolly-boat to pick up piece of timber, which was found to be covered with *Lepas*, among which were running about many Brachyurous crabs; there were also several Annelids. At 8.50 A.M. stopped to sound, and at 9 A.M. sounded in 2500 fathoms (Station 55). Lowered boats to try current; ascertained that a surface current was running N.E. at the rate of 4 miles per hour. Obtained serial temperatures at intervals of 100 fathoms down to 1000 fathoms. At 1 P.M. proceeded under steam, and towards evening sighted the light on Gibb's Hill, Bermuda. At 6 P.M. stopped and sounded in 1775 fathoms, deposit Globigerina Ooze, bottom temperature 36°·2 (Station 55A).

Distance at noon from Bermuda, 66 miles. Made good 97 miles. Amount of current 8 miles, direction N. 54° W.

Surface Organisms.—The following three species of Annelids are recorded as having been obtained from the log of wood:— Organisms from the Surface.

Annelida (M'Intosh, Zool. pt. 34).

Amphinome rostrata (Pallas). Several specimens; obtained at no other locality by the Challenger. Recorded from Atlantic.

Hermodice carunculata, Pallas. Large specimen (over a foot in length); obtained also at St. Thomas, Bermuda, and Cape Verdes.

Hipponoë gaudichaudi, Audouin and M.-Edwards. Several specimens; obtained also in the North Pacific. Recorded from Australia and Madeira.

STATIONS 55B AND 56

Stations 55B and 56 (Soundings 116 and 117), off Bermuda (see Chart 8).

May 29, 1873.
Temperature of air at noon, 75°·3 ; mean for the day, 74°·3.
Temperature of water at surface, 72°·0.

At 5.30 A.M. stopped and sounded in 1325 fathoms, deposit Coral Mud, containing 86·00 per cent. of carbonate of lime (Station 55B). At 7.45 A.M. stopped and sounded in 1075 fathoms, deposit Coral Mud, containing 83·02 per cent. of carbonate of lime, bottom temperature 38°·2 (Station 56). Put dredge over and veered 1600 fathoms; it came up at noon with a few specimens. The dredge was sent down again in the afternoon, and came up half full of mud and with a few specimens. A third haul of the dredge in the evening only produced a Sponge. Anchored for the night in 10 fathoms on the Chaddock Bank, S.W. of lighthouse.

ANIMALS FROM DREDGE.

The following species are recorded in the Zoological Reports from the dredge at Station 56 :—

TETRACTINELLIDA (Sollas, Zool. pt. 63).

Isops pachydermata, n.sp. One specimen ; obtained at no other locality.
Azorica pfeifferæ, Carter. One specimen ; obtained also at Station 33, Cape Verdes, Bahia, and Amboina.

HEXACTINELLIDA (Schulze, Zool. pt. 53).

Euplectella nodosa, n.sp. One specimen ; obtained at no other locality.
Rhabdodictyum delicatum, Schmidt. Two specimens ; obtained at no other locality by the Challenger. Recorded from Gulf of Mexico.
Aulocalyx irregularis, n.g., n.sp. One specimen ; obtained also at Stations 145 and 147, 310 and 1600 fathoms.
Farrea sp. (?). One specimen.
Lefroyella decora, Wyville Thomson, n.g., n.sp. Two specimens ; obtained also at Station 33. Only species of the genus.
Aphrocallistes bocagei, Wright. Several specimens ; for distribution see Station 23.
Chonelasma lamella, n.g., n.sp. One fragmentary specimen ; obtained also at Stations 148 and 170, 550 and 630 fathoms.
,, sp. (?). One specimen.
Dactylocalyx (?) *patella*, n.sp. Two specimens ; obtained also off coast of Portugal.

ALCYONARIA (Wright and Studer, Zool. pt. 64).

Sympodium armatum, n.sp. Obtained at no other locality.

Acanella simplex, Verrill. Obtained at no other locality by the Challenger. Recorded from Martinique and Barbadoes. STATION 56.

ACTINIARIA (Hertwig, Zool. pt. 73).

Amphianthus ornatum, n.g., n.sp. One specimen; obtained also at Stations 241 and 244, 2300 and 2900 fathoms.

Another Actinian undetermined.

CORALS (Moseley, Zool. pt. 7).

Deltocyathus italicus, M.-Edwards and Haime. Several specimens; for distribution see Station 24.

Bathyactis symmetrica (Pourtalès). For distribution see Station 24.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Amphiura duplicata, Lyman. Obtained at no other locality by the Challenger. Recorded from West Indies ("Blake").

Ophiacantha segesta, n.sp. One young specimen; obtained at no other locality.

ANOMURA (Henderson, Zool. pt. 69).

Parapagurus abyssorum, M.-Edwards. One specimen in shell of *Trochus* (*Margarita*) *infundibulum*; obtained also at Stations 68 (var. *scabra*, nov.), 106, 133, 195, 205, 218, 237, 300, 304 (?), and 335, 45 (?) to 2175 fathoms.

Munidopsis serratifrons (M.-Edwards). Three specimens; obtained at no other locality by the Challenger. Recorded from West Indies ("Blake").

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Limopsis aurita (Brocchi). Obtained also at Stations 23 and 73.

Lima multicostata, Sowerby. Obtained also at Station 172 and Port Jackson, 2 to 18 fathoms. Recorded from Mediterranean and Australia.

Amussium cancellatum, n.sp. Obtained also at Stations 24, 33, and St. Thomas.

SCAPHOPODA and GASTEROPODA (Watson, Zool. pt. 42).

Dentalium circumcinctum, n.sp. Obtained also at Stations II., 23, and 122.

Trochus (*Ziziphinus*) *tiara*, n.sp. Obtained also at Station 24.

,, (*Margarita*) *infundibulum*, n.sp. Obtained also at Station 146, 1375 fathoms.

,, (,, ?) *scintillans*, n.sp. Obtained also at Station 24.

Seguenzia monocingulata, Seguenza. For distribution see Station 24.

Station 56

Pleurotoma (*Mangelia*) *acanthodes*, n.sp. Obtained also at Station 75, 450 fathoms.
„ („) *tiara*, n.sp. Obtained also at Station 24.
Cassis sp. (?). Fry, same as at Station 120, 675 fathoms.
Dunkeria falcifera, n.sp. Obtained at no other locality.
Ringicula peracuta, n.sp. Obtained also at Stations 24 and 122.

The Station-book records also Pennatulid and Shrimp.

Excluding Protozoa, over 50 specimens of invertebrates were obtained at this Station, belonging to about 35 species, of which 17 are new to science, including representatives of 4 new genera ; 4 of the new species were not obtained elsewhere.

Willemoes-Suhm writes : "Among the things brought up were only a few deep-sea forms, but among shore things there were some forms interesting on account of the depth into which they descend on the rocky shores of Bermuda, for example : a Galatheid and *Trochus* containing *Pagurus* from 1000 fathoms."

Stations 57 to 57B

Stations 57 to 57B (Soundings 119 to 121), off Bermuda (see Chart 8).

May 30, 1873.
Temperature of air at noon, 76°·0 ; mean for the day, 75°·0.
Temperature of water :—

	°		°
Surface,	73·0	500 fathoms,	46·8
100 fathoms,	65·2	600 „	41·8
200 „	63·6	700 „	40·0
300 „	60·8	800 „	39·2
350 „	58·0	900 „	38·7
400 „	54·0	1000 „	38·2

At 5 A.M. weighed and proceeded under steam to sound round the S.W. side of Bermuda reef. At 8 A.M. stopped and sounded in 690 fathoms (Station 57). Put over dredge, which came up at 10.20 A.M. containing a few specimens. At 11 A.M. stopped and sounded in 1250 fathoms, deposit Coral Mud, containing 84·75 per cent. of carbonate of lime (Station 57A). At noon put over trawl. At 3 P.M. sounded in 1575 fathoms, deposit Coral Mud, containing 89·11 per cent. of carbonate of lime (Station 57B). Obtained serial temperatures at intervals of 100 fathoms down to 1000 fathoms. At 4 P.M. commenced heaving in trawl, but at 5.45 P.M. it fouled something at the bottom, and the rope parted.

The following species are recorded in the Zoological Reports from the dredge at Station 57 :—

Station 57. Animals from Dredge.

Corals (Moseley, Zool. pt. 7).

Caryophyllia communis (Seguenza). Two small specimens; obtained also at Stations 45, 50, 78, and 142.

Macrura (Spence Bate, Zool. pt. 52).

Nephropsis rosea (Willemoes-Suhm), n.sp. One specimen; obtained at no other locality.

In addition to the above, the Station-book records a Pennatulid.

At Bermuda.

The expedition remained in the vicinity of Bermuda on the first visit from April 4 till April 23, and on the second visit from May 28 till June 13, 1873. The following species are recorded in the Zoological Reports as having been obtained during the stay, in shallow water and on shore:—

Animals from Bermuda.

Keratosa (Poléjaeff, Zool. pt. 31).

Verongia hirsuta, Hyatt (?). One specimen (reefs); obtained at no other locality by the Challenger.

Monaxonida (Ridley and Dendy, Zool. pt. 59).

Pachychalina fibrosa, n.sp. Several pieces (either from Bermuda or Bahia); obtained also at Station 208 and Bahia, 7 and 20 fathoms.

Rhizochalina fistulosa (Bowerbank). Three specimens (either from Bermuda or Bahia); obtained also at Stations 73 and 188, 1000 and 28 fathoms.

Oceanapia robusta (Bowerbank). Two specimens and fragments (either from Bermuda or Bahia); obtained at no other locality by the Challenger. Recorded from Shetland and Barbadoes (?).

Tedania digitata (Schmidt), var. *bermudensis*, nov. One specimen; obtained also at Port Jackson (the species and var. *fibrosa*). A widely-distributed species.

Tetractinellida (Sollas, Zool. pt. 63).

Pilochrota tenuispicula, n.g., n.sp. One specimen; obtained at no other locality.

Hexactinellida (Schulze, Zool. pt. 53).

Euplectella (?) *nodosa*, n.sp. One specimen; obtained at no other locality.

Alcyonaria (Wright and Studer, Zool. pt. 64).

Plexaura valenciennesi, n.sp. One specimen (shallow water); obtained at no other locality.

At Bermuda.

Pseudoplexaura crassa (Ellis and Solander). Several specimens (shallow water); obtained at no other locality by the Challenger.

Gorgonia flabellum, Linné. Several specimens (moderate depths); obtained at no other locality by the Challenger. Recorded from Atlantic.

Actiniaria (Hertwig, Zool. pts. 15 and 73).

Ilyanthopsis longifilis, n.g., n.sp. One specimen (reefs); obtained at no other locality. Only species of the genus.

Zoanthus danæ, Le Conte (?). One colony (shallow water); obtained at no other locality by the Challenger.

,, sp. (?). One colony.

Corticifera lutea, Quoy and Gaimard. One colony (shallow water); obtained at no other locality by the Challenger.

Corals (Moseley, Zool. pt. 7).

Deltocyathus italicus, M.-Edwards and Haime, var. *calcar*, nov. One specimen (200 fathoms); obtained also at Stations 24, 56, 78, 120, 191 (?), and 285.

Reef Corals (Quelch, Zool. pt. 46).

Oculina diffusa, Lamarck. Many specimens; obtained also at St. Thomas.

,, *pallens*, Ehrenberg. One specimen; obtained at no other locality by the Challenger.

,, *varicosa*, Lesueur. Two or three specimens; obtained also at St. Thomas.

,, *coronalis*, n.sp. Obtained at no other locality.

,, *speciosa*, M.-Edwards and Haime. One specimen; obtained at no other locality by the Challenger.

,, *bermudensis*, Duchassaing and Michelotti. One specimen; obtained at no other locality by the Challenger.

Madracis decactis (Lyman). One specimen; obtained at no other locality by the Challenger.

Isophyllia strigosa (Duchassaing and Michelotti). Many specimens; obtained at no other locality by the Challenger.

,, *fragilis* (Dana). One specimen; obtained at no other locality by the Challenger.

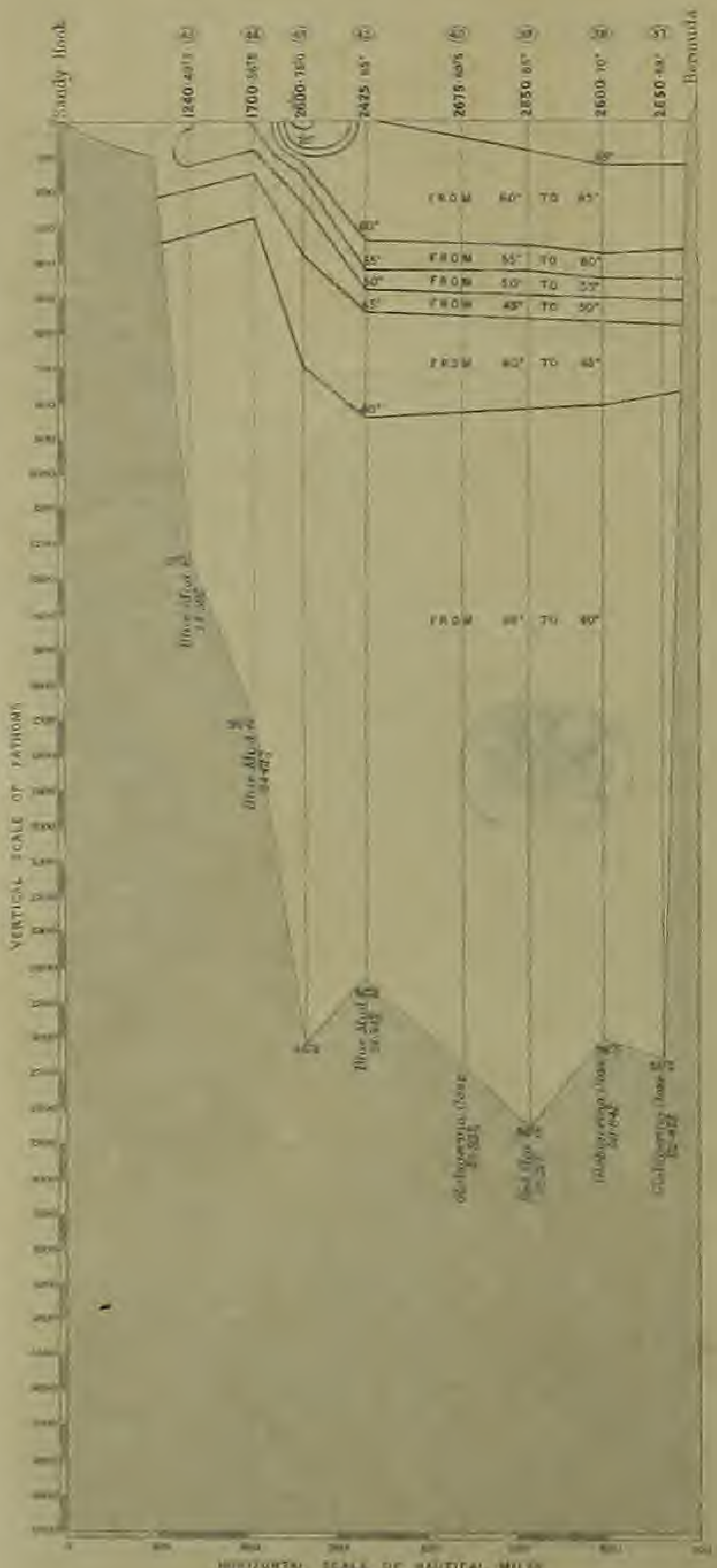
,, *australis*, M.-Edwards and Haime. Two specimens; obtained at no other locality by the Challenger.

,, *dipsacea* (Dana). Many specimens; obtained at no other locality by the Challenger.

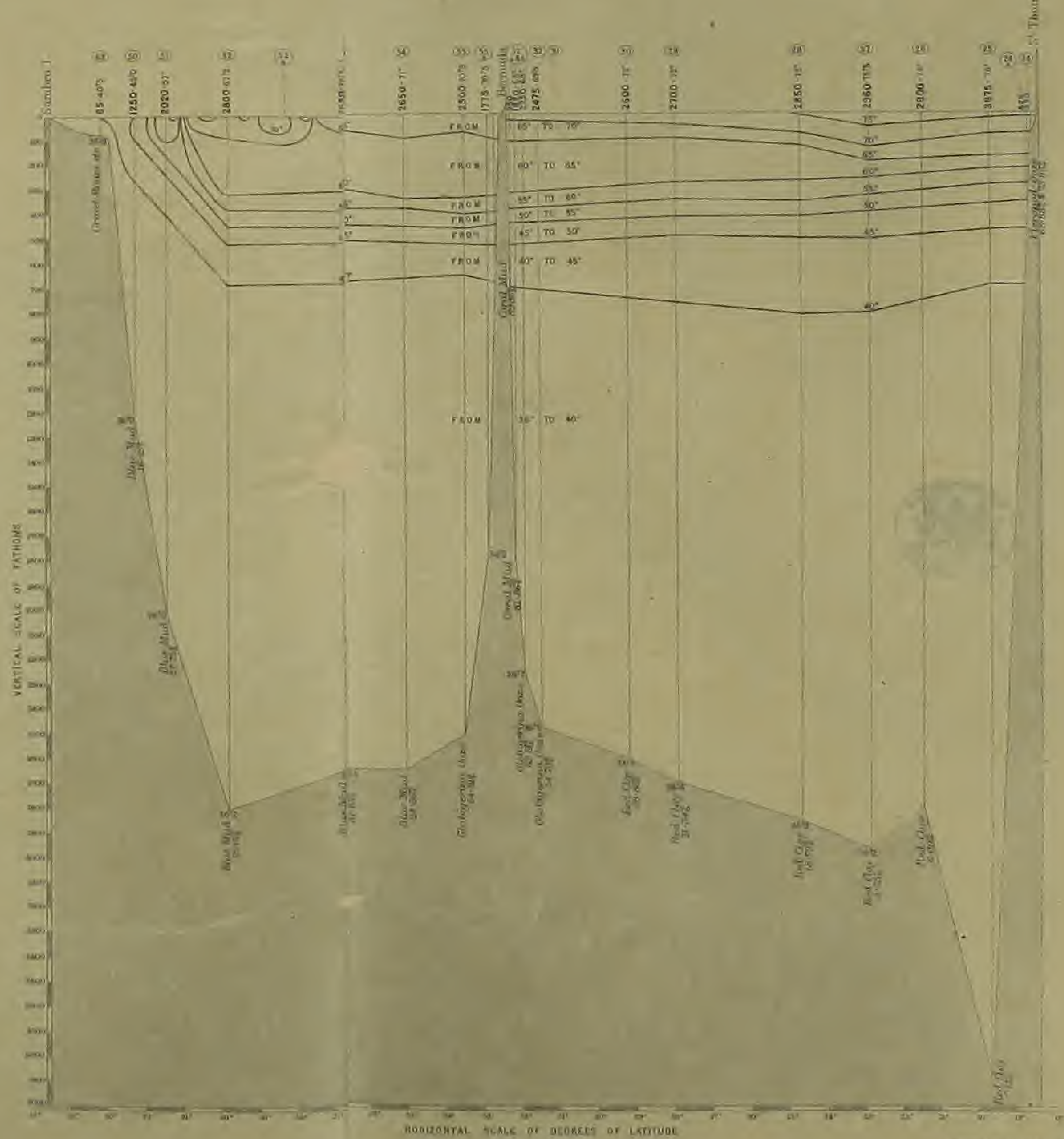
ATLANTIC OCEAN

For explanation of Symbols see Appendix I

Diagonal Temperature Section. Bermuda towards New York.



Meridional Temperature Section. Halifax to St. Thomas Id.



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Isophyllia marginata (Duchassaing and Michelotti). Two specimens; obtained at no other locality by the Challenger. AT BERMUDA.

,, *cylindrica* (Duchassaing and Michelotti). Many specimens; obtained at no other locality by the Challenger.

,, *knoxi* (Duchassaing and Michelotti). One specimen; obtained at no other locality by the Challenger.

Diploria cerebriformis (Lamarck). One specimen; obtained at no other locality by the Challenger.

Mæandrina labyrinthica (Ellis and Solander). One specimen; obtained at no other locality by the Challenger.

,, *sinuosissima*, M.-Edwards and Haime. One specimen; obtained at no other locality by the Challenger.

,, *strigosa*, Dana. Twenty-nine specimens; obtained at no other locality by the Challenger.

Astræa ananas (Ellis and Solander). One specimen; obtained at no other locality by the Challenger.

,, *coarctata* (Duchassaing and Michelotti). One specimen; obtained at no other locality by the Challenger.

Siderastræa galaxea (Ellis and Solander). One specimen; obtained at no other locality by the Challenger.

Agaricia fragilis, Dana. Many specimens; obtained also at St. Thomas.

Porites clavaria, Lamarck. Several specimens; obtained at no other locality by the Challenger.

Millepora alcicornis, Linné. Two specimens; obtained also at St. Thomas.

,, *ramosa*, Pallas. Two specimens; obtained at no other locality by the Challenger.

ASTEROIDEA (Sladen, Zool. pt. 51).

Asterina folium (Lütken), Agassiz. One specimen; obtained at no other locality by the Challenger. Recorded from West Indies and Florida.

Asterias (*Stolasterias*) *tenuispina*, Lamarck. (Reefs); obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophioglypha lepida, n.sp. (750 fathoms); obtained also at Stations 45, 46, 76, and 343.

Ophionereis reticulata (Say). (Shallow water); obtained also at Bahia.

Ophiocoma pumila, Lütken. Young specimens (shallow water); obtained at no other locality by the Challenger.

At Bermuda. ECHINOIDEA (Agassiz, Zool. pt. 9).

Toxopneustes variegatus (Lamarck). Obtained at no other locality by the Challenger.

Spatangus purpureus, Müller. (100 fathoms); obtained also at Station 75, 50 to 90 fathoms. Recorded from East Atlantic and Caribbean Sea.

HOLOTHURIOIDEA (Théel, Zool. pt. 39).

Synapta picta, n.sp. One specimen; obtained at no other locality.

Stichopus möbii, Semper. One specimen; obtained at no other locality by the Challenger. Recorded from West Indies.

„ *haytiensis*, Semper. One specimen; obtained at no other locality by the Challenger. Recorded from West Indies.

NEMERTEA (Hubrecht, Zool. pt. 54).

Tetrastemma agricola, Willemoes-Suhm, n.sp. Numerous specimens (Mangrove Swamps, Hungry Bay); obtained at no other locality.

Cerebratulus truncatus, n.sp. (?). One specimen; obtained also at Stations 48 and 49.

ANNELIDA (M'Intosh, Zool. pt. 34).

Hermodice carunculata, Pallas. Littoral region; obtained also at Station 55, St. Thomas, and Cape Verdes.

Eurythoë pacifica, Kinberg (?). Several specimens (between tide-marks); obtained at no other locality by the Challenger. Recorded from coral reefs of the Pacific.

Polynoë pustulata, n.sp. Two specimens (between tide-marks); obtained at no other locality.

Nereis (*Perinereis*) *melanocephala*, n.sp. One specimen (between tide-marks); obtained at no other locality.

Eunice vittata, Delle Chiaje, var. (?). Several specimens (between tide-marks); obtained also at Station 162, 38 fathoms. Recorded from Europe.

„ *cirrobranchiata*, n.sp. One specimen (between tide-marks); obtained at no other locality.

„ *barvicensis*, n.sp. One specimen (between tide-marks); obtained at no other locality.

„ sp. (?). Fragment (between tide-marks).

Aricia platycephala, n.sp. One specimen (between tide-marks); obtained at no other locality.

Cirratulus assimilis, n.sp. One specimen (between tide-marks); obtained at no other locality.

Terebella crassicornis, Schmarda (?). One specimen (between tide-marks); obtained at no other locality by the Challenger. Recorded from Jamaica. At Bermuda.

Dasychone bairdi, n.sp. Several specimens (between tide-marks); obtained at no other locality.

Cirripedia (Hoek, Zool. pt. 25).

Coronula diadema (Linné). Seven specimens; obtained at no other locality by the Challenger. Recorded from Vardö, Japan, and New Zealand.

Amphipoda (Stebbing, Zool. pt. 67).

Caprella danilevskii, Czerniavski. Three specimens; obtained at no other locality by the Challenger.

Isopoda.

Three specimens belonging to two species undetermined.

Phyllocarida (Sars, Zool. pt. 56).

Paranebalia longipes (Willemoes-Suhm), n.g., n.sp. Several specimens; obtained at no other locality.

Stomatopoda (Brooks, Zool. pt. 45).

Gonodactylus chiragra, Latreille. One specimen; obtained also at Station 36, St. Thomas, near Cape St. Roque, and Philippines.

Schizopoda (Sars, Zool. pt. 37).

Heteromysis bermudensis, n.sp. One specimen (shallow water); obtained at no other locality.

Macrura (Spence Bate, Zool. pt. 52).

Stenopus hispidus, Olivier. One specimen (shallow water); obtained also at Fiji. A widely-distributed species.

Alpheus bermudensis, n.sp. Three specimens (shallow water); obtained also at St. Thomas.

Brachycarpus savignyi, n.g., n.sp. One specimen (shallow water); obtained at no other locality.

Anomura (Henderson, Zool. pt. 69).

Remipes scutellatus (Fabricius). Eight specimens (shore); obtained also at Cape Verdes.

Petrolisthes armatus (Gibbes). One specimen (shallow water); obtained at no other locality by the Challenger. Recorded from Florida and West Indies.

AT BERMUDA

BRACHYURA (Miers, Zool. pt. 49).

Podochela riisei (Stimpson). Four specimens (shallow water); obtained also at Station 122, 30 to 350 fathoms. Recorded from Caribbean Sea and Gulf of Mexico.

Macrocœloma trispinosa (Latreille). Two specimens (shallow water); obtained also at Bahia. Recorded from West Indies.

Microphrys bicornutus (Latreille). Three specimens (shallow water); obtained at no other locality by the Challenger. Recorded from Caribbean Sea, Gulf of Mexico, and Brazil.

Mithrax (*Nemausa*) *rostrata*, M.-Edwards. Two specimens (shallow water); obtained at no other locality by the Challenger. Recorded from Caribbean Sea and Gulf of Mexico.

,, *forceps* (M.-Edwards). One specimen (shore); obtained also at Fernando Noronha and Bahia. Recorded from Guiana and West Indies.

Lophactæa lobata, M.-Edwards. Three specimens (shore); obtained at no other locality by the Challenger. Recorded from Indo-Pacific region and West Indian seas.

Panopeus herbstii, M.-Edwards, var. *serratus*, Saussure (?). One specimen (shallow water); obtained at no other locality by the Challenger. Recorded from American coasts.

Eurytium limosum (Say). Two specimens (Mangrove Swamps, Hungry Bay); obtained at no other locality by the Challenger. Recorded from east coasts of America, from New York to Rio Janeiro.

Eriphia gonagra (Fabricius). One specimen; obtained at no other locality by the Challenger. Recorded from Florida to Rio Janeiro.

Neptunus (*Achelous*) *depressifrons* (Stimpson). One specimen (shore); obtained at no other locality by the Challenger. Recorded from America.

Geocarcinus lagostoma, M.-Edwards (?). One specimen; obtained also at Ascension. Recorded from Australasia (?) to Cape, and west African coast to West Indies.

Cardiosoma guanhumi, Latreille. Two specimens; obtained at no other locality by the Challenger. Recorded from West Indies, Florida Keys, Brazil, and Cape Verdes.

Ocypoda arenaria (Catesby). One specimen; obtained also at Bahia. A widely-distributed species.

Grapsus maculatus (Catesby). Three specimens; obtained also at Cape Verdes, St. Paul's Rocks, Fernando Noronha, and Ascension. A widely-distributed species.

Pachygrapsus transversus, Gibbes. Three specimens (shore); obtained also at Cape Verdes and Port Jackson. A widely-distributed species. BERMUDA.

Goniopsis cruentatus (Latreille). Many specimens (some from Mangrove Swamps, Hungry Bay); obtained at no other locality by the Challenger. A widely-distributed species.

Calappa flammea (Herbst). Three specimens; obtained also at Simon's Bay, Cape. Recorded from St. Croix, Indian Ocean, and East Indies.

,, *gallus* (Herbst). One specimen; obtained also at Cape Verdes, Fernando Noronha, and Amboina. Recorded from Indo-Pacific region.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Lithodomus antillarum (Philippi). (Boring in coral); obtained at no other locality by the Challenger.

,, *appendiculatus* (Philippi). (Boring in coral); obtained at no other locality by the Challenger. Recorded from West Indies.

PTEROPODA (Pelseneer, Zool. pt. 65).

Cavolinia longirostris (Lesueur). (Surface, April 14, 1873.)

CEPHALOPODA (Hoyle, Zool. pt. 44).

Octopus bermudensis, n.sp. One specimen; obtained at no other locality.

TUNICATA (Herdman, Zool. pts. 17 and 38).

Ascidia nigra (Savigny). One specimen (shallow water); obtained also at Station 142, 150 fathoms. Recorded from West Indies and Red Sea.

Ecteinascidia turbinata, n.g., n.sp. One colony; obtained at no other locality by the Challenger. Recorded from Alexandria Harbour.

Clavelina oblonga, n.sp. One colony; obtained at no other locality.

Botrylloides nigrum, n.sp. Three colonies; obtained at no other locality.

Symplegma viride, n.g., n.sp. One colony (shallow water); obtained at no other locality. Only species of the genus.

Didemnum (?) *inerme*, n.sp. One colony (shallow water); obtained at no other locality.

FISHES (Günther, Zool. pt. 6).

Gerres lefroyi, Goode. Obtained at no other locality by the Challenger.

,, *jonesi*, Günther. Obtained at no other locality by the Challenger.

Sargus capensis, Smith. Obtained at no other locality by the Challenger.

Pimelepterus bosci, Lac. Obtained at no other locality by the Challenger.

Caranx caballus, Günther. Obtained at no other locality by the Challenger. Recorded from Panama.

Fundulus bermudæ, Günther. (Brackish water); obtained at no other locality by the Challenger. Recorded from Bermuda.

Belone jonesi, Goode. Obtained at no other locality by the Challenger.

In the foregoing list 110 species are enumerated from the shore and shallow water at Bermuda, of which 29 are new to science, including representatives of 6 new genera; 23 of the new species and 3 new genera were not obtained elsewhere.

Station 58 (Sounding 122), Bermuda to Azores (see Charts 6 and 8, and Diagram 3).

June 13, 1873; lat. 32° 37′ N., long. 64° 21′ W.
Temperature of air at noon, 75°·8; mean for the day, 75°·1.
Temperature of water at surface, 73°·5; bottom, 37°·2.
Depth, 1500 fathoms; deposit, Coral Mud, containing 77·38 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 5.30 A.M. got up steam. At 6 A.M. weighed and proceeded under steam through the Narrows. At 4.30 P.M. sounded in 1500 fathoms. At 5.25 P.M. made all plain sail.

Station 59 (Sounding 123), Bermuda to Azores (see Chart 6 and Diagram 7).

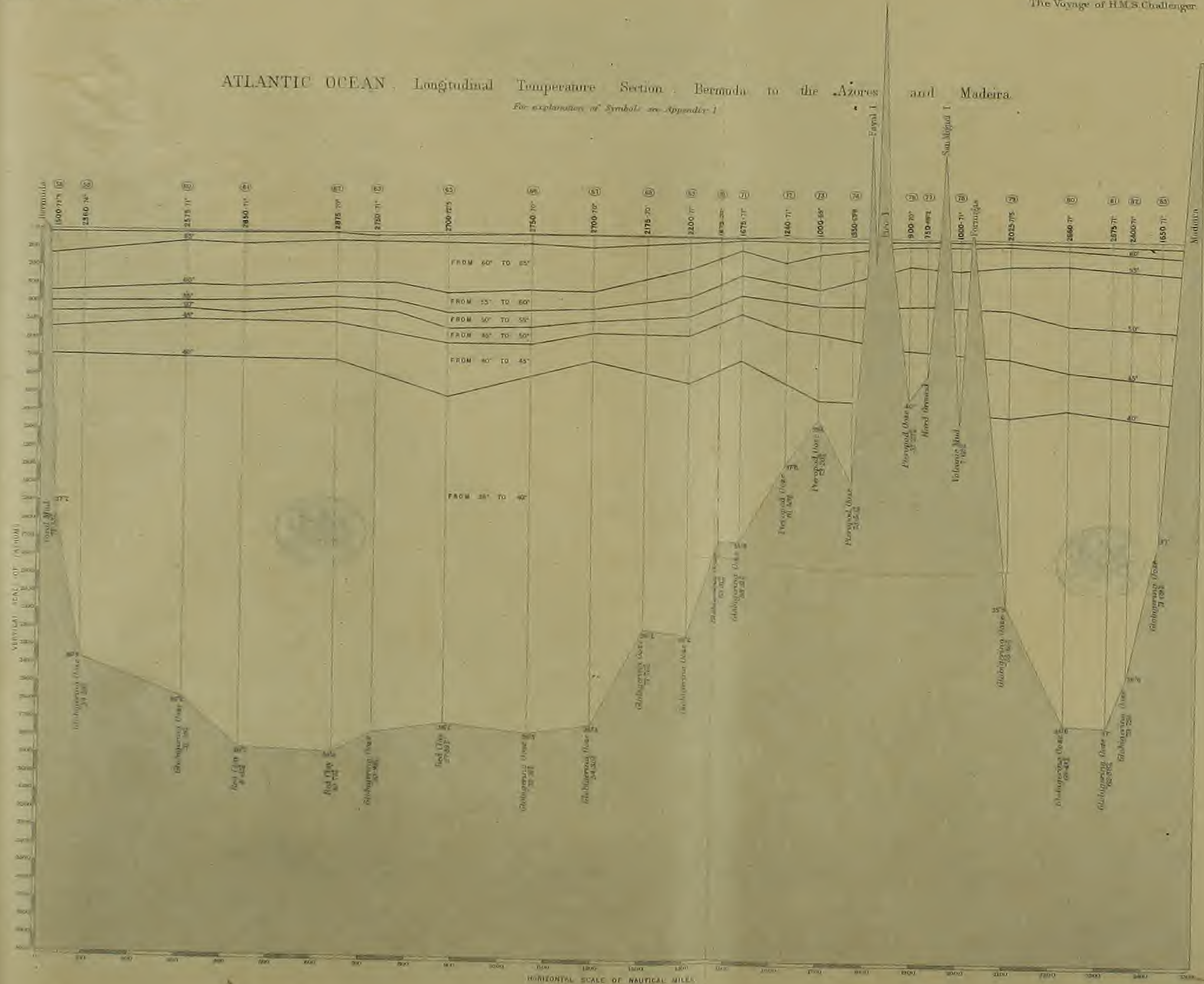
June 14, 1873; lat. 32° 54′ N., long. 63° 22′ W.
Temperature of air at noon, 75°·8; mean for the day, 75°·0.
Temperature of water:—

	°		°
Surface,	74·0	900 fathoms,	38·5
100 fathoms,	65·2	1000 "	38·3
200 "	63·5	1100 "	38·1
300 "	62·6	1200 "	37·9
400 "	54·2	1300 "	37·7
500 "	46·2	1400 "	37·5
600 "	41·8	1500 "	37·3
700 "	39·8	Bottom,	36·3
800 "	39·2		

Density at 60° F. at surface, 1·02715; bottom, 1·02650.
Depth, 2360 fathoms; deposit, Globigerina Ooze, containing 54·59 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

ATLANTIC OCEAN. Longitudinal Temperature Section. Bermuda to the Azores and Madeira.

For explanation of Symbols see Appendix I.



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At 1.30 P.M. shortened and furled sails, and got up steam to sound. At 2 P.M. sounded in 2360 fathoms. At 4 P.M. obtained serial temperatures at intervals of 100 fathoms down to 1500 fathoms. The carbonic acid was determined in water from the surface and bottom, and amounted to 41·5 and 47·2 milligrammes per litre respectively. At 7.30 P.M. made all plain sail. STATION 59.

Distance from Fayal at noon, 1720 miles. Made good 56 miles. Amount of current 19 miles, direction N. 38° E.

Surface Organisms.—Among the surface things were *Rhabdosoma*, *Oxycephalus*, and other Crustaceans. ORGANISMS FROM SURFACE-NETS.

Station 60 (Sounding 124), Bermuda to Azores (see Chart 6 and Diagram 3). STATION 60.

June 16, 1873; lat. 34° 28′ N., long. 58° 56′ W.
Temperature of air at noon, 75°·3; mean for the day, 73°·0.
Temperature of water:—

	°		°
Surface,	71·5	500 fathoms,	44·5
100 fathoms,	64·2	600 ,,	41·5
200 ,,	62·8	700 ,,	40·0
300 ,,	59·5	800 ,,	39·4
400 ,,	52·5	Bottom,	36·2

Density at 60° F. at surface, 1·02709; bottom, 1·02704.
Depth, 2575 fathoms; deposit, Globigerina Ooze, containing 31·38 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 5.20 A.M. shortened sail, and got up steam to sound. At 8 A.M. sounded in 2575 fathoms. At 10 A.M. put small trawl over. At 4.45 P.M. trawl came up, evidently not having reached the bottom, probably because there was more way on the ship than was supposed, a steady breeze blowing all the time. In the meshes of the trawl were found a few small surface and intermediate-water fishes. Obtained a series of temperatures at intervals of 100 fathoms down to 800 fathoms. A water-bottle was sent down attached to the sounding-line, and water from the bottom obtained. The carbonic acid was determined in the bottom water, and amounted to 50·0 milligrammes per litre.

Distance from Fayal at noon, 1482 miles. Made good 135 miles. Amount of current 12 miles, direction N. 33° E.

The following species are recorded from the trawl at this Station:— ANIMALS FROM TRAWL.

FISHES (Günther, Zool. pt. 57).

Gonostoma microdon, n.sp. Eight specimens; for distribution see Station 23.

STATION 60. *Chauliodus sloanii*, Bl. Schn. One specimen; obtained also at Stations 104, 191, 216A, and 235, 565 to 2500 fathoms. Recorded from Mediterranean and Atlantic.

The following animals were also in the trawl:—Two Medusæ, a large *Sagitta*, large Copepods, several *Salpæ*, and small fish. From its contents the naturalists were of opinion that the trawl had not touched the bottom.

STATION 61.

Station 61 (Sounding 125), Bermuda to Azores (see Chart 6 and Diagram 3).

June 17, 1873; lat. 34° 54′ N., long. 56° 38′ W.
Temperature of air at noon, 76°·0; mean for the day, 73°·5.
Temperature of water:—

	°		°
Surface, ...	71·0	200 fathoms, . . .	63·0
25 fathoms, . . .	67·2	300 ,, . . .	60·2
50 ,, . . .	66·0	400 ,, . . .	53·5
75 ,, . . .	65·0	500 ,, . . .	46·5
100 ,, . . .	64·0	Bottom, . . .	36·2

Density at 60° F. at surface 1·02708.

Depth, 2850 fathoms; deposit, Red Clay, containing 8·02 per cent. of carbonate of lime, and concretions covered with manganese, to one of which a *Scalpellum* was attached (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.30 A.M. shortened and furled sails, and got up steam to sound and trawl. At 7 A.M. put trawl over. At 10 A.M. sounded in 2850 fathoms. At 1 P.M. commenced heaving in trawl, which came up at 3 P.M. containing a few specimens. At 4 P.M. completed serial temperatures down to 500 fathoms, and at 4.10 P.M. made all plain sail.

Distance from Fayal at noon, 1356 miles. Made good 117 miles. Amount of current 7 miles, direction N. 13° W.

ANIMALS FROM TRAWL. The following species are recorded in the Zoological Reports from the trawl at this Station:—

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophioglypha bullata, Wyville Thomson, n.sp. Many specimens; obtained also at Stations 45, 54, and 133. The specimens were white coloured with a bluish tinge.

HOLOTHURIOIDEA (Théel, Zool. pt. 39). STATION 61.

Pseudostichopus villosus, n.g., n.sp. Two specimens; obtained also at Stations 146, 147, 156, 157, 216A, 244, 296, 302, and 325, 1375 to 2900 fathoms.

CIRRIPEDIA (Hoek, Zool. pt. 25).

Scalpellum regium, Wyville Thomson, n.sp. Six specimens; obtained also at Station 63, 2750 fathoms.

,, ,, var. *ovale*, nov. One specimen; obtained at no other locality.

FISHES (Günther, Zool. pt. 57).

Gonostoma microdon, n.sp. Three specimens; for distribution see Station 23. Similar specimens were frequently taken in the surface-net.

In addition to the foregoing, the following are recorded in the Station-book:—Two very small siliceous Sponges, worm-tubes, and fragment of a Crustacean.

Excluding Protozoa, about 40 specimens of invertebrates and fishes were obtained at this Station, belonging to about 7 species, of which 4 are new to science, including representative of 1 new genus.

Willemoes-Suhm writes: "The Annelid-tubes contained a very tender worm, which comes out entirely spoiled; in order not to spoil them all I put the tubes immediately into spirit. There was also a fragment of a shrimp, probably a Peneid or Palæmonid. The *Scalpella* as well as the Holothuriæ brought up seem to indicate that the Lusitanian deep-sea fauna extends down to these remote parts of the ocean."

Surface Organisms.—The following are recorded in the note-books:—Compound Radiolaria, Medusæ, Siphonophoræ, *Diphyes*, *Gleba*, *Sagitta*, very large specimens of *Alciopa*, Cirriped larvæ, *Phronima*, *Hyperia*, *Mysis*, *Lucifer*, *Atlanta*, *Cleodora* [= *Clio*], *Styliola*, and *Cuvierina*. ORGANISMS FROM SURFACE-NETS.

Station 62 (Sounding 126), Bermuda to Azores (see Chart 6 and Diagram 3). STATION 62.

June 18, 1873; lat. 35° 7′ N., long. 52° 32′ W.

Temperature of air at noon, 70°·8; mean for the day 72°·2.

Station 62.

Temperature of water :—

Surface,	70°·0	700 fathoms,	40°·0
100 fathoms,	63·4	800 „	39·2
200 „	62·5	900 „	38·9
300 „	58·2	1000 „	38·6
400 „	51·5	1100 „	38·3
500 „	45·2	1200 „	38·0
600 „	41·4	Bottom,	36·4

Density at 60° F. :—

Surface,	1·02716	500 fathoms,	1·02607
150 fathoms,	1·02708	Bottom,	1·02709
250 „	1·02687		

Depth, 2875 fathoms; deposit, Red Clay, containing 10·72 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 1.30 P.M. shortened and furled sails, and got up steam to sound. At 2.30 P.M. sounded in 2875 fathoms. At 4 P.M. obtained serial temperatures at intervals of 100 fathoms down to 1200 fathoms. Sent down water-bottle, and obtained specimens of water from 150, 250, and 500 fathoms. At 6 P.M. completed observations, and made all plain sail.

Distance from Fayal at noon, 1175 miles. Made good 187 miles. Amount of current 9 miles, direction S. 27° E.

Station 63.

Station 63 (Sounding 127), Bermuda to Azores (see Chart 6 and Diagram 3).

June 19, 1873; lat. 35° 29′ N., long. 50° 53′ W.

Temperature of air at noon, 70°·8; mean for the day, 70°·6.

Temperature of water at surface, 71°·0.

Density at 60° F. at surface, 1·02720; bottom, 1·02613.

Depth, 2750 fathoms; deposit, Globigerina Ooze, containing 33·93 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 10 A.M. put over small trawl and veered 3700 fathoms. At noon, shortened and furled sails, and proceeded under steam to sound. At 1 P.M. sounded in 2750 fathoms. At 3.45 P.M. commenced heaving in trawl, which came up at 7 P.M. containing several specimens. In the evening the water was brilliantly phosphorescent, and the tow-net was put out several times. At 7.30 P.M. made all plain sail.

Distance from Fayal at noon, 1077 miles. Made good 99 miles. Amount of current 2 miles, direction N. 39° E.

The following species are recorded in the Zoological Reports from the trawl at this Station :— Station 63. Animals from Trawl.

Annelida (M'Intosh, Zool. pt. 34).

Amphicteis gunneri (Sars), var. *atlantica*, nov. One specimen ; the species obtained also at Station VI.

Eupista darwini, n.g., n.sp., var. (?). One fragmentary specimen ; obtained also at Station 298, 2225 fathoms.

Lanassa benthaliana, n.sp. One fragmentary specimen ; obtained at no other locality.

Ehlersiella atlantica, n.g., n.sp. Several fragments ; obtained also at Station 76, 900 fathoms. Only species of the genus.

Œstrella levinseni, n.g., n.sp. Crustacean parasite on *Ehlersiella atlantica*.

Cirripedia (Hoek, Zool. pt. 25).

Scalpellum regium, Wyville Thomson, n.sp. Three specimens ; obtained also at Station 61.

Fishes (Günther, Zool. pt. 57).

Idiacanthus ferox, n.sp. One specimen ; obtained at no other locality.

Halosaurus rostratus, n.sp. One specimen ; obtained at no other locality.

In addition to the foregoing, the following are recorded in the Station-book :—Several small Hydroids on *Scalpellum*, and three Actiniæ, one with Nematodes in the body-wall and with remains of a *Mysis* in its stomach.

Excluding Protozoa, about 25 specimens of invertebrates and fishes were obtained at this Station, belonging to about 10 species, of which 8 are new to science, including representatives of 3 new genera ; 4 of the new species were not obtained elsewhere.

Willemoes-Suhm mentions a long black fish, perhaps allied to *Gonostoma*, and says : "We have got this group of fishes hitherto under very different circumstances ; they have been brought up by the trawl and dredge (450 to 1200 fathoms), and they have been caught when it was believed that the trawl or dredge had not reached the bottom, but they cannot appear very often at the surface, as we never got them in the tow-net. On the specimens of *Scalpellum* were little Hydroids not got before from such great depths, and there were some Actiniæ at first supposed to be worm-tubes. The worm-tubes contained animals in a good state of preservation, with six palettes on each side of the mouth, reminding me of *Pectinaria*. The tubes were composed of dark mud without *Globigerinæ*, which Foraminifera are almost exclusively used by another worm

Station 63

found in great depths, which I have hitherto been unable to get out of the tube in a satisfactory way."

Organisms from Surface Nets

Surface Organisms.—The following species are recorded from the surface near this Station (June 18, 19):—

Amphipoda (Stebbing, Zool. pt. 67).
Phrosina semilunata, Risso.

Schizopoda (Sars, Zool. pt. 37).
Euphausia pellucida, Dana.
Siriella thompsoni (M.-Edwards).

Macrura (Spence Bate, Zool. pt. 52).
Sergestes atlanticus, M.-Edwards.
Hippolyte bidentatus, n.sp.

Pelagic Hemiptera (White, Zool. pt. 19).
Halobates wüllerstorffi, Frauenfeld.

Pteropoda (Pelseneer, Zool. pt. 65).
Clio (Creseis) acicula (Rang).
,, *pyramidata*, Linné.
Cuvierina columnella (Rang).
Cavolinia trispinosa (Lesueur).

At night large quantities of luminous animals were observed in the water, and being nearly calm great numbers were caught in the tow-net, which was hauled in four times during the night. There were large specimens of *Alciopa* 5 dcm. in length and 6 mm. in breadth, *Tomopteris*, *Sagitta*, Cypris-like larva of a Cirriped, many Amphipods, especially *Phronima* and *Hyperia*, the Euphausidæ which have often been caught in great quantities, *Lucifer*, *Halobates*, many specimens of *Atlanta*, *Cleodora* [= *Clio*], *Styliola*, and *Cuvierina*.

Station 64.

Station 64 (Sounding 128), Bermuda to Azores (see Chart 6).

June 20, 1873; lat. 35° 35′ N., long. 50° 27′ W.
Temperature of air at noon, 73°·8; mean for the day, 72°·0.
Temperature of water:—

	°		°
Surface, ...	75·0	300 fathoms, . . .	58·8
100 fathoms, . . .	63·2	400 ,, . . .	52·5
200 ,, . .	62·5	500 ,, . . .	46·0

Depth, 2700 fathoms; deposit, Globigerina Ooze, containing 35·00 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 9 A.M. put dredge over, the principal object being to get a good sample of the bottom, since the trawl had in the last two hauls brought up some singular concretionary lumps, to which the barnacles were sometimes attached. The dredge used was a small one with two weights of 50 lbs. each a couple of fathoms behind. Dingy away with naturalists. At 3 P.M. commenced heaving in dredge, which came up at 5 P.M. with about a cwt. of ooze. At 5.25 P.M. proceeded under steam. STATION 64.

Distance from Fayal at noon, 1055 miles. Made good 22 miles. Amount of current 17 miles, direction N. 76° E.

The following species are recorded in the Zoological Reports from the dredge at this Station :— ANIMALS FROM DREDGE.

OSTRACODA (Brady, Zool. pt. 3).

Cythere dictyon, n.sp. Widely distributed (see Station 24).

„ *acanthoderma*, n.sp. Obtained also at Stations 73, 146, 191A, 246, 296, and 302, 580 to 2750 fathoms.

Krithe tumida, n.sp. Obtained also at Station 323, 1900 fathoms.

Xestoleberis expansa, n.sp. Obtained also at Station 323, 1900 fathoms.

POLYZOA (Busk, Zool. pt. 30).

Farciminaria delicatissima, n.sp. Obtained also at Stations 13, 14, 68, 89, and 106.

The Station-book records also :—*Ophioglypha bullata*, worm-tubes, and a Priapulid.

Willemoes-Suhm writes : "The dredge brought up some worm-tubes, probably containing the *Pectinaria*-like animal obtained yesterday. There was also a Priapulid, 16 mm. in length and 3 mm. in breadth, but very much spoiled. The pharynx was everted and covered by papillæ not, as in *Priapulus caudatus*, by teeth. The intestine was clearly traceable, though not down to the anus, and was partly filled with mud. The first caudal appendage resembled that of the northern species in form and transparent consistency, but the little rods and buds were absent ; there was some pigment and an opening at the end of the caudal appendage, which did not seem to have been fractured. The walls of the body showed very marked longitudinal fibres."

The following species of Radiolaria and fragment of Diatoms were observed in the deposit from this Station :— ORGANISMS FROM THE DEPOSIT.

RADIOLARIA (Haeckel, Zool. pt. 40).

Cenosphæra lethe, Haeckel.
Staurolonche hexagona, Haeckel.
Spongolarcus amphicentria, Haeckel.

DIATOMACEÆ.—Mr. Comber says : "I examined carefully a large quantity of material, but found no trace of any Diatom, except a fragment of a *Coscinodiscus* of the '*radiatus*' group, probably *Coscinodiscus radiatus*, Ehrenberg."

Station 64. Organisms from Surface Nets.

Surface Organisms.—The following species are recorded from the surface at this Station :—

Radiolaria (Haeckel, Zool. pt. 40).
- *Acrosphæra inflata*, Haeckel.
- *Xiphostylus ardea*, Haeckel.
- *Spongellipsis aplysina*. Haeckel.
- *Eucyrtidium scalarium*, Haeckel.
- *Lithocampe quadrarticulata*, Haeckel.

Brachyura (Miers, Zool. pt. 49).
- *Nautilograpsus minutus* (Linné).

Gasteropoda (Watson, Zool. pt. 42).
- *Ianthina rotundata*, Leach.
- *Litiopa melanostoma*, Rang.

In addition, the following are recorded in the note-books :—*Tetrastemma fuscum* on *Nautilograpsus*, *Scyllæa pelagica*, *Salpæ*, and the surface organisms mentioned on the 17th. The absence of *Phyllosoma*, Zoëæ, and Stomatopod larvæ is to be noted.

Moseley writes: "Murray went out and caught a number of very fine specimens of *Ianthina*, with *Scyllæa pelagica* and *Nautilograpsus minutus* living attached and simulating in some instances the colour of that animal and its float, being of a slightly mottled blue. Some *Fucus* (*nodosus* ?) of a bright yellow colour was found floating in a perfectly living condition. This we have not met with before, but only *Sargassum bacciferum*."

Willemoes-Suhm writes: "On closer examination the specimens of *Nautilograpsus* were found to be covered by small brown spots, which turned out to be little parasitic Nemerteans ; these animals have not hitherto been found living as parasites. The Nemertean is a small ordinary Tremacephalid, presenting no changes adduced by parasitism ; from its colour I have called it *Tetrastemma fuscum*, n.sp."

Station 65.

Station 65 (Sounding 129), Bermuda to Azores (see Chart 6 and Diagram 3).

June 21, 1873 ; lat. 36° 33′ N., long. 47° 58′ W.
Temperature of air at noon, 74°·8 ; mean for the day, 73°·3.
Temperature of water:—

	°		°
Surface,	72·5	900 fathoms,	40·0
100 fathoms,	64·0	1000 „	39·3
200 „	63·5	1100 „	38·7
300 „	61·2	1200 „	38·4
400 „	57·2	1300 „	38·1
500 „	52·0	1400 „	37·8
600 „	45·2	1500 „	37·5
700 „	42·0	Bottom,	36·2
800 „	41·0		

Density at 60° F. at surface, 1·02721 ; bottom, 1·02598.

Depth, 2700 fathoms; deposit, Red Clay, containing 27·59 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.). STATION 65.

At 3.30 P.M. got up steam, and at 4 P.M. shortened and furled sails, and proceeded under steam to sound. At 5 P.M. sounded in 2700 fathoms. Obtained serial temperatures at intervals of 100 fathoms down to 1500 fathoms. Sent down German water-bottle, and obtained sample of bottom water for analysis. At 7 P.M. completed temperatures, and at 7.15 P.M. proceeded under all plain sail.

Distance from Fayal at noon, 960 miles. Made good 102 miles. Amount of current 18 miles, direction N. 19° E.

Station 66 (Sounding 130), Bermuda to Azores (see Chart 6 and Diagram 3). STATION 66.

June 22, 1873; lat. 37° 24′ N., long. 44° 14′ W.

Temperature of air at noon, 72°·8; mean for the day, 72°·1.

Temperature of water:—

	°		°
Surface,	70·0	500 fathoms,	50·5
100 fathoms,	63·0	600 „	45·0
200 „	61·5	700 „	41·2
300 „	60·1	Bottom,	36·5
400 „	55·8		

Density at 60° F. at surface, 1·02712; bottom, 1·02621.

Depth, 2750 fathoms; deposit, Globigerina Ooze, containing 35·31 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 3.40 P.M. got up steam, and at 4 P.M. shortened and furled sail, and proceeded under steam to sound. Sounded in 2750 fathoms. Obtained serial temperatures at intervals of 100 fathoms down to 700 fathoms. Sent down slip water-bottle, and obtained sample of bottom water for analysis. At 7.40 P.M. made all plain sail.

Distance from Fayal at noon, 780 miles. Made good 180 miles. Amount of current 6 miles, direction W.

Station 67 (Sounding 131), Bermuda to Azores (see Chart 6 and Diagram 3). STATION 67.

June 23, 1873; lat. 37° 54′ N., long. 41° 44′ W.

Temperature of air at noon, 72°·3; mean for the day, 71°·0.

STATION 67

Temperature of water :—

Surface,	70·0	900 fathoms,	38·5
100 fathoms,	63·6	1000 „	38·3
200 „	60·8	1100 „	38·1
300 „	60·1	1200 „	37·9
400 „	55·0	1300 „	37·7
500 „	47·0	1400 „	37·5
600 „	42·5	1500 „	37·3
700 „	40·0	Bottom,	36·3
800 „	38·9		

Density at 60° F. at surface, 1·02699 ; bottom, 1·02614.

Depth, 2700 fathoms ; deposit, Globigerina Ooze, containing 54·30 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 11.30 A.M. shortened and furled sails, and got up steam to sound, and at noon proceeded under steam. At 1 P.M. sounded in 2700 fathoms. At 2 P.M. obtained a series of temperatures at intervals of 100 fathoms down to 1500 fathoms. Sent down slip water-bottle and obtained sample of bottom water. The carbonic acid was determined in the surface water, and amounted to 52·9 milligrammes per litre. At 4 P.M. completed observations, and at 4.10 P.M. made all plain sail.

Distance from Fayal at noon, 606 miles. Made good 168 miles. Amount of current 22 miles, direction N. 43° W.

STATION 68

Station 68 (Sounding 132), Bermuda to Azores (see Chart 6 and Diagram 3).

June 24, 1873 ; lat. 38° 3′ N., long. 39° 19′ W.

Temperature of air at noon, 72°·5 ; mean for the day, 71°·2.

Temperature of water at surface, 70°·0 ; bottom, 36°·2.

Density at 60° F. :—

Surface,	1·02688	500 fathoms,	1·02605
150 fathoms,	1·02681	Bottom,	1·02612
250 „	1·02645		

Depth, 2175 fathoms ; deposit, Globigerina Ooze, containing 71·76 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 9.20 A.M. shortened and furled sails, and got up steam to trawl and sound. At 10 A.M. put trawl over, and at 12.30 P.M. sounded in 2175 fathoms. At 4.45 P.M. trawl came up with a few specimens. The carbonic acid was determined in the bottom water, and amounted to 53·6 milligrammes per litre.

Distance from Fayal at noon, 496 miles. Made good 110 miles. Amount of current 15 miles, direction N. 55° W. STATION 68.

The following species are recorded in the Zoological Reports from the trawl at this Station :— ANIMALS FROM TRAWL.

ISOPODA (Beddard, Zool. pt. 48).

Eurycope abyssicola, n.sp. One specimen; obtained at no other locality.

ANOMURA (Henderson, Zool. pt. 69).

Parapagurus abyssorum, M.-Edwards, var. *scabra*, nov. One specimen in *Buccinum*-shell invested by Zoanthoid polypes; for distribution of the species see Station 56.

POLYZOA (Busk, Zool. pt. 30).

Bugula reticulata, n.sp., var. *unicornis*, nov. Obtained also at Stations 101, 104, 106, 147, 299, 303, and 320, 600 to 2500 fathoms.

Farciminaria delicatissima, n.sp. Obtained also at Stations 13, 14, 64, 89, and 106.

Bifaxaria reticulata, n.g., n.sp. Obtained also at Station 13.

In addition, the following are recorded in the Station-book :—Sponge, another Crustacean, and a small fish allied to *Gonostoma*.

Excluding Protozoa, about 10 specimens of invertebrates and fishes were obtained at this Station, belonging to about 8 species, of which 5 are new to science, including representative of 1 new genus; 1 of the new species was not obtained elsewhere.

Station 69 (Sounding 133), Bermuda to Azores (see Chart 6 and Diagram 3). STATION 69.

June 25, 1873; lat. 38° 23′ N., long. 37° 21′ W.

Temperature of air at noon, 72°·8; mean for the day, 71°·3.

Temperature of water :—

Surface,	71·0°	900 fathoms,	39·7°
100 fathoms,	61·5	1000 „	39·1
200 „	59·5	1100 „	38·7
300 „	56·5	1200 „	38·4
400 „	52·0	1300 „	38·1
500 „	47·3	1400 „	37·8
600 „	43·4	1500 „	37·5
700 „	41·4	Bottom,	36·2
800 „	40·2		

STATION 69.

Density at 60° F. at surface, 1·02712.
Depth, 2200 fathoms; deposit, Globigerina Ooze.

At 9.20 A.M. shortened and furled sails, and got up steam to sound and trawl. At 10 A.M. put trawl over, and at 12.30 P.M. sounded in 2200 fathoms. A water-bottle was sent down attached to the sounding-line, but it came up empty, the line having fouled the slip-valve. At 2 P.M. obtained serial temperatures at intervals of 100 fathoms down to 1500 fathoms. At 5.30 P.M. trawl came up, containing a large red Schizopod and *Pyrosoma*. At 5.50 P.M. made all plain sail.

Distance from Fayal at noon, 404 miles. Made good 95 miles. Amount of current 27 miles, direction N. 19° W.

ANIMALS FROM TRAWL.

The following species are recorded in the Zoological Reports from the trawl at this Station:—

SCHIZOPODA (Sars, Zool. pt. 37).

Gnathophausia gigas, Willemoes-Suhm, n.g., n.sp. One specimen; part of the moulted skin of another specimen was obtained at Station 157, 1950 fathoms.

TUNICATA (Herdman, Zool. pt. 76).

Pyrosoma spinosum, n.sp. Gigantic specimen, of which only pieces were preserved (may have been caught near the surface). Obtained also at Station 133, 1900 fathoms.

The above *Pyrosoma* was 4 feet 2 inches in length and 9 inches in diameter: a wonderfully perfect and beautiful specimen dotted all over with red dots, each dot being the visceral nucleus of an individual. It showed phosphorescence at night when irritated, and one could write one's name on it with the finger. It all broke up into separate animals before morning. In each individual was an ovum not yet sufficiently developed to show the quadripartite embryo. The trawl evidently did not reach the bottom.

STATION 70.

Station 70 (Sounding 134), Bermuda to Azores (see Chart 6 and Diagram 3).

June 26, 1873; lat. 38° 25′ N., long. 35° 50′ W.
Temperature of air at noon, 73°·3; mean for the day, 71°·1.
Temperature of water at surface, 70°·0.
Density at 60° F. at surface, 1·02708.
Depth, 1675 fathoms; deposit, Globigerina Ooze, containing 83·31 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 9.30 A.M. shortened and furled sails, and put trawl over. At noon got up steam, and at 1.30 P.M. sounded in 1675 fathoms. Tried currents at surface, 50, 100, 200, and 300 fathoms. Found current at 50 and 100 fathoms running N.E. by N. at the rate of 1 mile per hour, but no current at 200 and 300 fathoms. At 5.20 P.M. trawl came up with a small quantity of mud and several specimens. At 8 P.M. made all plain sail. STATION 70.

Distance from Fayal at noon, 332 miles. Made good 72 miles. Amount of current 4 miles, direction N. 38° W.

The following species are recorded in the Zoological Reports from the trawl at this Station:— ANIMALS FROM TRAWL.

DEEP-SEA KERATOSA (Haeckel, Zool. pt. 82).

Holopsamma cretaceum, n.sp. One specimen; obtained at no other locality.

ALCYONARIA (Wright and Studer, Zool. pt. 64).

Strophogorgia fragilis, n.g., n.sp. Obtained at no other locality.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophiomitra (?) sp. Damaged specimen.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Salenia varispina, Agassiz. Two specimens; for distribution see Station 23.

ANNELIDA (M'Intosh, Zool. pt. 34).

Lætmonice producta, Grube, var. *willemoesi*, nov. Obtained also at Stations 133, 146, 169, and 184, 700 to 1900 fathoms. A widely-distributed species.

OSTRACODA (Brady, Zool. pt. 3).

Cythere dictyon, n.sp. Widely distributed (see Station 24).

,, *dasyderma*, n.sp. Widely distributed (see Station 5).

Krithe producta, n.sp. Widely distributed; obtained at Stations 70, 76, 85, 120, 122, 145, 146, 164, 167, 174, 296, 300, 302, 305, 308, 311, and 335, 50 to 1825 fathoms.

Cytheropteron mucronalatum, n.sp. Obtained also at Stations 224, 246, 296, 300, and 302, 1375 to 2050 fathoms.

PYCNOGONIDA (Hoek, Zool. pt. 10).

Phoxichilidium oscitans, n.sp. One specimen; obtained at no other locality.

STATION 70. LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Verticordia tornata (Jeffreys). Two valves; obtained also at Station 106, 1850 fathoms.

Leda excisa (Philippi). Two valves; obtained at no other locality by the Challenger.

Modiolaria semigranata (Reeve). Obtained at no other locality by the Challenger. Recorded from the Canaries. Fossil—(?)

GASTEROPODA (Watson, Zool. pt. 42).

Ianthina exigua, Lamarck. Obtained also at Stations 73, 75, 78, and 120, 450 to 1000 fathoms. A widely-distributed species.

Columbella sp. (?).

Pleurotoma (*Mangelia*) sp. (?).

POLYZOA (Busk, Zool. pt. 30; Waters, pt. 79).

Menipea clausa, n.sp. Obtained at no other locality. (Waters places it as a synonym of *Scrupocellaria marsupiata*, Jullien, obtained by the "Travailleur," north-west of Spain, 2018 fathoms.)

Farciminaria gracilis, n.sp. Obtained also at Station 122, 32 to 400 fathoms.

Bifaxaria minuta, n.g., n.sp. One fragmentary specimen; obtained at no other locality.

In addition to the foregoing, the following are recorded in the Station-book:—Sponge, Pennatulid, several Polyps, Starfish, and small spiny blind Isopod.

Excluding Protozoa, nearly 50 specimens of invertebrates were obtained at this Station, belonging to about 24 species, of which 11 are new to science, including representatives of 2 new genera; 5 of the new species were not obtained elsewhere.

Willemoes-Suhm writes: "The last three trawlings (June 24, 25, and 26), besides procuring some interesting animals, seem to show that we have entered a deep-sea region where decidedly northern forms prevail. For example, on the 24th the common northern *Palythoa* was found, this time infesting the house of a large *Pagurus* distinguished by immense claws on its ambulatory feet; also a blind Isopod belonging to the eyeless Munopsidae family, all the members of which occur in high northern latitudes. On the 25th there was a large red Schizopod which, though showing some Phyllopodal characters, has its nearest allies among the Schizopods, the genus *Lophogaster* harmonising with it in the main morphological points. This creature has been got by M. Sars in depths of 60 fathoms (north of Europe), and must have been caught not very far from the bottom, as shrimps like *Mysis* and of this size always rest from time to time, and then go on swimming again. It might, however, be said that it is, like *Euphausia*, a pelagic

Station 70.

animal, if it were not for its red colour, but the habits of its nearest relatives speak very much against this idea. On the 26th, again, there occurred the widely-distributed *Salenia*, an Aphroditacean (*Hermione* ?), which I think we got in 83 fathoms off Halifax, also a Pycnogonid belonging to the genus *Zetes*, discovered by Krøyer in the north, and taken by us in 1200 fathoms off the coast of North America. I do not think that these forms have anything to do with the shallow-water fauna of the Azores, which is probably more Mediterranean than northern."

Organisms from the Deposit.

The following species of Pteropoda and Foraminifera were observed in the deposit from this Station (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.) :—

Pteropoda (Pelseneer, Zool. pt. 65).

Cavolinia trispinosa (Lesueur).
Cavolinia gibbosa (Rang).

Foraminifera (Brady, Zool. pt. 22).—The pelagic species, which make up about 84 per cent. of the carbonate of lime present in the deposit, are marked thus × :—

Biloculina depressa, d'Orbigny.
,, ,, var. *murrhyna*, Schwager.
,, *irregularis*, d'Orbigny.
,, *sphæra*, d'Orbigny.
,, sp. (?).
Miliolina cuvieriana (d'Orbigny).
,, *seminulum* (Linné).
,, *tricarinata* (d'Orbigny).
,, *venusta* (Karrer).
Planispirina contraria (d'Orbigny).
Pelosina rotundata, Brady.
,, sp. (?).
Psammosphæra fusca, Schulze.
Hyperammina ramosa, Brady.
Rhabdammina abyssorum, Sars.
Rhizammina algæformis, Brady.
Reophax fusiformis (Williamson).
,, *guttifera*, Brady.
,, *scorpiurus*, Montfort.
Haplophragmium agglutinans (d'Orbigny).
,, *latidorsatum* (Bornemann) (?).
Thurammina papillata, Brady.
Trochammina ringens, Brady.
Webbina clavata, Jones and Parker.
Textularia concava (Karrer).
Verneuilina pygmæa (Egger).
Gaudryina pupoides, d'Orbigny.
Bulimina buchiana, d'Orbigny.
Virgulina schreibersiana, Czjzek.
,, *subsquamosa*, Egger.
Virgulina texturata, Brady.
Cassidulina subglobosa, Brady.
Lagena apiculata (Reuss).
,, *auriculata*, Brady.
,, *exsculpta*, Brady.
,, *formosa*, Schwager.
,, *globosa* (Montagu).
,, *lævigata* (Reuss).
,, *longispina*, Brady.
,, *marginata* (Walker and Boys).
,, *orbignyana* (Seguenza).
,, *squamosa* (Montagu).
Nodosaria communis, d'Orbigny.
,, *consobrina*, d'Orbigny.
,, *raphanus* (Linné).
,, sp. (?).
Vaginulina legumen (Linné).
Polymorphina angusta, Egger.
,, *lanceolata*, Reuss.
,, *regina*, Brady, Parker, and Jones.
Uvigerina asperula, Czjzek.
,, *pygmæa*, d'Orbigny.
× *Globigerina æquilateralis*, Brady.
× ,, *bulloides*, d'Orbigny.
× ,, ,, var. *triloba*, Reuss.
× ,, *conglobata*, Brady.
× ,, *digitata*, Brady.
× ,, *dubia*, Egger.
× ,, *dutertrei*, d'Orbigny (?).
× ,, *inflata*, d'Orbigny.

Station 70

× *Globigerina rubra*, d'Orbigny.
× ,, *sacculifera*, Brady.
× *Orbulina universa*, d'Orbigny.
× *Hastigerina pelagica* (d'Orbigny).
× *Pullenia obliquiloculata*, Parker and Jones.
,, *sphæroides* (d'Orbigny).
× *Sphæroidina dehiscens*, Parker and Jones.
Discorbina bertheloti (d'Orbigny).
Truncatulina lobatula (Walker and Jacob).
,, *robertsoniana*, Brady.
,, *tenera*, Brady (?).
,, *ungeriana* (d'Orbigny).
,, *wuellerstorfi* (Schwager).
× *Pulvinulina canariensis* (d'Orbigny).
× ,, *crassa* (d'Orbigny).
,, *elegans* (d'Orbigny).
× ,, *menardii* (d'Orbigny).
× ,, ,, var. *fimbriata*, Brady.
× ,, *micheliniana* (d'Orbigny).
,, *partschiana* (d'Orbigny).
× ,, *patagonica* (d'Orbigny).
,, *pauperata*, Parker and Jones.
Rotalia orbicularis, d'Orbigny.
,, *soldanii*, d'Orbigny.
Nonionina umbilicatula (Montagu).

Organisms from Surface.

Surface Organisms.—The following species is recorded from the surface at this Station :—

Brachyura (Miers, Zool. pt. 49).

Nautilograpsus minutus (Linné).

The following species are recorded from the surface between Bermuda and the Azores, June 1873 :—

Macrura (Spence Bate, Zool. pt. 52).

Gennadas intermedius, n.g., n.sp.

Isopoda.

Three Isopods, genera and species undetermined.

Moseley writes : "A piece of *Fucus* (*nodosus* ?) was picked up by Murray on the surface, with three specimens of *Nautilograpsus minutus* adhering to it. Tizard caught a turtle (*Chelone imbricata*) covered with *Lepas anatifera*, and with some specimens of *Æolis* on it, as seen on a log some time ago. The *Lepas* was full of ova in the Nauplius and very early stages."

Station 71.

Station 71 (Sounding 135), Bermuda to Azores (see Chart 6 and Diagram 3).

June 27, 1873 ; lat. 38° 18′ N., long 34° 48′ W.
Temperature of air at noon, 73°·3 ; mean for the day, 71°·6.

Temperature of water :— STATION 71.

Surface,	71·0	500 fathoms,	42·8
25 fathoms,	64·2	600 ,,	41·2
50 ,,	61·0	700 ,,	39·9
75 ,,	59·9	800 ,,	39·0
100 ,,	58·8	900 ,,	38·4
200 ,,	55·2	1000 ,,	37·9
300 ,,	50·8	Bottom,	36·8
400 ,,	46·0		

Density at 60° F. at surface, 1·02696 ; bottom, 1·02668.

Depth, 1675 fathoms; deposit, Globigerina Ooze, containing 88·31 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 9 A.M. shortened sails, and got up steam to sound. At 11 A.M. sounded in 1675 fathoms. At 1 P.M. put over trawl, and obtained serial temperatures down to 1000 fathoms. Sent down slip water-bottle attached to sounding-line, and obtained sample of water for analysis. The carbonic acid was determined in the bottom (?) water, and amounted to 59·2 milligrammes per litre. At 7.40 P.M. trawl came up almost empty, having fouled the line. At 8 P.M. made all plain sail.

Distance from Fayal at noon, 284 miles. Made good 48 miles. Amount of current 16 miles, direction S. 72° E.

The following species are recorded in the Zoological Reports from the trawl at this Station :— ANIMALS FROM TRAWL.

ALCYONARIA (Wright and Studer, Zool. pt. 64).

Telesto rigida, n.sp. Obtained at no other locality.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Arca (*Barbatia*) *pteroessa*, n.sp. Obtained also at Stations 16, 24, 73, 237, and 246.

A fragment of Euplectellid (?) is also recorded in the Station-book.

Station 72 (Sounding 136), Bermuda to Azores (see Chart 6 and Diagram 3). STATION 72.

June 28, 1873 ; lat. 38° 34′ N., long. 32° 47′ W.

Temperature of air at noon, 72°·0 ; mean for the day, 70°·8.

Station 72

Temperature of water :—

Surface, ...	71·0°	500 fathoms, ...	45·2°
25 fathoms, . . .	64·2	600 ,, ...	43·2
50 ,, . . .	63·4	700 ,, ...	41·3
75 ,, . . .	62·6	800 ,, ...	40·0
100 ,, . . .	61·8	900 ,, ...	39·2
200 ,, . . .	57·7	1000 ,, ...	38·5
300 ,, . . .	52·5	1100 ,, ...	38·1
400 ,, . . .	48·0	Bottom, ...	37·8

Density at 60° F. at surface, 1·02718.

Depth, 1240 fathoms; deposit, Pteropod Ooze, containing 81·59 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 4 P.M. shortened and furled sails, and got up steam to sound. At 4.30 P.M. sounded in 1240 fathoms. Obtained a series of temperatures down to 1100 fathoms. At 6.30 P.M. completed observations, and at 6.40 P.M. made all plain sail.

Distance from Fayal at noon, 210 miles, and from Flores, 114 miles. Made good 73 miles. Amount of current 15 miles, direction N. 57° E.

Organisms from the Deposit.

DIATOMACEÆ.—The following species of Diatoms were observed by Mr. Comber in the deposit from this Station, and shells of *Tellina* are recorded in the Station-book (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.) :—

Nitzschia marina, Grunow.	*Coscinodiscus nodulifer*, Janisch.
Grammatophora serpentina, Ehrenberg.	,, *decrescens*, Grunow.
Hemidiscus cuneiformis, Wallich.	,, *radiatus*, Ehrenberg.
Coscinodiscus excentricus, Ehrenberg.	,, *africanus*, Janisch.
,, *lineatus*, Ehrenberg.	*Ethmodiscus* sp. (?).
,, *tumidus*, Janisch.	*Asteromphalus brookei*, Bailey.
,, *curvatulus*, Grunow.	*Bacteriastrum varians*, Lauder.

Station 73

Station 73 (Sounding 137), Bermuda to Azores (see Charts 6 and 10, and Diagram 3).

June 30, 1873; lat. 38° 30′ N., long. 31° 14′ W.

Temperature of air at noon, 68°·8; mean for the day, 68°·5.

Temperature of water :—

Surface, ...	69·0°	600 fathoms, ...	43·4°
100 fathoms, . . .	59·8	700 ,, ...	42·0
200 ,, . . .	57·0	800 ,, ...	41·0
300 ,, . . .	54·0	900 ,, ...	40·0
400 ,, . . .	49·0	Bottom, ...	39·4
500 ,, . . .	45·5		

Density at 60° F. at bottom, 1·02691. STATION 73.

Depth, 1000 fathoms; deposit, Pteropod Ooze, containing 73·20 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6 A.M. shortened and furled sails, and got up steam to sound and dredge. Sounded in 1000 fathoms, and put dredge over. At 11 A.M. dredge came up with a large quantity of ooze, and many specimens. Dredge put over again. At 1.30 P.M. obtained serial temperatures at intervals of 100 fathoms down to the bottom. At 4 P.M. dredge came up reversed, but the tangles contained a number of specimens similar to those of the previous haul. The carbonic acid was determined in the bottom (?) water, and amounted to 44·6 milligrammes per litre. At 4.20 P.M. proceeded under steam.

Distance from Fayal at noon, 114 miles. Made good 44 miles. Amount of current 8 miles, direction S. 34° W. The island of Flores was faintly visible during the day.

The following species are recorded in the Zoological Reports from the dredge at this Station :— ANIMALS FROM DREDGE.

MONAXONIDA (Ridley and Dendy, Zool. pt. 59).

Rhizochalina fistulosa (Bowerbank) (?). Numerous fragments; obtained also at Station 188, 28 fathoms, and off Bahia or Bermuda (?). Recorded from Australia and Arafura Sea.

Trichostemma sarsii, n.sp. Five specimens; obtained also at Station 184, 1400 fathoms.

TETRACTINELLIDA (Sollas, Zool. pt. 63).

Thenea schmidtii, n.n. Two specimens; obtained also at Stations IV. and 24.

HEXACTINELLIDA (Schulze, Zool. pt. 53).

Hyalonema (*Stylocalyx*) *thomsoni*, Marshall, var. *exiguum*, nov. One fragmentary specimen; obtained at no other locality by the Challenger. The species recorded from North Atlantic ("Porcupine").

CORALS (Moseley, Zool. pt. 7).

Stephanotrochus nobilis, n.g., n.sp. One specimen; obtained at no other locality.

Flabellum alabastrum, n.sp. Several specimens; obtained also at Station 78, 1000 fathoms.

Bathyactis symmetrica (Pourtalès). For distribution see Station 24.

HYDROIDA (Allman, Zool. pt. 70).

Cryptolaria humilis, n.sp. Obtained at no other locality.

STATION 73. ASTEROIDEA (Sladen, Zool. pt. 51).

Plutonaster notatus, n.g., n.sp. Obtained at no other locality.

Neomorphaster eustichus, n.g., n.sp. Obtained also at Station 76, 900 fathoms. Only species of the genus.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophiactis canotia, n.sp. Three specimens; obtained at no other locality.

ECHINOIDEA (Agassiz, Zool. pt 9).

Salenia varispina, Agassiz. For distribution see Station 23.

ANNELIDA (M'Intosh, Zool. pt. 34).

Leanira hystricis, Ehlers. Two fragmentary specimens; obtained also at Station 76, 900 fathoms. Recorded from North Atlantic ("Porcupine" and "Knight Errant").

Staurocephalus atlanticus, n.sp. A few fragments; obtained at no other locality.

OSTRACODA (Brady, Zool. pt. 3).

Cythere dictyon, n.sp. Widely distributed (see Station 24).

,, *acanthoderma*, n.sp. Obtained also at Stations 64, 146, 191A, 246, 296, and 302.

,, *irpex*, n.sp. Obtained also at Stations 78 and 335, 1000 and 1425 fathoms.

CIRRIPEDIA (Hoek, Zool. pt. 25).

Dichelaspis sessilis, n.sp. One specimen (attached to spine of Echinid); obtained at no other locality.

SCHIZOPODA (Sars, Zool. pt. 37).

Gnathophausia zoëa, Willemoes-Suhm, n.g., n.sp. One specimen; obtained also at Stations 106, 126, and 171, 600 to 1850 fathoms. Taken subsequently by French expedition in Bay of Biscay.

Eucopia australis, Dana. Obtained also at Stations 50, 92, 107, 146, 158, and 237.

ANOMURA (Henderson, Zool. pt. 69).

Pagurodes (?) sp. One imperfect specimen in shell of *Pleurotoma*.

BRACHYURA (Miers, Zool. pt. 49).

Ethusa microphthalma, Smith. One specimen; obtained at no other locality by the Challenger. Recorded from coast of New England.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35). STATION 73.

Semele (*Abra*) *profundorum*, n.sp. Obtained also at Stations 85, 98, and 244, 1125 to 2900 fathoms.

Callocardia (?) *atlantica*, n.sp. Obtained also at Station 78, 1000 fathoms.

Neæra circinata, Jeffreys. Obtained also at Station 85, 1125 fathoms. Recorded from North Atlantic.

„ *wollastonii*, n.sp. Obtained at no other locality.

Dacrydium vitreum (Möller). Obtained also at Station 78, 1000 fathoms.

Arca (*Barbatia*) *pteroessa*, n.sp. Obtained also at Stations 16, 24, 71, 237, and 246.

Limopsis aurita (Brocchi). Obtained also at Stations 23 and 56.

Amussium lucidum (Jeffreys). Obtained also at Stations 78 and 120, 1000 and 675 fathoms.

SCAPHOPODA and GASTEROPODA (Watson, Zool. pt. 42).

Dentalium capillosum, Jeffreys. For distribution see Station II.

Addisonia excentrica (Tiberi). Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean.

Trochus (*Margarita*) *rhina*, n.sp. Obtained also at Stations 75 and 78, 450 and 1000 fathoms.

Seguenzia ionica, n.sp. Obtained also at Station 24.

„ *carinata*, Jeffreys. Obtained also at Stations 78, 85, and 120, 675 to 1125 fathoms. Recorded from North Atlantic ("Valorous" and "Porcupine").

Ianthina exigua, Lamarck. Obtained also at Stations 70, 75, 78, and 120.

„ *rotundata*, Leach. Obtained also at Stations 64 and 133.

Scalaria acus, n.sp. Obtained also at Station 24.

Columbella sp. (?).

Pleurotoma (*Mangelia*) *macra*, n.sp. Obtained also at Station 78, 1000 fathoms.

„ sp. (?).

Clathurella formosa (Jeffreys). Obtained also at Stations 24, 78, and 85.

„ *chariessa*, n.sp. Obtained also at Stations 24, 78, 85, and 122.

„ *chyta*, n.sp. Obtained at no other locality.

Clionella quadruplex, n.sp. Obtained at no other locality.

Odostomia (*Turbonilla*) *compressa*, Jeffreys. Obtained also at Station 75, 450 fathoms. Recorded from Atlantic and Mediterranean.

Actæon amabilis, n.sp. Obtained also at Station 85, 1125 fathoms.

Bulla semilevis, Seguenza. Obtained also at Stations 75 and 78, 450 and 1000 fathoms. Recorded from Bay of Biscay. Fossil—Middle Pliocene of Calabria.

STATION 73.

Scaphander punctostriatus (Mighels). Obtained also at Stations 24 and 78.
,, *gracilis*, n.sp. Obtained also at Station 78, 1000 fathoms.
Utriculus leucus, n.sp. Obtained at no other locality.
,, n.sp. (?). Specimen in bad condition.
Cylichna ovata, Jeffreys. Obtained also at Stations 24, 75, 78, and 122.
Rotella (?) sp.

BRACHIOPODA (Davidson, Zool. pt. 1).

Terebratula vitrea (Born), var. *minor*, Philippi. One specimen and fragments; obtained also at Stations 24 and 142.

In addition to the foregoing, the following are recorded in the Station-book :—Three specimens of a second species of *Salenia*, two specimens of *Echinocyamus pusillus*, and two species of Polyzoa.

Excluding Protozoa, nearly 100 specimens of invertebrates were obtained at this Station, belonging to about 59 species, of which 29 are new to science, including representatives of 4 new genera; 10 of the new species were not obtained elsewhere.

Willemoes-Suhm writes: "From the animals brought up by the dredge no very definite conclusions can be drawn, as most of them have rather a neutral European deep-sea character. The new *Gnathophausia*, *Pagurus*, and the big *Flabellum* are perhaps peculiar to the Azores plateau."

STATION 74.

Station 74 (Sounding 138), Bermuda to Azores (see Charts 6 and 10, and Diagram 3).

July 1, 1873; lat. 38° 22′ N., long. 29° 37′ W.
Temperature of air at noon, 70°·8; mean for the day, 69°·4.
Temperature of water at surface, 69°·8.
Depth, 1350 fathoms; deposit, Pteropod Ooze, containing 73·50 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6 A.M. stopped and sounded in 1350 fathoms. At 4 P.M. rounded Guia Point and made for anchorage in Horta Bay. At 4.45 P.M. stopped and came to in 14 fathoms.

Distance from Fayal at noon, 19 miles. Made good 98 miles. Amount of current 5 miles, direction W.

ORGANISMS FROM SURFACE.

Surface Organisms.—The following species is recorded as having been found attached to a box picked up at the surface on this date :—

CIRRIPEDIA (Hoek, Zool. pt. 25).

Lepas anatifera, Linné.

Station 75 (Sounding 139), off the Azores (see Chart 10). STATION 75.

July 2, 1873; lat. 38° 38′ N., long. 28° 28′ 30″ W.

Temperature of air at noon, 70°·8; mean for the day, 68°·6.

Temperature of water at surface, 70°·0.

Depth, 450 fathoms; deposit, Volcanic Mud, containing 20·59 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 9 A.M. got up steam, and at 11 A.M. weighed anchor and proceeded under steam out of Horta Bay towards Magdalena Bank. At 11.45 A.M. stopped and put dredge over, hauling it in occasionally from a depth of 50 to 90 fathoms, deposit Volcanic Sand, containing 68·73 per cent. of carbonate of lime. It brought up many specimens. At 4 P.M. sounded in 450 fathoms, and sent down dredge, which brought up numerous specimens. At 5 P.M. made all plain sail, and shaped course for San Miguel, the principal island of the Azores.

ANIMALS FROM DREDGE.

The following species are recorded in the Zoological Reports as having been obtained in the dredge on this date; where the depth is not given, the animals are reported as from 450 fathoms:—

MONAXONIDA (Ridley and Dendy, Zool. pt. 59).

Reniera implexa, Schmidt, var. (?). About a dozen specimens; obtained at no other locality by the Challenger. Recorded from the Adriatic.

Gellius angulatus (Bowerbank). Three specimens; obtained at no other locality by the Challenger. Recorded from British seas.

Plocamia coriacea (Bowerbank), var. *elegans*, nov. One specimen; obtained at no other locality. Recorded from British seas.

Suberites carnosus (Johnston). One specimen; obtained also at Port Jackson, 6 to 15 fathoms, and Fernando Noronha. Recorded from Britain, Kerguelen, and Vancouver's Island (?).

„ *elongatus*, n.sp. Eight specimens; obtained at no other locality.

Polymastia agglutinans, n.sp. Two specimens; obtained at no other locality.

CALCAREA (Poléjaeff, Zool. pt. 24).

Leucosolenia blanca (M.-Maclay), var. *bathybia*, nov. Two specimens; obtained at no other locality. The species recorded from Mediterranean.

Leuconia crucifera, n.sp. One fragmentary specimen; obtained at no other locality.

ALCYONARIA (Wright and Studer, Zool. pt. 64).

Bellonella bocagei (Kent). Several specimens; obtained at no other locality by the Challenger.

STATION 75. CORALS (Moseley, Zool. pt. 7).

Caryophyllia clavus, Scacchi, var. *smithi*, Duncan (?). Several small specimens; obtained also at Station 308, 175 fathoms.

Paracyathus de filippii (Duchassaing and Michelotti). Numerous specimens (50 fathoms); obtained also at Station 190, 49 fathoms.

HYDROIDA (Allman, Zool. pts. 20 and 70).

Polyplumaria pumila, n.sp. Several fragmentary specimens; obtained at no other locality.

Aglaophenia filicula, n.sp. Obtained at no other locality.

,, *acacia*, n.sp. Obtained at no other locality.

Halecium beanii, Johnston. Obtained also at Station 163A, 150 fathoms. Recorded from Britain.

Perisiphonia filicula, n.g., n.sp. Obtained also at Station 163A, 150 fathoms. The only other species of the genus (*Perisiphonia pectinata*) was taken at Station 169.

Sertularia laxa [*exigua*], n.sp. Obtained at no other locality.

Diphasia pinaster (Ellis and Solander). Obtained at no other locality by the Challenger. Recorded from European seas.

Thuiaria pharmacopola, n.sp. Obtained at no other locality.

ASTEROIDEA (Sladen, Zool. pt. 51).

Astropecten hermatophilus, n.sp. Obtained at no other locality.

Chætaster longipes (Retzius), Sars. Obtained also at Station 36.

Ophidiaster attenuatus, Gray. Obtained at no other locality by the Challenger. Recorded from Mediterranean.

,, *ophidianus* (Lamarck), Agassiz (?). One small specimen; obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophiothrix lütkeni, Wyville Thomson (?). Obtained at no other locality by the Challenger.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Spatangus purpureus, Müller. (50 to 90 fathoms); obtained also at Bermuda, 100 fathoms.

Brissus damesi, n.sp. Obtained also at Station 122, 350 fathoms.

ANNELIDA (M'Intosh, Zool. pt. 34).

Lepidonotus squamatus (Linné). One specimen; obtained at no other locality by the Challenger. Recorded from Virginian coast.

Sigalion buskii, M'Intosh. One injured specimen ; obtained at no other locality by the Challenger. Recorded from Shetland. STATION 75.

Glycera tesselata, Grube. One injured specimen ; obtained also at Station 142 (?), 150 fathoms. Recorded from North Atlantic.

„ *capitata*, Œrsted. One specimen ; obtained also at Station II.

Ditrypa arietina, Müller. Dead tubes inhabited by Gephyreans ; obtained also at Station VIIp.

OSTRACODA (Brady, Zool. pt. 3).

Bairdia victrix, Brady. For distribution see Station 24.

„ *angulata*, Brady. One or two specimens; obtained also at Stations 185 and 305, 155 and 165 fathoms. Recorded from Magellan Strait.

Cythere dictyon, n.sp. Widely distributed (see Station 24).

Cytherella lata, n.sp. A few detached valves ; obtained also at Stations 24, 120, 185, and 191.

ANOMURA (Henderson, Zool. pt. 69).

Anapagurus pusillus, n.sp. Several specimens (50 to 90 fathoms) ; obtained also at Station VIIp. and Simon's Bay, Cape.

BRACHYURA (Miers, Zool. pt. 49).

Inachus leptochirus, Leach. Three specimens (50 to 90 fathoms) ; obtained at no other locality by the Challenger.

Pisa (*Arctopsis*) *tribulus* (Linné). One specimen (50 to 90 fathoms) ; obtained also at Station VIIp.

Lambrus (*Parthenolambrus*) *massena*, Roux. One specimen (50 to 90 fathoms) ; obtained also at Cape Verdes. Recorded from Mediterranean and Senegambia.

„ („) *expansus*, Miers. Three specimens (50 to 90 fathoms); obtained at no other locality by the Challenger. Recorded from Madeira.

Heterocrypta maltzani, Miers. Two specimens (50 to 90 fathoms) and one specimen (450 fathoms) ; obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean.

Xanthodes melanodactylus, M.-Edwards. Numerous specimens (50 to 90 fathoms) ; obtained also at Canaries and Cape Verdes. Recorded from North and South Atlantic.

STATION 75. *Pilumnus spinifer*, M.-Edwards (?). Several specimens (50 to 90 fathoms); obtained at no other locality by the Challenger. Recorded from Mediterranean.

Portunus corrugatus (Pennant). One specimen (50 to 90 fathoms); obtained also at Cape Verdes and Stations 161 and 162, 33 and 38 fathoms. Recorded from European seas and Japan.

Calappa granulata (Linné). Two specimens (50 to 90 fathoms); obtained at no other locality by the Challenger.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Neæra curta, Jeffreys. One specimen; obtained also at Station 33.

Saxicava arctica, Linné. Obtained also at Stations 135, 141, 142, 144A, 145, 150, 311, 313, and Port Jackson, 2 to 245 fathoms. A widely-distributed species. Fossil — Upper Tertiary formations.

Errilia castanea (Montagu). Obtained also at Stations VIIP. and 78.

Semele (Abra) longicallus (Scacchi). Obtained at no other locality by the Challenger. Recorded from Atlantic. Fossil—Italy and Norway.

Tellina (——?) *donacina*, Linné. Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil—Coralline Crag and Subappenine Tertiaries.

Venus (Ventricola) casina, Linné. Single valve (50 to 90 fathoms); obtained also at Station VIIP.

,, (,,) *effossa*, Bivona. A few odd valves; obtained also at Station VIIP.

,, (*Chione*) *ovata*, Pennant. (50 to 90 fathoms); obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean.

Circe minima (Montagu). Obtained also at Station VIIP.

Cardium (Acanthocardium) papillosum, Poli. (50 to 90 and 450 fathoms); obtained also at Station VIIP.

,, (*Papyridea*) *transversale*, Deshayes. Obtained also at Station VIIP.

Chama gryphoides, Linné. Obtained also at Station VIIP.

Cryptodon flexuosus (Montagu). Single valve; obtained at no other locality by the Challenger.

Montacuta pura, n.sp. Obtained also at Station VIII.

Leda messanensis, Seguenza. Obtained also at Station VIII.

Limopsis minuta (Philippi). Obtained also at Stations II., VIIP., VIII., and 24.

Arca tetragona, Poli. Obtained at no other locality by the Challenger. Recorded from Atlantic. STATION 75.

Lima (Mantellum) loscombii, Sowerby. Obtained also at Station 135, 100 to 150 fathoms.

Pecten pusio (Linné). Obtained also at Station VIIP.

„ *gibbus* (Linné). One or two small valves; obtained at no other locality by the Challenger. Recorded from west coast of Africa and West Indies.

„ *philippii*, Récluz. Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean.

„ *testæ*, Bivona. Single valve; obtained at no other locality by the Challenger. Recorded from Mediterranean.

SCAPHOPODA and GASTEROPODA (Watson, Zool. pt. 42).

Dentalium entalis, Linné, var. *orthrum*, nov. The species obtained also at Stations II., VIII., 49, 145, and 344.

„ *dentalis*, Linné. (50 to 90 fathoms); obtained also at Simon's Bay, Cape. Recorded from North Atlantic and Mediterranean. Fossil—Upper Miocene onwards.

Cadulus gracilis, Jeffreys. Obtained also at Stations 78 and 85, 1000 and 1125 fathoms. Recorded from North Atlantic ("Valorous").

Acmæa virginea (Müller). Obtained at no other locality by the Challenger. Recorded from Arctic and Atlantic. Fossil—Upper Pliocene of Britain and Scandinavia.

Trochus (Zizyphinus) exasperatus, Pennant. (50 to 90 fathoms); obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil—Lowest Pliocene of Sicily and Calabria onwards.

„ („) *zizyphinus*, Linné. (50 to 90 fathoms); obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil—Miocene and Middle Pliocene onwards.

„ (*Margarita*) *rhina*, n.sp. Obtained also at Stations 73 and 78.

„ („) *azorensis*, n.sp. Obtained at no other locality.

Scissurella alta, n.sp. (50 to 90 fathoms); obtained also at Station 24.

Ianthina exigua, Lamarck. Obtained also at Stations 70, 73, 78, and 120.

Trachysma delicatum (Philippi). Obtained also at Stations 78 and 122, 1000 and 350 fathoms. Recorded from Mediterranean and North Atlantic ("Porcupine").

STATION 75

Murex (*Ocinebra*) *aciculatus*, Lamarck. One dead specimen ; obtained at no other locality by the Challenger. Recorded from N.E. Atlantic and Mediterranean. Fossil—Coralline Crag, Italian Tertiaries and Middle Pliocene.

,, (*Pseudomurex*) *fusulus*, Brocchi. Obtained at no other locality by the Challenger. Recorded from Madeira and Mediterranean. Fossil—Upper Miocene of Italy.

Columbella (*Anachis*) *haliæeti*, Jeffreys. Obtained also at Station II.

,, (*Zafra*) *greci*, Philippi. Obtained at no other locality by the Challenger. Recorded from Mediterranean. Fossil—Post-Pliocene of Sicily.

Marginella (*Gibberula*) *miliaria* (Linné). Obtained also at Station VIIP.

Pleurotoma (*Drillia*) *incrassata*, Dujardin. Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil—Middle Miocene onwards.

,, (*Mangelia*) *eritmeta*, n.sp. Obtained at no other locality.

,, (,,) *acanthodes*, n.sp. (?). One injured specimen ; obtained also at Station 56.

Clathurella crispata (Jan). Obtained also at Station 122, 350 fathoms. Recorded from Mediterranean. Fossil—Middle Miocene onwards and Pleistocene.

,, *leufroyi* (Michaud). Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil—Miocene, Upper Pliocene, and Pleistocene.

,, *reticulata* (Renier). Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil—Middle Miocene onwards.

Cypræa (*Trivia*) *candidula*, Gaskoin. (50 to 90 fathoms); obtained also at Station VIIP.

Natica variabilis, Recluz. Obtained also at Station VIIP.

Odostomia nitens, Jeffreys. Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean.

,, (*Obeliscus*) *nitidula* (Adams). Obtained also at Station 24.

,, (*Turbonilla*) *compressa*, Jeffreys. Obtained also at Station 73.

Eulima famelica, n.sp. Obtained at no other locality.

,, , fragments of two other species.

Cerithiopsis fayalensis, n.sp. Five specimens ; obtained at no other locality by the Challenger. Recorded from North Atlantic ("Porcupine," &c.).

Bittium reticulatum (Costa). Obtained also at Station VIIp. STATION 75.

,, *amblyterum*, n.sp. Obtained at no other locality by the Challenger. Recorded from North Atlantic.

,, *abruptum*, n.sp. Obtained at no other locality.

,, sp. (?).

Triforis perversa (Linné). Obtained also at Stations VIIp. and 122.

Cithna tenella (Jeffreys) (?). One specimen; obtained also at Stations 78, 85, 120, and 122, 350 to 1125 fathoms. Recorded from North Atlantic and Mediterranean. Fossil—Middle Pliocene onwards.

Rissoa fayalensis, n.sp. Obtained at no other locality.

,, (*Alvania*) *calathus*, Forbes and Hanley (?). One injured specimen; obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil—Middle Pliocene.

,, (,,) *cancellata* (Costa). Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil—Upper Miocene.

,, (,,) *hispidula* (Monterosato). Obtained at no other locality by the Challenger. Recorded from Mediterranean. Fossil—Middle Pliocene onwards.

,, (,,) *tarsodes*, n.sp. Obtained at no other locality.

,, (*Setia*) *quisquiliarum*, n.sp. Obtained at no other locality.

Actæon exilis, Jeffreys. Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil—Middle Pliocene of Calabria.

Bulla pinguicula, Jeffreys. One broken specimen; obtained at no other locality by the Challenger. Recorded from Bay of Biscay.

,, *semilevis*, Seguenza. Obtained also at Stations 73 and 78.

Cylichna alba (Brown). Obtained also at Station 122, 350 fathoms. Recorded from the whole North Atlantic and Arctic, and Japan. Fossil—Norwich Crag and Middle Pliocene of Calabria onwards.

,, *ovata*, Jeffreys (?). Obtained also at Stations 24, 73, 78, and 122.

Philine quadrata (Wood) (?). (50 to 90 fathoms); obtained also at Station 78, 1000 fathoms.

Rotella (?) sp. (50 to 90 and 450 fathoms.)

Minute shell, genus unknown.

STATION 75. POLYZOA (Busk, Zool. pts. 30 and 50 ; Waters, pt. 79).

Hippothoa divaricata, Lamouroux. Obtained also at Station 135, 60 to 1000 fathoms. A widely-distributed species.

Carbasea pedunculata, n.sp. Obtained also at Station 76, 900 fathoms.

Membranipora albida, Hincks (?). Obtained also at Station 172, 18 fathoms.

,, *galeata*, Busk, var. *multifida*, nov. On test of Ascidian ; the species obtained also at Stations 145, 149, 150, 320, and Simon's Bay, Cape.

Micropora coriacea (Esper). Obtained also at Station 135, 75 to 90 fathoms. Recorded from British seas and Gulf of Florida.

Retepora imperati, Busk. Obtained also at Cape Verdes, 100 to 120 fathoms. Recorded from Mediterranean ("Porcupine"). [Waters calls it *Retepora tesselata*, Hincks, var. *imperati*, Busk].

,, *atlantica*, n.sp. (?). (50 to 90 and 450 fathoms); obtained at no other locality by the Challenger. Recorded from Gulf of Florida (?), Tenerife, and Adriatic.

Cribrilina radiata (Moll). Obtained also at Station 135, 75 to 90 fathoms. Recorded from North Atlantic and Mediterranean.

Flustramorpha hastigera, n.sp. (50 to 90 and 450 fathoms); obtained at no other locality. [Waters calls it *Diporula hastigera* (Busk)].

Smittia orotavensis, n.sp. Obtained at no other locality by the Challenger. Recorded from Tenerife and Britain (?).

Mucronella (*Phylactella* ?) *canalifera*, n.sp. (50 to 90 and 450 fathoms); obtained at no other locality by the Challenger. Recorded from Madeira.

Adeonella distoma, Busk (?). (50 to 90 and 450 fathoms) ; obtained also at Station 122, 350 fathoms (var. *imperforata*, nov.). Recorded from North Atlantic ("Porcupine"), Capri, and Golfe de Gascogne. Fossil—Miocene. [Waters calls it *Microporella distoma* (Busk)].

Cellepora ovalis, n.sp. Parasitic on a bundle of radical fibres of a Sertularian ; obtained at no other locality.

,, *ansata*, n.sp. Parasitic on small Sertularian (?); obtained at no other locality.

Idmonea milneana, d'Orbigny. Obtained also at Stations 145 and 151, 75 to 150 fathoms. Recorded from Australia and southern parts of South America.

,, *irregularis*, Meneghini. Obtained at no other locality by the Challenger. Recorded from Mediterranean, Bay of Biscay, and Queensland.

TUNICATA (Herdman, Zool. pt 38). Station 75.

———— (?) *clava*, n.sp. One specimen without Ascidiozooids, therefore the genus is doubtful.

Excluding Protozoa, over 200 specimens of invertebrates were obtained in these dredgings, belonging to 128 species, of which 37 are new to science, including representative of 1 new genus ; 22 of the new species were not obtained elsewhere.

From the shallower water (50 to 90 fathoms) about 90 specimens were obtained, belonging to 26 species, of which 6 were taken also in 450 fathoms ; 5 of the species are new, of which 3 were taken also in 450 fathoms. From the deeper water (450 fathoms) about 120 specimens were obtained, belonging to 115 species, of which 36 are new.

Organisms from the Deposit.

The following species of Pteropoda, Heteropoda, and Diatoms were observed in the deposit from 450 fathoms (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.) :—

PTEROPODA (Pelseneer, Zool. pt. 65).

Limacina inflata (d'Orbigny).
Peraclis bispinosa, n.sp.
Clio (*Styliola*) *subula* (Quoy and Gaimard).
Clio pyramidata, Linné.
Cavolinia trispinosa (Lesueur).

HETEROPODA (Smith, Zool. pt. 72).

Atlanta peronii, Lesueur.
,, *souleyeti*, Smith.
Atlanta fusca, Eydoux and Souleyet.

DIATOMACEÆ.—The following species of Diatoms were observed by Mr. Comber.

Amphora proteus, Gregory.
,, *robusta*, Gregory.
,, *gigantea*, Grunow.
,, *littoralis*, Donkin.
,, *crassa*, Gregory.
Navicula hennedyii, W. Smith.
,, *clavata*, Gregory.
,, *lyra*, Ehrenberg.
,, *gregoriana*, Greville.
,, *prætexta*, Ehrenberg.
,, *californica*, Greville.
,, *rimosa*, Greville.
,, *sandriana*, Grunow.
,, *bullata*, Norman, var.
,, *brasiliensis*, Grunow.
,, *latissima*, Gregory.
,, *maxima*, Gregory.
,, *angulosa*, Gregory.
,, *smithii*, Brebisson.
Navicula mediterranea, Grunow.
,, *lineata*, Donkin.
,, *fusca*, Ralfs.
,, *didyma*, Kutzing.
,, *multicostata*, Grunow.
,, *bombus*, Kutzing.
,, *incurvata*, Gregory.
,, *constricta*, Grunow.
,, *executa*, A. Schmidt.
,, *forficula* (= *Pinnularia*, O'Meara).
,, *campylodiscus*, Grunow.
,, *aspera*, Ehrenberg.
,, *consors*, A. Schmidt.
,, *distans*, Ralfs.
Pleurosigma angulatum, W. Smith.
Cocconeis scutellum, Ehrenberg, and var.
,, *pseudomarginata*, Gregory.
Orthoneis splendida, Grunow.
Achnanthes longipes, Agardh.

Station 75

Nitzschia marina, Grunow.
,, *panduriformis*, Gregory.
Surirella fastuosa, Ehrenberg.
,, *macraeana*, Greville.
,, *patens*, A. Schmidt.
,, *lata*, W. Smith.
,, *laxa*, Janisch.
Campylodiscus thuretii, Brebisson.
,, *ralfsii*, W. Smith.
Synedra gaillionii, Ehrenberg.
,, *superba*, Kutzing.
Grammatophora undulata, Ehrenberg.
,, *marina*, Kutzing, var. *subundulata*, Grunow.
,, *serpentina*, Ehrenberg.
Rhabdonema adriaticum, Kutzing.
Cerataulus turgidus, Ehrenberg.
Biddulphia pulchella, Gray.
Triceratium atlanticum, Castracane.
,, *antidiluvianum*, Van Heurck.
,, *arcticum*, Brightwell, and var.
,, *serratum*, Wallich, forma *tetragona*.
,, *formosum*, Brightwell.
Triceratium pentacrinus, Wallich.
Hemidiscus cuneiformis, Wallich.
Stictodiscus parallelus (= *Triceratium*, Greville), forma *hexagona*.
Coscinodiscus lineatus, Ehrenberg.
,, *leptopus*, Grunow.
,, *anguste-lineatus*, A. Schmidt.
,, *nitidus*, Gregory.
,, *subtilis*, Ehrenberg.
,, *atlanticus*, Castracane.
,, *nodulifer*, Janisch.
,, *decrescens*, Grunow.
,, *marginatus*, Ehrenberg.
,, *radiatus*, Ehrenberg.
,, *asteromphalus*, Ehrenberg.
Ethmodiscus sp. (?).
Hyalodiscus scoticus, Grunow.
,, *subtilis*, Bailey.
,, *lævis*, Ehrenberg.
Asteromphalus brookei, Bailey.
Actinoptychus splendens, Ralfs.
Actinocyclus sparsus (= *Eupodiscus*, Gregory).
,, *japonicus*, Castracane.

Station 76

Station 76 (Sounding 140), off the Azores (see Chart 10 and Diagram 3).

July 3, 1873; lat. 38° 11′ N., long. 27° 9′ W.
Temperature of air at noon, 71°·8; mean for the day, 69°·9.
Temperature of water:—

	°		°
Surface,	70·0	500 fathoms,	47·3
100 fathoms,	56·5	600 ,,	45·2
200 ,,	53·6	700 ,,	43·1
300 ,,	51·6	800 ,,	41·2
400 ,,	49·5	Bottom,	40·0

Density at 60° F. at surface, 1·02699; 150 fathoms, 1·02662; bottom, 1·02688.
Depth, 900 fathoms; deposit, Pteropod Ooze, containing 52·22 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 9.15 A.M. shortened and furled sails, and got up steam to sound and dredge. Sounded in 900 fathoms. Put over dredge. At 2 P.M. obtained temperatures at intervals of 100 fathoms down to the bottom. Hove up dredge with some specimens, and put it over again. At 4.15 P.M. hove up dredge, which contained a few specimens. At 6 P.M. completed temperatures, and at 7.30 P.M. made all plain sail.

Distance from St. Michael's at noon, 67 miles.

The following species are recorded in the Zoological Reports from the dredge at this Station:— Station 76. Animals from Dredge.

Hydroida (Allman, Zool. pt. 20).

Cladocarpus pectiniferus, n.sp. Obtained at no other locality.

Crinoidea (Carpenter, Zool. pt. 32).

Rhizocrinus rawsoni, Pourtalès. Three specimens without arms; obtained at no other locality by the Challenger. Recorded from North Atlantic ("Porcupine," American, and French expeditions).

Asteroidea (Sladen, Zool. pt. 51).

Pontaster venustus, n.g., n.sp. One young specimen; obtained also at Station 79, 2025 fathoms.

Neomorphaster eustichus, n.g., n.sp. Obtained also at Station 73. Only species of the genus.

Ophiuroidea (Lyman, Zool. pt. 14).

Ophioglypha lepida, n.sp. Obtained also at Stations 45, 46, 343, and Bermuda.

Ophiomusium lymani, Wyville Thomson. Obtained also at Stations 45, 50, 135, 169, 191, 235, and 296.

Amphiura otteri, Ljungman. Obtained also at Stations 45, 50, and 78.

Ophiogeron edentulus, n.g., n.sp. Obtained also at Station 175, 1350 fathoms. Only species of the genus.

Annelida (M'Intosh, Zool. pt. 34).

Leanira hystricis, Ehlers. One injured specimen; obtained also at Station 73.

Praxilla (?) sp. One fragmentary specimen.

Terebella (*Lanice*) sp. (?). Tubes only.

Ehlersiella atlantica, n.g., n.sp. One fragmentary specimen; obtained also at Station 63. Only species of the genus.

Ostracoda (Brady, Zool. pt. 3).

Bairdia formosa, Brady. Numerous specimens; obtained also at Stations 120, 122, and 191 (?), 350 to 675 fathoms. Recorded from Mediterranean.

Bairdia victrix, Brady. For distribution see Station 24.

Cythere dictyon, n.sp. Widely distributed (see Station 24).

Krithe producta, n.sp. Widely distributed (see Station 70).

Station 76

Isopoda (Beddard, Zool. pt. 48).

Eurycope atlantica, n.sp. One specimen ; obtained at no other locality.
Anceus bathybius, n.sp. One fragmentary specimen ; obtained at no other locality.
Two Isopods, genus and species undetermined.

Polyzoa (Busk, Zool. pt. 30).

Cellularia biloba, n.sp. Obtained at no other locality.
Carbasea pedunculata, n.sp. Obtained also at Station 75.

In addition to the foregoing, the following are recorded in the Station-book :— Siliceous Sponge, *Deltocyathus agassizii* and another Coral, Cirriped on Hydrozoon, and two Amphipods.

Excluding Protozoa, over 50 specimens of invertebrates were obtained at this Station, belonging to about 25 species, of which 13 are new to science, including representatives of 4 new genera ; 4 of the new species were not obtained elsewhere.

Organisms from the Deposit

The following species of Pteropoda were observed in the deposit from this Station (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.) :—

Pteropoda (Pelseneer, Zool. pt. 65).

Limacina inflata (d'Orbigny).
,, *triacantha* (Fischer).
Peraclis bispinosa, n.sp.
Clio pyramidata, Linné.
Cavolinia trispinosa (Lesueur).

Station 77

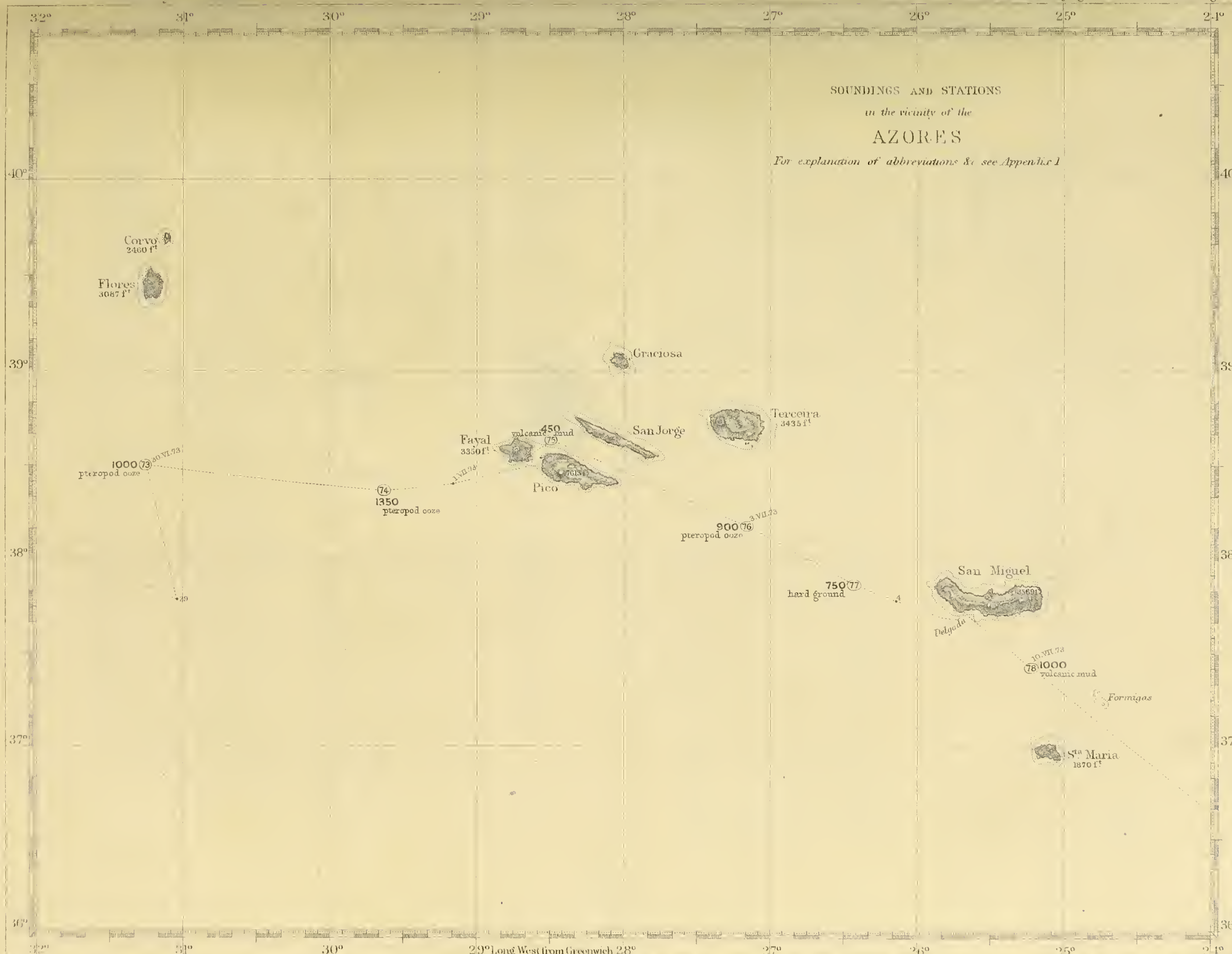
Station 77 (Sounding 141), off the Azores (see Chart 10 and Diagram 3).

July 4, 1873 ; lat. 37° 52′ N., long. 26° 26′ W.
Temperature of air at noon, 69°·8 ; mean for the day, 69°·8.
Temperature of water at surface, 69°·0.
Density at 60° F. at surface, 1·02686 ; bottom, 1·02675.
Depth, 750 fathoms ; deposit, Hard Ground.

At 4 A.M. shortened sail, at 4.30 A.M. got up steam, and at 5.30 A.M. sounded in 750 fathoms. Sent down slip water-bottle, and obtained specimen of bottom water. At 6.30 A.M. made all plain sail. At 4.30 P.M. got up steam, and at 4.50 P.M. proceeded under steam towards Ponta Delgada. At 6.40 P.M. stopped and secured ship to buoy off the town of Ponta Delgada, St. Michael's, Azores.

At St. Michael's, Azores

Remained at St. Michael's till 5 P.M. on July 9.



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Station 78 (Sounding 142), off the Azores (see Chart 10 and Diagram 3). STATION 78.

July 10, 1873; lat. 37° 26′ N., long. 25° 13′ W.
Temperature of air at noon, 73°·8; mean for the day, 71°·5.
Temperature of water:—

Surface,	71·0°	200 fathoms,	54·5°
100 fathoms,	57·6	300 ,,	51·5
150 ,,	56·0		

Depth, 1000 fathoms; deposit, Volcanic Mud, containing 7·68 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 9.20 A.M. shortened and furled sails, and got up steam to sound and dredge. At 10 A.M. sounded in 1000 fathoms, and at 11 A.M. put dredge over, veering 1500 fathoms. Took serial temperatures down to 300 fathoms. At 3 P.M. dredge came up about three-quarters full of mud, and with many specimens. At 3.15 P.M. made all plain sail. At 4.20 P.M. observed Formigas Rocks on port bow. At 8.15 P.M. threw overboard one of Hohn's patent lights for experiment, and observed its light for 18 minutes.

The following species are recorded in the Zoological Reports from the dredge at this Station:— ANIMALS FROM DREDGE.

TETRACTINELLIDA (Sollas, Zool. pt. 63).

Tetilla sandalina, n.sp. Two specimens; obtained at no other locality.

ALCYONARIA (Wright and Studer, Zool. pt. 64).

Clavularia elongata, n.sp. Obtained at no other locality.

CORALS (Moseley, Zool. pt. 7).

Caryophyllia communis (Seguenza). Numerous specimens; for distribution see Station 45.

Deltocyathus italicus, M.-Edwards and Haime. Fifty specimens; for distribution see Station 24.

Stephanotrochus diadema, n.g., n.sp. One injured specimen; obtained also at Station 120, 675 fathoms.

Flabellum alabastrum, n.sp. Several specimens; obtained also at Station 73.

Bathyactis symmetrica (Pourtalès). Several specimens; for distribution see Station 24.

ASTEROIDEA (Sladen, Zool. pt. 51).

Plutonaster abbreviatus, n.g., n.sp. Obtained at no other locality.

STATION 78.

Aphroditaster gracilis, n.g., n.sp. Obtained at no other locality. Only species of the genus.

Pentagonaster lepidus, n.sp. Obtained at no other locality.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophiernus vallincola, n.g., n.sp. Obtained also at Stations 146 and 156, 1375 and 1975 fathoms. Only species of the genus.

Ophiocten hastatum, n.sp. Obtained also at Stations 146 and 168, 1375 and 1100 fathoms.

Amphiura otteri, Ljungman. Obtained also at Stations 45, 50, and 76.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Salenia varispina, Agassiz. For distribution see Station 23.

Phormosoma uranus, Wyville Thomson, n.sp. Obtained also at Station VI.

HOLOTHURIOIDEA (Théel, Zool. pt. 39).

Holothuria lactea, n.sp. Two fragmentary specimens; obtained also at Station 169, 700 fathoms.

OSTRACODA (Brady, Zool. pt. 3).

Cythere dictyon, n.sp. Widely distributed (see Station 24).

,, *irpex*, n.sp. Obtained also at Stations 73 and 335.

Cypridina gracilis, n.sp. Obtained at no other locality.

CIRRIPEDIA (Hoek, Zool. pt. 25).

Scalpellum acutum, n.sp. One specimen; obtained also at Station 170, 520 to 630 fathoms.

AMPHIPODA (Stebbing, Zool. pt. 67).

Amaryllis haswelli, n.sp. One specimen; obtained at no other locality.

ISOPODA (Beddard, Zool. pt. 48).

Ischnosoma spinosum, n.sp. One specimen; obtained at no other locality.

Leiopus leptodactylus, n.g., n.sp. Numerous specimens; obtained at no other locality. Only species of the genus.

ANOMURA (Henderson, Zool. pt. 69).

Lithodes agassizii, Smith. Two specimens; obtained at no other locality by the Challenger. Recorded from east coast of United States.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Callocardia (?) *atlantica*, n.sp. Obtained also at Station 73.

Neæra obesa, Lovén. Single valve; obtained at no other locality by the Challenger. Recorded from both sides of the North Atlantic ("Porcupine," &c.).

,, *azorica*, n.sp. Single valve; obtained at no other locality.

Cryptodon croulinensis, (Jeffreys). Single valve; obtained also at Stations VIII. and 33.

Dacrydium vitreum (Möller). Obtained also at Station 73.

Nucula reticulata, Jeffreys. A few valves; obtained at no other locality by the Challenger. Recorded from North Atlantic ("Valorous").

Leda confinis, n.sp. Obtained at no other locality.

,, *jeffreysi*, Hidalgo. Obtained also at Station 344, 420 fathoms.

Lima (*Limatula*) *subovata*, Jeffreys. Obtained at no other locality by the Challenger.

,, (,,) *confusa*, n.sp. Obtained also at Stations 23 and 120.

Amussium propinquum, n.sp. Two odd valves; obtained at no other locality.

,, *lucidum* (Jeffreys). Obtained also at Stations 73 and 120.

SCAPHOPODA and GASTEROPODA (Watson, Zool. pt. 42).

Dentalium capillosum, Jeffreys. Obtained also at Stations II., 24, and 73.

,, *subterfissum*, Jeffreys. Obtained also at Stations 85 and 120, 1125 and 675 fathoms. Recorded from Davis Strait and North Atlantic ("Valorous," "Lightning," and "Porcupine").

Cadulus gracilis, Jeffreys. Obtained also at Stations 75 and 85.

,, *tumidosus*, Jeffreys. Obtained also at Station 85, 1125 fathoms. Recorded from North Atlantic ("Valorous," "Porcupine," and "Josephine"). Fossil—Pliocene of Messina.

Lepeta (*Pilidium*) *fulva* (Müller). Dead shell; obtained at no other locality by the Challenger. Recorded from northern and Arctic seas of Europe and America. Fossil—Post-Tertiary of Norway.

Trochus (*Margarita*) *rhina*, n.sp. Obtained also at Stations 73 and 75.

Seguenzia carinata, Jeffreys. For distribution see Station 73.

Ianthina exigua, Lamarck. For distribution see Station 70.

Trachysma delicatum (Philippi). For distribution see Station 75.

Buccinum (?) *aquilarum*, n.sp. Obtained at no other locality.

Pleurotoma (*Pleurotomella*) *pruina*, n.sp. Obtained at no other locality.

,, (,,) sp. (?).

,, (*Mangelia*) *macra*, n.sp. Obtained also at Station 73.

,, (,,) *incincta*, n.sp. Obtained at no other locality.

Clathurella formosa, Jeffreys. Obtained also at Stations 24, 73, and 85.

,, *chariessa*, n.sp. Obtained also at Stations 24, 73, 85, and 122.

,, , two other species undetermined.

Cithna tenella (Jeffreys). For distribution see Station 75.

Fenella elongata, n.sp. Obtained also at Station 24.

Actæon globulinus (Forbes) (?). One fragmentary specimen; obtained at no other locality by the Challenger. Recorded from Mediterranean. Fossil—Middle Pliocene of Calabria.

,, (*Acteonina*) *chariis*, n.sp. Obtained at no other locality.

,, sp. (?).

Bulla semilevis, Seguenza. Obtained also at Stations 73 and 75.

Scaphander punctostriatus (Mighels). Obtained also at Stations 24 and 73.

,, *gracilis*, n.sp. Obtained also at Station 73.

Cylichna ovata, Jeffreys (?). Obtained also at Stations 24, 73, 75, and 122.

Philine quadrata (Wood). Obtained also at Station 75.

Cæcum sp. (?).

Cassis (?) sp., fry.

In addition to the foregoing, the following are recorded in the Station-book:—Palythoid on *Bulla*, damaged specimen of *Clymene* (not preserved), and *Cuma*.

Excluding Protozoa, over 200 specimens of invertebrates were obtained at this Station, belonging to about 70 species, of which 32 are new to science, including representatives of 6 new genera; 16 of the new species and 2 new genera were not obtained elsewhere.

Willemoes-Suhm writes: "The dredge brought up a great variety of animals. With the exception of the genus *Archaster*, which, like *Salenia*, is found on the coast of Portugal, the animals differed from those we formerly got in this neighbourhood. Among the Crustacea there was a *Cuma*, same as got living at Station 47, off North America, and a *Tanais*, which was blind and remarkable on account of its second pair of legs being very powerfully developed. *Tanais* also, though an ordinary form, was got once off North America (Station 44). There was also a little indifferent Amphipod, of which I am doubtful whether it really comes from deep water or not, and two specimens of a Brachyurous crab [= *Lithodes agassizii*] having, like *Pericera*, a spiny rostrum and also long and pointed spines all over the body; the abdomen was perfectly soft, colour rose. On the pumice-stones I found worm-tubes like those from our last dredging; they were remarkable for having a sort of door, shaped like a dust-pan, which evidently shuts when the worm retires. The inhabitant was an *Owenia* of the Clymenidæ family, a perfect specimen of which, however, I could not get."

Moseley found that the colouring matter of *Stephanotrochus diadema* gave three absorption bands, solution in sulphuric acid two bands. STATION 78.

The following species of Pteropoda, Heteropoda, Foraminifera, and Diatoms were observed in the deposit from this Station (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.):— ORGANISMS FROM THE DEPOSIT.

PTEROPODA (Pelseneer, Zool. pt. 65).

Limacina inflata (d'Orbigny).
,, *triacantha* (Fischer).
,, *helicoides*, Jeffreys.
Peraclis reticulata (d'Orbigny).
,, *bispinosa*, n.sp.
Clio (*Creseis*) *acicula* (Rang).
,, (*Hyalocylix*) *striata* (Rang).
,, (*Styliola*) *subula* (Quoy and Gaimard).
,, *polita* (Craven, MS.).
Clio pyramidata, Linné.
,, *cuspidata* (Bosc).
Cuvierina columnella (Rang).
Cavolinia trispinosa (Lesueur).
,, *quadridentata* (Lesueur).
,, *longirostris* (Lesueur).
,, *gibbosa* (Rang).
,, *tridentata* (Forskål).
,, *inflexa* (Lesueur).

HETEROPODA (Smith, Zool. pt. 72).

Atlanta peronii, Lesueur.
Atlanta souleyeti, Smith.

FORAMINIFERA (Brady, Zool. pt. 22).—The pelagic species, which make up about 39 per cent. of the carbonate of lime present in the deposit, are marked thus × :—

Biloculina bulloides, d'Orbigny.
,, *depressa*, d'Orbigny.
,, *ringens* (Lamarck).
,, *sphæra*, d'Orbigny.
Spiroloculina arenaria, Brady.
,, *limbata*, d'Orbigny.
Miliolina auberiana (d'Orbigny).
,, *seminulum* (Linné).
,, *tricarinata* (d'Orbigny).
,, *trigonula* (Lamarck).
Ophthalmidium inconstans, Brady.
Planispirina celata (Costa).
,, *contraria* (d'Orbigny).
Cornuspira foliacea (Philippi).
Astrorhiza angulosa, Brady.
,, *granulosa*, Brady.
Storthosphæra confusa, Brady (?).
,, sp. (?).
Psammosphæra fusca, Schulze.
Hyperammina ramosa, Brady.
,, *vagans*, Brady.
Rhabdammina abyssorum, Sars.
,, *discreta*, Brady.
Rhizammina algæformis, Brady.
Reophax adunca, Brady.
,, *dentaliniformis*, Brady.
,, *pilulifera*, Brady.
,, *scorpiurus*, Montfort.
Haplophragmium canariense (d'Orbigny).
,, *globigeriniforme* (Parker and Jones).
,, *latidorsatum* (Bornemann).
,, *rotulatum*, Brady (?).
,, *tenuimargo*, Brady (?).
Placopsilina vesicularis, Brady (?).
Thurammina papillata, Brady.
Hormosina carpenteri, Brady.
Trochammina lituiformis, Brady.
,, *pauciloculata*, Brady.
Textularia agglutinans, d'Orbigny.
,, *quadrilatera*, Schwager.
Verneuilina propinqua, Brady.
Gaudryina pupoides, d'Orbigny.
,, ,, var. *chilostoma*, Reuss.
,, *subrotundata*, Schwager (?).
Bulimina buchiana, d'Orbigny.
,, *inflata*, Seguenza.

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Bulimina subteres, Brady.
Virgulina schreibersiana, Czjzek.
,, *subsquamosa*, Egger.
Bolivina dilatata, Reuss.
,, *porrecta*, Brady.
,, *punctata*, d'Orbigny.
,, *textilarioides*, Reuss.
Cassidulina subglobosa, Brady.
Chilostomella ovoidea, Reuss.
Lagena lagenoides (Williamson).
,, *marginata* (Walker and Boys).
,, *semistriata*, Williamson.
Nodosaria (*Glandulina*) *lævigata*, d'Orbigny.
,, *soluta*, Reuss.
Marginulina glabra, d'Orbigny.
Cristellaria compressa, d'Orbigny.
,, *cultrata* (Montfort).
,, *variabilis*, Reuss.
Uvigerina asperula, Czjzek.
× *Globigerina æquilateralis*, Brady.
× ,, *bulloides*, d'Orbigny.
× ,, *conglobata*, Brady.
× *Globigerina inflata*, d'Orbigny.
× ,, *rubra*, d'Orbigny.
× ,, *sacculifera*, Brady.
× *Orbulina universa*, d'Orbigny.
× *Hastigerina pelagica* (d'Orbigny).
Pullenia quinqueloba, Reuss.
Spirillina decorata, Brady.
Truncatulina humilis, Brady.
,, *lobatula*, Walker and Jacob.
,, *robertsoniana*, Brady.
,, *wuellerstorfi* (Schwager).
Rupertia stabilis, Wallich.
× *Pulvinulina canariensis* (d'Orbigny).
× ,, *crassa* (d'Orbigny).
,, *elegans* (d'Orbigny).
× ,, *micheliniana* (d'Orbigny).
× ,, *patagonica* (d'Orbigny).
,, *pauperata*, Parker and Jones.
Rotalia orbicularis, d'Orbigny.
,, *soldanii*, d'Orbigny.
Polytrema miniaceum (Linné).
Nonionina pompilioides (Fichtel and Moll).

DIATOMACEÆ.—The following species of Diatoms were observed by Mr. Comber:—

Amphora proteus, Gregory.
,, *pellucida*, Gregory.
,, *robusta*, Gregory.
,, *egregia*, Ehrenberg.
,, *grundleri*, A. Schmidt.
,, *cymbifera*, Gregory.
,, *eulensteinii*, Grunow.
,, *digitus*, A. Schmidt.
,, *obtusa*, Gregory.
,, *fusca*, A. Schmidt.
,, *arenaria*, Donkin.
,, *sulcata*, Brebisson.
,, *grevilleana*, Gregory.
,, *crassa*, Gregory.
,, *formosa*, Cleve.
,, *biseriata*, Gregory.
Navicula kennedyii, W. Smith.
,, ,, var. *granulata*, Grunow.
,, ,, ,, *controversa*, A. Schmidt.
,, *clavata*, Gregory.
,, *lyra*, Ehrenberg.
,, *gregoriana*, Gregory.
,, *prætexta*, Ehrenberg.
,, *polysticta*, Greville.
,, *sandriana*, Grunow.
Navicula bullata, Norman, and var.
,, *latissima*, Gregory.
,, *angulosa*, Gregory.
,, *maxima*, Gregory.
,, *smithii*, Brebisson.
,, *fusca*, Ralfs.
,, *lineata*, Donkin.
,, *donkinii*, O'Meara.
,, *æstiva*, Donkin.
,, *approximata*, Greville.
,, *nummularia*, Greville.
,, *forficula* (= *Pinnularia*, O'Meara).
,, *campylodiscus*, Grunow.
,, *eugenia*, A. Schmidt.
,, *cincta*, Kutzing.
,, *didyma*, Kutzing.
,, *bombus*, Kutzing.
,, *multicostata*, Grunow.
,, *aspera*, Ehrenberg.
,, *consors*, A. Schmidt.
,, *distans*, Ralfs.
,, *cœlata* (= *Cocconeis*, O'Meara).
Stauroneis gregorii, Ralfs.
Pleurosigma balticum, W. Smith.
,, *directum*, Grunow.

Pleurosigma strigilis, W. Smith.
Rhoikosigma reichardtiana, Grunow.
Toxonidea insignis, Donkin.
Cocconeis scutellum, Ehrenberg, and var.
,, *dirupta*, Gregory.
,, *interrupta*, Grunow.
,, *pseudomarginata*, Gregory.
,, *grantiana*, Greville.
Orthoneis splendida, Grunow.
,, *coronata* (= *Cocconeis*, Brightwell).
Nitzschia marina, Grunow.
,, *insignis*, Gregory.
,, *plana*, W. Smith.
,, *panduriformis*, Gregory.
Surirella fastuosa, Ehrenberg.
,, *macraeana*, Greville.
,, *lata*, W. Smith.
Campylodiscus thuretii, Brebisson.
,, *ralfsii*, W. Smith.
,, *hodgsonii*, W. Smith.
,, *hibernicus*, Ehrenberg.
Synedra superba, Kutzing.
,, *gaillionii*, Ehrenberg.
,, *pulchella*, Kutzing.
,, *baculus*, Gregory.
Achnanthes brevipes, Agardh.
Rhabdonema adriaticum, Kutzing.
Grammatophora serpentina, Ehrenberg.
,, *marina*, Kutzing, and var.
,, *macilenta*, W. Smith.
Climacosphenia moniligera, Ehrenberg.
Dimeregramma minus, Ralfs.
Epithemia turgida, Kutzing.
,, *gibba*, Kutzing.
Cerataulus turgidus, Ehrenberg.
,, *lævis*, Ralfs.
Biddulphia mobiliensis, Grunow.
,, *pulchella*, Gray.
,, *tuomeyii*, Roper.
,, *aurita*, Brebisson.
Triceratium atlanticum, Castracane.
,, *antidiluvianum*, van Heurck.
,, *arcticum*, Brightwell.
,, ,, var. *japonica minor*, A. Schmidt.
Triceratium nobilis (= *Amphitetras*, Greville).
,, *serratum*, Wallich.
,, *pentacrinus*, Wallich, forma *tetragona*.
,, *flexuosum*, Greville.
,, *alternans*, Bailey.
,, *irregulare*, Greville.
Hemidiscus cuneiformis, Wallich.
Auliscus cœlatus, Bailey.
Aulacodiscus petersii, Ehrenberg.
Stictodiscus parallelus (= *Triceratium*, Greville), forma *hexagona*.
Coscinodiscus lineatus, Ehrenberg.
,, *anguste-lineatus*, A. Schmidt.
,, *blandus*, A. Schmidt.
,, *excentricus*, Ehrenberg.
,, *nitidus*, Gregory.
,, ,, var. *sparsa*, Rattray.
,, *curvatulus*, Grunow.
,, ,, var. *directa*, Rattray.
,, ,, ,, *subocellata*, Grunow.
,, *subtilis*, Ehrenberg.
,, *tuberculatus*, Greville.
,, *concavus*, Gregory.
,, *centralis*, Ehrenberg.
,, *nodulifer*, Janisch, and var.
,, *decrescens*, Grunow.
,, *radiatus*, Ehrenberg.
,, ,, var. *minor*, Rattray.
,, *oculus-iridis*, Ehrenberg.
,, *marginatus*, Ehrenberg.
,, *concinnus*, W. Smith.
,, *asteromphalus*, Ehrenberg.
,, *elegans*, Greville.
Stoschia admirabilis, Janisch.
Ethmodiscus sp. (?).
Stephanopyxis turris, Ralfs.
Asteromphalus brookei, Bailey.
,, *roperianus*, Ralfs.
Actinocyclus murrayensis, Castracane.
Actinoptychus splendens, Ralfs.
,, *vulgaris*, Schumann.
Hyalodiscus subtilis, Bailey.
,, *lævis*, Ehrenberg.
Bacteriastrum varians, Lauder.

Proximity to land is indicated by the occurrence of three fresh-water species. Of these, two were found by Grunow in marine soundings off Franz Josef's Land.

Station 79.

Station 79 (Sounding 143), Azores to Madeira (see Chart 6 and Diagram 3).

July 11, 1873; lat. 36° 21′ N., long. 23° 31′ W.
Temperature of air at noon, 74°·3; mean for the day, 71°·6.
Temperature of water:—

	°		°
Surface,	71·5	900 fathoms,	40·8
100 fathoms,	56·4	1000 "	39·6
200 "	53·5	1100 "	38·7
300 "	51·6	1200 "	38·0
400 "	49·8	1300 "	37·7
500 "	47·9	1400 "	37·4
600 "	46·0	1500 "	37·2
700 "	44·0	Bottom,	35·9
800 "	42·3		

Depth, 2025 fathoms; deposit, Globigerina Ooze, containing 55·65 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 9.15 A.M. shortened and furled sails, and got up steam to sound and dredge. At 10 A.M. sounded in 2025 fathoms, and at 11 A.M. put dredge over, veering 2800 fathoms. At 2 P.M. took serial temperatures at intervals of 100 fathoms down to 1500 fathoms. At 4 P.M. commenced heaving in dredge, which came up at 5.45 P.M. containing a small quantity of ooze and a few specimens.

Distance at noon from Pt. Pargo, the most westerly extremity of Madeira, 376 miles. Made good 105 miles. Amount of current 12 miles, direction S. 55° W.

Animals from Dredge.

The following species are recorded in the Zoological Reports from the dredge at this Station:—

ASTEROIDEA (Sladen, Zool. pt. 51).

Pontaster venustus, n.g., n.sp. Obtained also at Station 76.
Dytaster biserialis, n.g., n.sp. Two specimens; obtained at no other locality.

CUMACEA (Sars, Zool. pt. 55).

Diastylis erinaceus, n.sp. One specimen and fragment; obtained at no other locality.
" *mystacina*, n.sp. One specimen; obtained at no other locality.

Organisms from the Surface.

Surface Organisms.—Willemoes-Suhm states that in the surface water were specimens of *Pyrosoma* and large *Salpa*-colonies.

Station 80 (Sounding 144), Azores to Madeira (see Chart 6 and Diagram 3). STATION 80.

July 12, 1873; lat. 35° 3′ N., long. 21° 25′ W.
Temperature of air at noon, 73°·8; mean for the day, 70°·7.
Temperature of water:—

Surface,	71°·0	500 fathoms,	49°·5
25 fathoms,	63·2	600 „	47·9
50 „	59·7	700 „	45·5
75 „	57·8	800 „	43·1
100 „	56·4	900 „	40·5
200 „	53·6	1000 „	39·0
300 „	52·0	Bottom,	36·6
400 „	50·9		

Density at 60° F. at surface, 1·02706; 600 fathoms, 1·02667; bottom, 1·02601.
Depth, 2660 fathoms; deposit, Globigerina Ooze, containing 66·43 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 1.15 P.M. shortened and furled sails, and got up steam to sound. At 2 P.M. sounded in 2660 fathoms. At 3 P.M. obtained serial temperatures down to 1000 fathoms, and water from 600 fathoms. At 4.45 P.M. completed observations, and at 5 P.M. made all plain sail.

Distance at noon from Pt. Pargo, Madeira, 256 miles. Made good 120 miles. Amount of current 14 miles, direction S. 27° W.

Station 81 (Sounding 145), Azores to Madeira (see Chart 6 and Diagram 3). STATION 81.

July 13, 1873; lat. 34° 11′ N., long. 19° 52′ W.
Temperature of air at noon, 73°·5; mean for the day, 71°·5.
Temperature of water at surface, 71°·0; bottom, 37°·0.
Density at 60° F. at surface, 1·02710.
Depth, 2675 fathoms; deposit, Globigerina Ooze, containing 62·38 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 3.45 P.M. shortened and furled sails, and got up steam to sound. At 5 P.M. sounded in 2675 fathoms. At 6.20 P.M. completed heaving in line, and at 7.5 P.M. made all plain sail.

Distance at noon from Pt. Pargo, Madeira, 171 miles. Made good 85 miles. Amount of current 13 miles, direction S. 45° W.

STATION 81.
ORGANISMS FROM SURFACE-NETS.

Surface Organisms.—The following species are recorded from the surface at this Station :—

PTEROPODA (Pelseneer, Zool. pt. 65).
Clio (*Creseis*) *acicula* (Rang).

AMPHIPODA (Stebbing, Zool. pt. 67).
Phorcorrhaphis zamboangæ, n.sp.

Willemoes-Suhm writes : "In the morning some surface things were brought to me, among which I found some *Diphyes*, an Amphipod of probably unknown genus, many small Schizopods, *Styliola*, and many of those small bicornous *Salpæ*, besides the Zoëæ and ever-present *Sagitta*. There was also a *Salpa* presenting a peculiarity in the lilac glands of the digestive cavity ; these glands showed interruptions due either to want of secretion, which is not very likely, or to separation into several."

STATION 82.

Station 82 (Sounding 146), Azores to Madeira (see Chart 6 and Diagram 3).

July 14, 1873 ; lat. 33° 46′ N., long. 19° 17′ W.

Temperature of air at noon, 72°·8 ; mean for the day, 71°·9.

Temperature of water :—

	°		°
Surface,	70·7	700 fathoms,	46·2
25 fathoms,	65·5	800 ,,	43·6
50 ,,	61·8	900 ,,	41·2
75 ,,	59·3	1000 ,,	39·7
100 ,,	57·8	1100 ,,	39·0
200 ,,	53·8	1200 ,,	38·6
300 ,,	52·0	1300 ,,	38·2
400 ,,	51·0	1400 ,,	37·8
500 ,,	49·6	1500 ,,	37·5
600 ,,	48·2	Bottom,	36·6

Density at 60° F. at surface, 1·02715 ; bottom, 1·02695.

Depth, 2400 fathoms ; deposit, Globigerina Ooze, containing 79·79 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 8.30 A.M. got up steam, and at 9.15 A.M. shortened and furled sails. At 10.30 A.M. sounded in 2400 fathoms. Took serial temperatures down to 1500 fathoms. Made current observations, and found surface current running south at the rate of a quarter of a mile per hour. At 3 P.M. completed observations, and made all plain sail. At 7.30 P.M. shortened and furled square sails, and got up steam. At 7.40 P.M. proceeded under steam.

Distance at noon from Pt. Pargo, Madeira, 116 miles. Made good 54 miles. Amount of current 10 miles, direction S. 14° W.

Station 83 (Sounding 147), Azores to Madeira (see Chart 6 and Diagram 3). STATION 83.

July 15, 1873; lat. 33° 13′ N., long. 18° 13′ W.
Temperature of air at noon, 72°·3; mean for the day, 70°·6.
Temperature of water at surface, 71°·0; bottom, 37°·0.
Density at 60° F. at surface, 1·02742; bottom, 1·02626.
Depth, 1650 fathoms; deposit, Globigerina Ooze, containing 71·09 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.30 A.M. shortened sail and stopped to sound. At 7 A.M. sounded in 1650 fathoms. Sent down water-bottle and obtained sample of bottom water for analysis. At 8.15 A.M. put dredge over and veered 2000 fathoms. At 11.45 A.M. dredge came up containing a few specimens. At noon made all plain sail. At 2.45 P.M. sighted Madeira. At 10.30 P.M. shortened and furled sail, and proceeded under steam.

Pt. Pargo, Madeira, distant at noon, 52 miles. Made good 64 miles. Amount of current 6 miles, direction S. 16° W.

The following species is recorded from the dredge at this Station:— ANIMALS FROM DREDGE.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophiomusium armigerum, n.sp. Obtained also at Stations 106, 299 (?), and 332, 1850 to 2200 fathoms.

In addition, the Station-book records:—An Antipathid and two specimens of *Archaster*.

The Challenger remained at Madeira from 7 A.M. on July 16 till 8 P.M. on July 17. (For animals procured at Madeira, see page 125.) AT MADEIRA.

Station 84, Madeira to Cape Verde Islands (see Chart 6). STATION 84.

July 18, 1873; lat. 30° 38′ N., long. 18° 5′ W.
Temperature of air at noon, 72°·3; mean for the day, 71°·4.
Temperature of water:—

Surface,	71·0°	400 fathoms,	50·0°
25 fathoms,	68·0	500 "	48·3
50 "	64·6	600 "	46·2
75 "	62·5	700 "	44·4
100 "	61·0	800 "	42·6
200 "	56·3	900 "	41·2
300 "	53·0	1000 "	40·0

Density at 60° F. at surface, 1·02729.

STATION 84. At 4 A.M., daylight, observed Madeira Island astern. Under sail the whole forenoon, with a stiff breeze from the N.E., ship rolling occasionally. At 1.30 P.M. shortened and furled sails, and got up steam to obtain serial temperatures down to 1000 fathoms. At 3.45 P.M. completed temperatures, and at 4 P.M. made all plain sail. Depth here according to Admiralty charts about 2400 fathoms.

Distance at noon from Palma Island, Canaries, 115 miles; from St. Vincent, Cape Verdes, 920 miles. Made good 120 miles.

[*Stochasmus exilis* is given by Spence Bate, and *Ophiomitra chelys* by Lyman, as from this Station, but they are both evidently from Station 85.]

STATION 85. **Station 85** (Sounding 149), Madeira to Cape Verde Islands (see Charts 5 and 6, and Diagram 7).

July 19, 1873; lat. 28° 42′ N., long. 18° 6′ W.

Temperature of air at noon, 74°·8; mean for the day, 71°·7.

Temperature of water:—

Surface, ...	69·2°	200 fathoms, . . .	54·8°
25 fathoms, . . .	63·0	300 ,, . . .	51·5
50 ,, . . .	61·2	400 ,, . . .	48·5
75 ,, . . .	59·8	500 ,, . . .	46·0
100 ,, . . .	58·5		

Density at 60° F. at surface, 1·02735.

Depth, 1125 fathoms; deposit, Volcanic Mud, containing 6·54 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 8.30 A.M. shortened and furled sails, got up steam to sound, and sounded in 1125 fathoms. At 10 A.M. put dredge over. At 1.15 P.M. commenced heaving in dredge, which came up at 3 P.M. half full of mud, and with many specimens. Obtained a series of temperatures down to 500 fathoms. At 3.40 P.M. proceeded towards the dredging ground of Station 3 in the cruise from Tenerife to St. Thomas. Made good about 130 miles.

ANIMALS FROM DREDGE. The following species are recorded in the Zoological Reports from the dredge at this Station:—

ALCYONARIA (Wright and Studer, Zool. pt. 64).

Pleurocorallium johnsoni, Gray. Obtained also at Station 3.

Ceratoisis palmæ, n.sp. A few fragments; obtained at no other locality.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophiomitra chelys (Wyville Thomson), n.sp. Obtained also at Stations 3 and 33. [Stated in error to be from Station 84.]

OSTRACODA (Brady, Zool. pt. 3).

Cythere dasyderma, n.sp. Widely distributed (see Station 5).
,, (?) *serratula*, n.sp. A few separate valves; obtained also at Stations 24 and 335.
Krithe producta, n.sp. Widely distributed (see Station 70).

MACRURA (Spence Bate, Zool. pt. 52).

Sfochasmus exilis, n.g., n.sp. One injured specimen; obtained at no other locality. Only species of the genus. [Stated in error to be from Station 84.]

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Neæra circinata, Jeffreys. Obtained also at Station 73.
Semele (*Abra*) *profundorum*, n.sp. Obtained also at Stations 73, 98, and 244.
Verticordia quadrata, n.sp. Single valve; obtained at no other locality.

SCAPHOPODA and GASTEROPODA (Watson, Zool. pt. 42).

Dentalium subterfissum, Jeffreys. Obtained also at Stations 78 and 120.
Siphodentalium pusillum, n.sp. Obtained at no other locality.
Cadulus gracilis, Jeffreys. Obtained also at Stations 75 and 78.
,, *tumidosus*, Jeffreys. Obtained also at Station 78.
Trochus sp. (?).
Basilissa munda, n.g., n.sp. Obtained at no other locality.
Seguenzia carinata, Jeffreys. For distribution see Station 73.
Purpura (?) sp., fry.
Pleurotoma (*Mangelia*) sp. (?).
Clathurella formosa (Jeffreys). Obtained also at Stations 24, 73, and 78.
,, *chariessa*, n.sp. Obtained also at Stations 24, 73, 78, and 122.
Cassis (?), two species, fry.
Natica sp. (?). Obtained also at Stations 24, 120, and 122.
Cithna tenella (Jeffreys). For distribution see Station 75.
Rissoa (*Alvania*) *deliciosa*, Jeffreys. Obtained also at Station 122, 350 fathoms. Recorded from N.E. Atlantic and Mediterranean.
,, *amblia*, n.sp. Obtained at no other locality.
Actæon amabilis, n.sp. Obtained also at Station 73.
Bellerophina sp. (?).

Station 85.

In addition to the foregoing, the Station-book records also :—Spicules of *Euplectella*, Annelid tubes, and Polyzoon.

Excluding Protozoa, nearly 100 specimens of invertebrates were obtained at this Station, belonging to about 32 species, of which 15 are new to science, including representatives of 2 new genera; 6 of the new species and 1 new genus were not obtained elsewhere.

Organisms from the Deposit

The following species of Pteropoda, Heteropoda, and Foraminifera were observed in the deposit from this Station (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.) :—

Pteropoda (Pelseneer, Zool. pt. 65).

Limacina inflata (d'Orbigny).
" *triacantha* (Fischer).
" *lesueuri* (d'Orbigny).
" *bulimoides* (d'Orbigny).
Peraclis reticulata (d'Orbigny).
" *bispinosa*, n.sp.
Clio (*Creseis*) *acicula* (Rang).
" (*Hyalocylix*) *striata* (Rang).
" (*Styliola*) *subula* (Quoy and Gaimard).
Clio polita (Craven, MS.).
" *pyramidata*, Linné.
" *cuspidata* (Bosc).
Cuvierina columnella (Rang).
Cavolinia trispinosa (Lesueur).
" *quadridentata* (Lesueur).
" *gibbosa* (Rang).
" *uncinata* (Rang).
" *inflexa* (Lesueur).

Heteropoda (Smith, Zool. pt. 72).

Carinaria lamarckii, Peron and Lesueur (?).
Atlanta peronii, Lesueur.
" *inflata*, Eydoux and Souleyet.
Atlanta souleyeti, Smith.
" *fusca*, Eydoux and Souleyet.

Foraminifera (Brady, Zool. pt. 22.)—The pelagic species, which make up about 30 per cent. of the carbonate of lime present in the deposit, are marked thus × :—

Biloculina bulloides, d'Orbigny.
" *depressa*, d'Orbigny.
" *irregularis*, d'Orbigny.
" *sphæra*, d'Orbigny.
Miliolina seminulum (Linné).
Ophthalmidium inconstans, Brady.
" sp. (?).
Planispirina sigmoidea, Brady.
Cornuspira foliacea (Philippi).
Pelosina variabilis, Brady (?).
Pilulina jeffreysii, Carpenter.
Hyperammina arborescens (Norman).
" *elongata*, Brady.
" *ramosa*, Brady.
Rhabdammina abyssorum, Sars.
Aschemonella catenata (Norman).
" *ramuliformis*, Brady.
Haliphysema sp. (?).
Reophax adunca, Brady.
" *dentaliniformis*, Brady.
" *guttifera*, Brady.
" *membranacea*, Brady (?).
Haplophragmium globigeriniforme (Parker and Jones).
" *latidorsatum* (Bornemann).
Thurammina papillata, Brady.
Hormosina carpenteri, Brady.
Trochammina proteus, Karrer.
Webbina clavata, Jones and Parker.
Cyclammina pusilla, Brady.
Textularia agglutinans, d'Orbigny.
" *quadrilatera*, Schwager.
Verneuilina pygmæa (Egger).
Gaudryina pupoides, d'Orbigny, var. *chilostoma*, Reuss.

Gaudryina rugosa, d'Orbigny.
Bulimina buchiana, d'Orbigny.
,, *elegans*, d'Orbigny (?).
,, *inflata*, Seguenza.
,, *pyrula*, d'Orbigny.
Bolivina beyrichi, Reuss.
,, *robusta*, Brady.
Cassidulina subglobosa, Brady.
Chilostomella ovoidea, Reuss.
Lagena acuticosta, Reuss.
,, *lagenoides* (Williamson).
,, *marginata* (Walker and Boys).
,, *orbignyana* (Seguenza).
,, *semistriata*, Williamson.
Nodosaria obliqua (Linné).
,, *scalaris* (Batsch).
,, sp. (?).
Rhabdogonium tricarinatum (d'Orbigny).
Cristellaria articulata, Reuss.
,, *crepidula* (Fichtel and Moll).
Polymorphina lactea (Walker and Jacob).
,, *sororia*, Reuss, var. *cuspidata*, Brady.
,, sp. (?).
Uvigerina pygmæa, d'Orbigny.
Sagrina columellaris, Brady.
× *Globigerina æquilateralis*, Brady.
× ,, *bulloides*, d'Orbigny.
× ,, *conglobata*, Brady.
× *Globigerina dubia*, Egger.
× ,, *inflata*, d'Orbigny.
× ,, *rubra*, d'Orbigny.
× ,, *sacculifera*, Brady.
× *Orbulina universa*, d'Orbigny.
× *Hastigerina pelagica*, d'Orbigny.
× *Pullenia obliquiloculata*, Parker and Jones.
,, *quinqueloba*, Reuss.
Spirillina decorata, Brady.
Planorbulina mediterranensis, d'Orbigny.
Truncatulina culter (Parker and Jones).
,, *ungeriana* (d'Orbigny).
,, *wuellerstorfi* (Schwager).
Rupertia stabilis, Wallich.
× *Pulvinulina canariensis* (d'Orbigny).
× ,, *crassa*, (d'Orbigny).
× ,, *elegans* (d'Orbigny).
,, *hauerii* (d'Orbigny).
× ,, *menardii* (d'Orbigny).
× ,, *micheliniana* (d'Orbigny).
,, *pauperata*, Parker and Jones.
× ,, *tumida*, Brady.
Rotalia calcar, d'Orbigny.
,, *soldanii*, d'Orbigny.
Polytrema miniaceum (Linné).
Nonionina umbilicatula (Montagu).
Amphistegina lessonii, d'Orbigny.
Operculina (?) sp.

Moseley writes: "In addition to the Pteropods, &c., I found in the mud an entire well-preserved leaf of a shrub (holly ?), which, from its whiteness and general appearance, had evidently been at the bottom a considerable time; we were six miles from shore. This is the first land-vegetable fragment we have obtained from deep water, and interesting as showing how land remains become mingled with marine ones in even deep-sea deposits. In the mud were, further, masses of the corallum previously obtained, coated with manganese. On one piece was a small *Spirorbis* also encrusted, thus showing the encrustation was entirely post-mortem."

Station 86 (Sounding 150), Madeira to Cape Verde Islands (see Chart 6).

July 21, 1873; lat. 25° 46′ N., long. 20° 34′ W.
Temperature of air at noon, 74°·3; mean for the day, 72°·1.
Temperature of water at surface, 71°·0; bottom, 36°·6.
Density at 60° F. at bottom, 1·02626.

Station 86.

Depth, 2300 fathoms; deposit, Globigerina Ooze, containing 57·77 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 5.30 A.M. got up steam, and sounded in 2300 fathoms. Being too far westward of Station 3, at 8 A.M. steamed about 22 miles east. Obtained sample of bottom water for analysis. A thermometer was broken by pressure.

Station 87.

Station 87.

At 12.20 P.M. stopped and put dredge over, veering 2000 fathoms. At 2 P.M. sounded in 1675 fathoms. Imbedded in the sounding-lead were found fragments of coral coated with manganese, similar to that brought up by the dredge on nearly the same spot on a former occasion. At 5.15 P.M. hove up dredge, containing a few branches of the same coral and a few specimens. At 5.20 P.M. made all plain sail.

Distance at noon from St. Vincent, Cape Verdes, 600 miles. Made good 77 miles. Amount of current 17 miles, direction S. 64° W.

Animals from Dredge.

The following species are recorded in the Zoological Reports from the dredge at this Station :—

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophiomusium pulchellum, Wyville Thomson, n.sp. Obtained also at Stations 122 and 142, 350 and 150 fathoms.

Ophiomitra carduus, n.sp. Obtained at no other locality.

MACRURA (Spence Bate, Zool. pt. 52).

Eryoneicus cæcus, n.g., n.sp. One specimen; obtained at no other locality. Only species of the genus. [Stated in error to have been taken at Station VIIv., 1620 fathoms.]

Acanthephyra purpurea, M.-Edwards. One specimen; obtained also at Stations 40 and 354.

Hymenodora mollicutis, n.sp. One specimen; obtained also at Stations 104, 133, 156, 157, and 318, 1675 to 2500 fathoms.

POLYZOA (Busk, Zool. pt. 30).

Nellia simplex, Busk. Two specimens; obtained at no other locality by the Challenger.

The Station-book records also:—Several pieces of Gorgonoid Coral coated with manganese.

Excluding Protozoa, about a dozen specimens of invertebrates were obtained at this Station, belonging to 7 species, of which 4 are new to science, including representative of 1 new genus; 2 of the new species and the new genus were not obtained elsewhere. STATION 87.

Willemoes-Suhm writes: "In the dredge was a shrimp, probably a Peneid, which apparently shows that these animals live on the bottom, for it is improbable that a shrimp could penetrate deeply into the mud during the passage of the dredge through the surface water. There was also a transparent, very spiny, blind larva of a Brachyurous crab [=*Eryoneicus cæcus*], probably answering to the Megalopa-stage, but remarkable, in addition to its blindness, for the development of the first pair of cheliferous legs and the presence of only one largely developed, and three very slightly developed, pairs of pereiopods, though the swimmerettes were normal. Of the internal organs one could see a bright-red stomach and, on both sides of it, a yellow liver. The spines were placed in rows on the carapace, and also covered the legs and abdomen, but there was no very spiny rostrum, which, however, might appear in a subsequent stage. The full-grown crab to which this larva belongs is evidently blind, and might bear some resemblance to the *Pericera*-like crab taken on July 10 [=*Lithodes agassizii*], which, however, had a pair of well-developed eyes and a rostrum composed of strong spines. This is, as far as I am aware, the first instance of a larva of a deep-sea Crustacean being brought up in the dredge."

A longicorn beetle (*Clytus*) was blown on board, perhaps from Africa.

Station 88 (Sounding 152), Madeira to Cape Verde Islands (see Chart 6 and Diagram 7). STATION 88.

July 22, 1873; lat. 23° 58′ N., long. 21° 18′ W.

Temperature of air at noon, 75°·3; mean for the day, 73°·7.

Temperature of water :—

Surface,	72°·0	600 fathoms,	43°·2
100 fathoms,	61·0	700 ,,	42·0
200 ,,	55·4	800 ,,	41·0
300 ,,	50·4	900 ,,	40·1
400 ,,	46·8	1000 ,,	39·3
500 ,,	44·5	Bottom,	36·4

Density at 60° F. at surface, 1·02755; 400 fathoms, 1·02627; bottom, 1·02618.

Depth, 2300 fathoms; deposit, Globigerina Ooze, containing 64·38 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 1.20 P.M. shortened and furled sails, and got up steam to sound. Sounded in 2300 fathoms. At 3 P.M. took serial temperatures at intervals of 100 fathoms down to

Station 88. 1000 fathoms, one of the thermometers being broken by the pressure. Sent down water-bottle, and obtained samples of water from the bottom, 600 and 400 fathoms. At 4.50 P.M. completed temperatures, and at 5 P.M. made all plain sail.

Distance at noon from St. Vincent, 478 miles. Made good 119 miles. Amount of current 11 miles, direction S. 53° W.

Station 89. **Station 89** (Sounding 153), Madeira to Cape Verde Islands (see Chart 6 and Diagram 7).

July 23, 1873; lat. 22° 18′ N., long. 22° 2′ W.

Temperature of air at noon, 74°·8; mean for the day, 73°·8.

Temperature of water :—

	°		°
Surface,	73·5	900 fathoms,	40·0
100 fathoms,	64·0	1000 ,,	39·0
200 ,,	56·0	1100 ,,	38·0
300 ,,	50·5	1200 ,,	37·4
400 ,,	47·0	1300 ,,	37·0
500 ,,	44·5	1400 ,,	36·8
600 ,,	43·0	1500 ,,	36·7
700 ,,	42·0	Bottom ,,	36·6
800 ,,	41·0		

Density at 60° F. at surface, 1·02719.

Depth, 2400 fathoms; deposit, Globigerina Ooze, containing 58·50 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 9.20 A.M. shortened and furled sails, and got up steam to trawl and sound. At 9.45 A.M. put trawl over and veered 3000 fathoms. At noon sounded in 2400 fathoms. At 1 P.M. took serial temperatures at intervals of 100 fathoms down to 1500 fathoms. At 4.30 P.M. commenced heaving in trawl, which came up at 6.30 P.M. containing a few specimens. At 6.45 P.M. made all plain sail. Since the previous day the colour of the surface water changed from blue to green.

Distance at noon from St. Vincent, 362 miles. Made good 117 miles. Amount of current 5 miles, direction S.

Animals from Trawl. The following species are recorded in the Zoological Reports from the trawl at this Station :—

Deep-Sea Keratosa (Haeckel, Zool. pt. 82).

Ammoconia auloplegma, n.g., n.sp. Obtained at no other locality.

Psammopemma calcareum, n.sp. Obtained at no other locality.

ASTEROIDEA (Sladen, Zool. pt. 51). STATION 89.

Lonchotaster tartareus, n.g., n.sp. Obtained at no other locality.
Thoracaster cylindratus, n.g., n.sp. Obtained at no other locality.
Freyella tuberculata, n.sp. Obtained also at Station 346, 2350 fathoms. Recorded subsequently from Indian Ocean ("Investigator").

COPEPODA (Brady, Zool. pt. 23).

Lernæa abyssicola, n.sp. Parasitic on *Ceratias uranoscopus*.

POLYZOA (Busk, Zool. pt. 30).

Bugula mirabilis, n.sp. Several specimens; obtained at no other locality.
Farciminaria delicatissima, n.sp. Obtained also at Stations 13, 14, 64, 68, and 106.

FISHES (Günther, Zool. pt. 57).

Ceratias uranoscopus, Murray, n.sp. One specimen; obtained at no other locality. Recorded subsequently from New England (U.S. Fish Commission).

The Station-book records also :—Trunk of Pennatulid, red Holothurian with *Stylifer* in its cloaca, and two specimens of *Scalpellum* on a Polyzoon.

Excluding Protozoa, about 20 specimens of invertebrates and fishes were obtained at this Station, belonging to about 12 species, of which 9 are new to science, including representatives of 3 new genera; 7 of the new species were not obtained elsewhere.

Station 90 (Sounding 154), Madeira to Cape Verde Islands (see Chart 6 and Diagram 7). STATION 90.

July 24, 1873; lat. 20° 58′ N., long. 22° 57′ W.
Temperature of air at noon, 74°·8; mean for the day, 73°·7.
Temperature of water :—

Surface,	74°·0	800 fathoms,	39°·8
100 fathoms,	62·2	900 ,,	39·1
200 ,,	56·0	1000 ,,	38·6
300 ,,	50·7	1100 ,,	38·2
400 ,,	46·7	1200 ,,	37·8
500 ,,	44·0	1300 ,,	37·4
600 ,,	42·2	1400 ,,	37·0
700 ,,	40·8	Bottom,	36·4

STATION 90.

Density at 60° F. :—

Surface,	1·02688	400 fathoms,	1·02610
100 fathoms,	1·02735	500 ,,	1·02605
150 ,,	1·02661	Bottom,	1·02645
300 ,,	1·02645		

Depth, 2400 fathoms; deposit, Globigerina Ooze.

At 11.20 A.M. shortened and furled sails, and got up steam to sound. At 1 P.M. sounded in 2400 fathoms. At 2.30 P.M. took serial temperatures at intervals of 100 fathoms down to 1400 fathoms, and obtained sample of bottom water for analysis. At 4 P.M. completed temperatures, and at 4.10 P.M. made all plain sail. The water still retained its green colour.

Distance at noon from St. Vincent, Cape Verdes, 268 miles. Made good 95 miles. Amount of current 4 miles, direction S. 63° W.

STATION 91

Station 91 (Sounding 155), Madeira to Cape Verde Islands (see Chart 6 and Diagram 7).

July 25, 1873; lat. 19° 4′ N., long. 24° 6′ W.

Temperature of air at noon, 75°·8; mean for the day, 74°·1.

Temperature of water :—

Surface,	74·0	600 fathoms,	41·9
100 fathoms,	60·0	700 ,,	40·7
200 ,,	54·0	800 ,,	39·8
300 ,,	49·5	900 ,,	39·1
400 ,,	46·2	1000 ,,	38·6
500 ,,	43·5	Bottom,	36·5

Density at 60 F. :—

Surface,	1·02710	300 fathoms,	1·02623
100 fathoms,	1·02637	400 ,,	1·02606
200 ,,	1·02649	Bottom,	1·02696

Depth, 2075 fathoms; deposit, Globigerina Ooze, containing 60·95 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 1.15 P.M. shortened and furled sails, and got up steam to sound. At 2 P.M. sounded in 2075 fathoms, and obtained serial temperatures at intervals of 100 fathoms down to 1000 fathoms. Sent down water-bottle and procured samples of water from 100, 200, 300, and 400 fathoms, and bottom. The water, which for the last two days had been of a green colour, returned to its dark blue tint. At 4.30 P.M. completed observations, and at 4.45 P.M. made all plain sail. STATION 91.

Distance at noon from St. Vincent, 144 miles. Made good 125 miles. Amount of current 11 miles, direction S. 51° W.

Station 92 (Sounding 156), Madeira to Cape Verde Islands (see Chart 6 and Diagram 7). STATION 92.

July 26, 1873 ; lat. 17° 54′ N., long. 24° 41′ W.

Temperature of air at noon, 76°·5 ; mean for the day, 74°·3.

Temperature of water :—

	°		°
Surface,	74·7	800 fathoms,	39·9
50 fathoms,	68·0	900 ,,	39·3
100 ,,	62·0	1000 ,,	38·8
200 ,,	52·0	1100 ,,	38·3
300 ,,	47·2	1200 ,,	38·0
400 ,,	44·2	1300 ,,	37·8
500 ,,	42·4	1400 ,,	37·6
600 ,,	41·4	1500 ,,	37·5
700 ,,	40·5		

Density at 60° F. :—

Surface,	1·02699	75 fathoms,	1·02715
45 fathoms,	1·02745	100 ,,	1·02680

Depth, 1975 fathoms; deposit, Globigerina Ooze, containing 57·15 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 7.35 A.M. shortened and furled sails, and got up steam to sound and dredge. At 8 A.M. put dredge over, and veered 1500 fathoms. At 9.30 A.M. sounded in 1975 fathoms, and veered dredge rope to 2500 fathoms. At noon took serial temperatures down to 1500 fathoms. At 4 P.M. hove up dredge, which contained one or two specimens. At 4.10 P.M. made all plain sail. At 11 P.M. observed San Antonio Island ahead.

Distance at noon from San Antonio, 48 miles, and from St. Vincent, 61 miles. Made good 83 miles. Amount of current 8 miles, direction W.

The following species is recorded from the dredge at this Station :— ANIMALS FROM DREDGE.

SCHIZOPODA (Sars, Zool. pt. 37).

Eucopia australis, Dana. Obtained also at Stations 50, 73, 107, 146, 158, and 237.

Station 92

The Station-book records also :—A soft Holothurian, and a small Sternoptychid fish evidently from the surface.

Moseley writes : " In the swabs was a Holothurian with gelatinous test, resembling that of *Salpa* in appearance, and with curious simple-spoked wheels in the epidermis."

Organisms from the Surface.

Surface Organisms.—A flying fish (*Exocoetus nigricans*) came on board, but not many have been seen lately.

Stations 93 to 93c.

Station 93 to 93c (Sounding 157 to 160), off Cape Verde Islands (see Chart 11).

July 27, 1873.
Temperature of air at noon, 75°·8 ; mean for the day, 75°·7.
Temperature of water at surface, 75°·0.

At 6.30 A.M. got up steam, and at 9 A.M. proceeded under steam to sound. At 9.30 A.M. sounded in 1070 fathoms, deposit Volcanic Mud, containing 8·29 per cent. of carbonate of lime (Station 93). At 10.30 A.M. completed sounding, stopped engines, and made all plain sail. At 11.45 A.M. got up steam, and at 12.15 P.M. sounded in 1000 fathoms, deposit Volcanic Mud, containing 13·65 per cent. of carbonate of lime (Station 93A). At 2 P.M. stopped and sounded in 465 fathoms, deposit Volcanic Mud, containing 13·63 per cent. of carbonate of lime, bottom temperature 43°·5 (Station 93B). At 3 P.M. stopped and sounded in 52 fathoms, deposit Coralline Sand, containing 94·20 per cent. of carbonate of lime (Station 93c). At 3.15 P.M. proceeded, at 4 P.M. passed Bird Island, and at 4.15 P.M. stopped and anchored in 7 fathoms. The four soundings taken to-day are in a line from the middle of the entrance of the channel between San Antonio and St. Vincent Islands, up to near Bird Island at the entrance to Porto Grande.

Organisms from the Deposit.

DIATOMACEÆ.—The following species of Diatoms were observed by Mr. Comber in the deposit from Station 93A, 1000 fathoms :—

Amphora proteus, Gregory.
,, *grundleri*, A. Schmidt.
,, *crassa*, Gregory.
Navicula kennedyii, W. Smith.
,, *clavata*, Gregory.
,, *lyra*, Ehrenberg.
,, *prætexta*, Ehrenberg, and var.
,, *bullata*, Norman.
,, *directa*, Ralfs.
,, *marginata*, Lewis.
,, *smithii*, Brebisson.
Navicula fusca, Ralfs.
,, *didyma*, Kutzing.
,, *interrupta*, Kutzing.
,, *multicostata*, Grunow.
,, *incurvata*, Gregory.
,, *bomboides*, A. Schmidt.
,, *cincta*, Kutzing.
,, *aspera*, Ehrenberg.
Pleurosigma directum, Grunow.
Cocconeis pseudomarginata, Gregory.
Nitzschia marina, Grunow.

STATION 93A.

Nitzschia panduriformis, Gregory.
Surirella lata, W. Smith.
„ *laxa*, Janisch.
„ *fastuosa*, Ehrenberg.
Campylodiscus horologium, Williamson.
Glyphodesmis williamsonii, Grunow.
Grammatophora marina, Kutzing.
„ *macilenta*, W. Smith.
Synedra superba, Kutzing.
Biddulphia pulchella, Gray.
„ *tuomeyii*, Roper.
„ sp. (?).
Cerataulus turgidus, Ehrenberg.
Triceratium atlanticum, Castracane.
„ *antidiluvianum*, van Heurck.
„ *sculptum*, Shadbolt.
„ *arcticum*, Brightwell.
„ sp. (?), forma *hexagona*.
Hemidiscus cuneiformis, Wallich.
Auliscus punctatus, Bailey.
„ *pruinosus*, Bailey.
„ sp. (?).
Pseudauliscus peruvianus, Rattray.
Eupodiscus radiatus, Bailey.
Stictodiscus californicus, Greville.
„ „ var. *nankoorensis*, Grunow.
Aulacodiscus petersii, Ehrenberg.
„ *amœnus*, Greville.
„ *kilkellyanus*, Greville.
Coscinodiscus lineatus, Ehrenberg.
„ *excentricus*, Ehrenberg.
„ *curvatulus*, Grunow.
„ *concavus*, Gregory.
„ *nitidus*, Gregory.
„ *concinnus*, W. Smith.
„ *nodulifer*, Janisch.
„ *radiatus*, Ehrenberg.
„ *oculus-iridis*, Ehrenberg.
„ *elegans*, Greville.
Ethmodiscus sp. (?).
Paralia sulcata, Cleve.
Actinoptychus splendens, Ralfs.
„ *undulatus*, Ehrenberg.
Asteromphalus roperianus, Ralfs.
„ *arachne*, Ralfs.
Melosira granulata, Ralfs.

AT ST. VINCENT, CAPE VERDES.

The Challenger remained at St. Vincent from 4.15 P.M. on July 27 till 10.15 A.M. on August 5. During this time dredgings were conducted by Mr. Murray from the steam pinnace in the harbour, in depths of from 7 to 30 fathoms; the deposit was a Calcareous Sand containing 89·47 per cent. of carbonate of lime.

Stations 93D to 94 (Soundings 161 to 165), off Cape Verde Islands (see Chart 11).

STATIONS 93D TO 94.

August 5, 1873.
Temperature of air at noon, 81°·3; mean for the day, 78°·3.
Temperature of water at surface, 78°·0.

At 9.30 A.M. got up steam. At 9.45 A.M. shortened cable, and at 10.15 A.M. weighed anchor, and proceeded under steam to the westward of Bird Island. At 10.50 A.M. stopped outside Bird Island, and put over current drag. Steamed as required to follow current drag. At noon, picked up current drag. At 1.25 P.M. stopped to obtain sketch of entrance to St. Vincent Harbour. Sounded in 103 fathoms, deposit Coralline Mud (Station 93D). At 2 P.M. proceeded. At 3.15 P.M. sounded in 85 fathoms, deposit Coralline Mud (Station 93E). At 4 P.M. stopped and sounded in 260 fathoms, deposit Volcanic Mud, containing 56·59 per cent. of carbonate of lime (Station 93F). At 5 P.M. stopped and sounded in 675 fathoms, deposit Volcanic Mud, containing 39·25 per cent.

STATIONS 93D TO 94.

of carbonate of lime (Station 93G). At 6.35 P.M. stopped and sounded in 1150 fathoms, deposit Volcanic Mud, containing 47·52 per cent. of carbonate of lime (Station 94). At 7.25 P.M. made all plain sail, and proceeded towards Porto Praya, St. Iago.

ORGANISMS FROM THE SURFACE.

Surface Organisms.—Willemoes-Suhm writes: "At night a great many small specimens of *Pyrosoma* were in the water, and some were taken in the tow-net. Also, an *Acridium* came on board."

AT ST. IAGO, CAPE VERDES.

The Challenger remained at St. Iago from 7.30 A.M. on August 7 till 8.30 P.M. on August 9, during which time the steam pinnace dredged and trawled with tangles on the Red Coral ground, in 80 to 100 fathoms.

CAPE VERDES.

The expedition visited the Cape Verde Islands on the outward voyage from July 27 till August 9, 1873, and on the homeward voyage from April 16 till April 26, 1876 (for description of the islands, see *Narr. Chall. Exp.*, vol. i. pp. 183–191). On both visits, Mr. Murray conducted dredgings from the steam pinnace in the harbour of St. Vincent in depths of 7 to 50 fathoms. The deposit was a Calcareous Sand, containing 87 to 94 per cent. of carbonate of lime, chiefly made up of Foraminifera and Calcareous Algæ. In some places the shells of *Amphistegina lessonii* made up fully two-thirds of the whole deposit. *Polystomella*, *Discorbina*, and *Orbiculina* were also abundant. The deposits around the islands from 200 fathoms down to 1150 fathoms were Volcanic Sands and Muds, containing from 13 to 50 per cent. of carbonate of lime, in which Pteropod and Heteropod shells were abundant. The following species are recorded in the Zoological Reports as having been obtained in the vicinity:—

ANIMALS FROM CAPE VERDES.

MONAXONIDA (Ridley and Dendy, Zool. pt. 59).

Reniera tufa, n.sp. Two pieces (Porto Praya, 100 to 128 fathoms); obtained at no other locality.

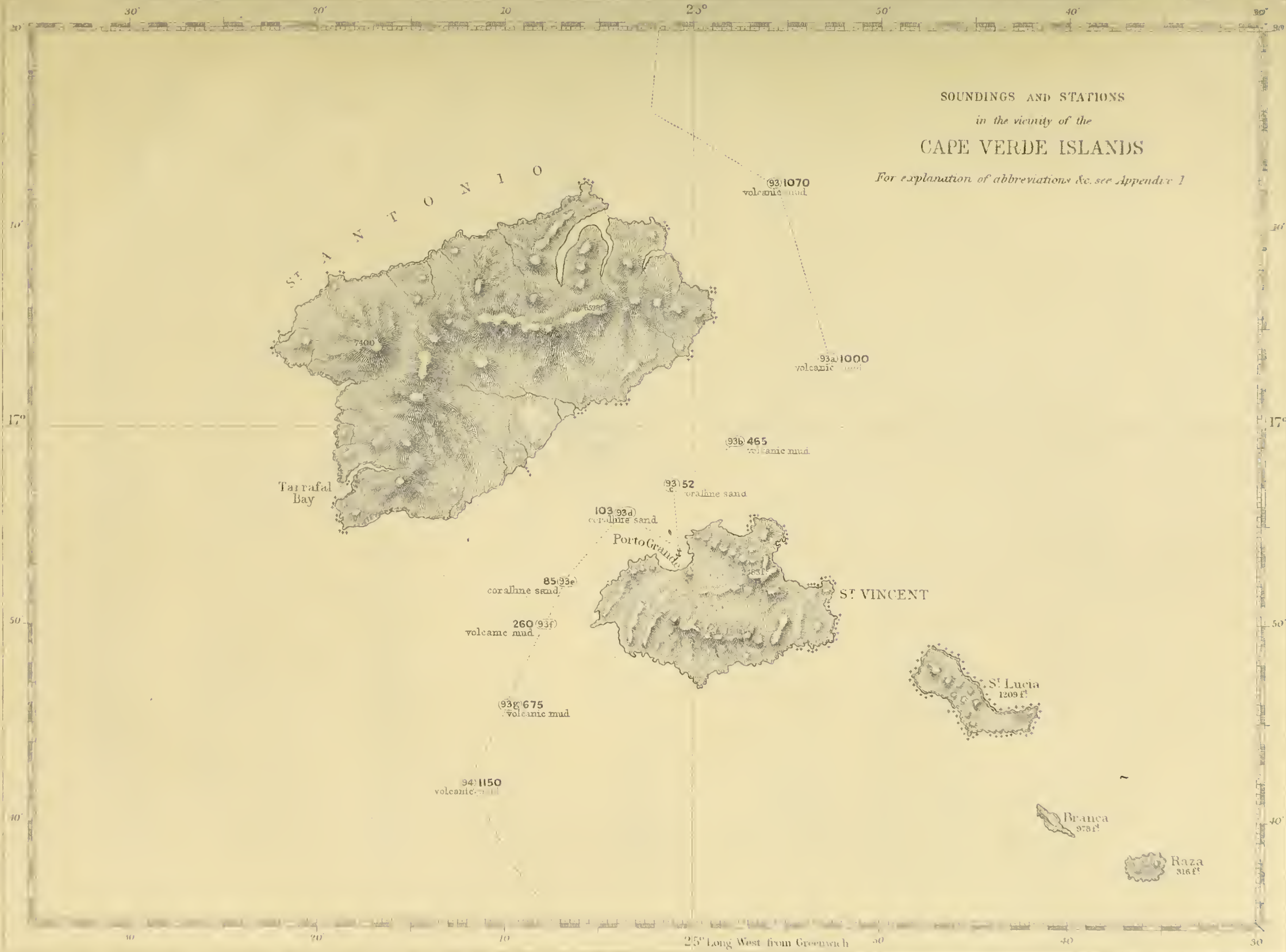
Hymeniacidon caruncula, Bowerbank. Two specimens (St. Vincent, shallow water); obtained at no other locality by the Challenger. Recorded from British Islands and Port Jackson.

Axinella monticularis, n.sp. Four specimens (St. Vincent, shallow water, and Harbour, 7 to 20 fathoms); obtained at no other locality.

,, (?) *lunæcharta*, n.sp. Three specimens (St. Vincent, shallow water, and Harbour, 7 to 20 fathoms); obtained at no other locality.

TETRACTINELLIDA (Sollas, Zool. pt. 63).

Pœcillastra crassiuscula, n.sp. One specimen (Porto Praya, 100 to 128 fathoms); obtained at no other locality.



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Sphinctrella cribrifera, n.sp. Several specimens (Porto Praya, 100 to 128 fathoms); obtained at no other locality. CAPE VERDES.

,, *gracilis*, n.sp. One specimen (Porto Praya, 100 to 128 fathoms); obtained at no other locality.

,, *ornatus*, n.sp. One specimen (Porto Praya, 100 to 128 fathoms); obtained at no other locality.

Calthropella simplex, n.g., n.sp. One specimen (Porto Praya); obtained at no other locality. Only species of the genus.

Corallistes masoni (Bowerbank). Several specimens (Porto Praya, 100 to 128 fathoms); obtained at no other locality by the Challenger. Recorded from Madeira.

Azorica pfeifferæ, Carter. One specimen (Porto Praya, 100 to 128 fathoms); obtained also at Stations 33, 56, Bahia, and Amboina.

Astropeplus pulcher, n.g., n.sp. One specimen (Porto Praya); obtained at no other locality. Only species of the genus.

HEXACTINELLIDA (Schulze, Zool. pt. 53).

Sympagella nux, Schmidt. One specimen (St. Iago, 100 to 128 fathoms); obtained at no other locality by the Challenger. Recorded from Florida and coasts of Spain and Portugal.

CALCAREA (Poléjaeff, Zool. pt. 24).

Grantia tuberosa, n.sp. One specimen and fragments (off St. Vincent); obtained at no other locality.

ALCYONARIA (Wright and Studer, Zool. pt. 64).

Corallium rubrum, Lamarck. (St. Vincent and St. Iago, 80 to 120 fathoms); obtained at no other locality by the Challenger. Recorded from Mediterranean.

ACTINIARIA (Hertwig, Zool. pts. 15 and 73).

Calliactis polypus (Forskål). Six specimens on Gasteropod shell (St. Vincent); obtained also at Station 208, 18 fathoms.

Halcampella sp. (?). One damaged specimen (St. Vincent, shallow water).

CORALS (Moseley, Zool. pt. 7).

Caryophyllia profunda, n.sp. (?). Fragment (St. Iago, 100 to 120 fathoms); obtained also at Station 135, 100 to 150 fathoms.

CAPE VERDES.

Madracis asperula, M.-Edwards and Haime. (St. Vincent, shallow water); obtained also at Station 36 and Fernando Noronha.

Dendrophyllia cornigera, Blainville. One specimen (St. Iago, 100 to 120 fathoms); obtained also at Station 190, 49 fathoms.

REEF CORALS (Quelch, Zool. pt. 46).

Astræa fragum (Esper). Many specimens (St. Vincent, shore); obtained at no other locality by the Challenger. Recorded from West Indies.

Porites guadaloupensis, Duchassaing and Michelotti. Several specimens (St. Vincent, rock-pools); obtained at no other locality by the Challenger.

,, *superficialis*, Duchassaing and Michelotti. One specimen (St. Vincent, rock-pools); obtained at no other locality by the Challenger.

HYDROIDA (Allman, Zool. pt. 20).

Streptocaulus pulcherrimus, n.g., n.sp. (Porto Praya, 100 fathoms); obtained at no other locality. Only species of the genus.

ASTEROIDEA (Sladen, Zool. pt. 51).

Pontaster venustus, n.g., n.sp., var. *robusta*, nov. One specimen (Cape Verdes); the species obtained also at Stations 76 and 79.

Psilaster cassiope, n.g., n.sp. (Cape Verdes); obtained at no other locality.

,, *patagiatus*, n.g., n.sp. (Cape Verdes); obtained at no other locality.

Pentagonaster semilunatus, Linck. One specimen (Cape Verdes); obtained at no other locality by the Challenger. A widely-distributed species.

Nymphaster albidus, n.g., n.sp. (Cape Verdes); obtained at no other locality.

Pentaceros dorsatus (Linné), Perrier. Several specimens (Porto Praya); obtained at no other locality by the Challenger. Recorded from Cape Verdes.

Linckia guildingii, Gray. (Porto Praya); obtained at no other locality by the Challenger. Recorded from Bermuda, West Indies, and Bahia.

Narcissia canariensis (d'Orbigny). One specimen (St. Vincent); obtained at no other locality by the Challenger. Recorded from Canaries.

Asterias (*Stolasterias*) *glacialis*, Müller. (St. Vincent); obtained at no other locality by the Challenger. Recorded from Arctic, North Atlantic, and Mediterranean.

OPHIUROIDEA (Lyman, Zool. pt. 14). CAPE VERDES.

Amphiura josephinæ, Ljungman (?). (St. Vincent); obtained at no other locality by the Challenger.

Ophiostigma africanum, n.sp. (St. Vincent); obtained at no other locality.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Cidaris tribuloides (Lamarck). (St. Vincent, 15 to 20 fathoms); obtained also at Fernando Noronha and Bahia.

Arbacia pustulosa (Leske). (St. Vincent); obtained at no other locality by the Challenger.

Diadema setosum, Gray. (St. Vincent); obtained also at St. Thomas, Philippines, and Tahiti.

Echinometra subangularis (Leske). (St. Vincent); obtained also at Ascension.

Sphærechinus granularis (Lamarck). (St. Vincent); obtained also at Station 75.

NEMERTEA (Hubrecht, Zool. pt. 54).

Eupolia delineata (delle Chiaje). One specimen (St. Vincent); obtained at no other locality by the Challenger. Recorded from Mediterranean.

Drepanophorus rubrostriatus, Hubrecht. One specimen (St. Vincent); obtained at no other locality by the Challenger. Recorded from Mediterranean and Madeira.

GEPHYREA (Selenka, Zool. pt. 36).

Aspidosiphon speculator, n.sp. Three specimens (St. Vincent, shallow water); obtained at no other locality.

ANNELIDA (M'Intosh, Zool. pt. 34).

Hermodice carunculata, Pallas. Two specimens (St. Vincent); obtained also at St. Thomas and Bermuda.

Hermione hystrix (Savigny). Two specimens (St. Vincent); obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean.

Lagisca tenuisetis, n.sp. One specimen (St. Vincent); obtained at no other locality.

„ *peracuta*, n.sp. Several specimens (St. Vincent); obtained at no other locality.

Phyllodoce (*Anaitis*?) *sancti-vincentis*, n.sp. One specimen (St. Vincent); obtained at no other locality.

Hesione (*Fallacia*) *pantherina*, Risso. One specimen (St. Vincent); obtained at no other locality by the Challenger.

CAPE VERDES.

Nereis atlantica, n.sp. One specimen (St. Vincent); obtained at no other locality.
,, (*Platynereis*) *dumerilii*, Audouin and M.-Edwards, var. Two specimens (St. Vincent); obtained at no other locality by the Challenger. Recorded from North Atlantic.
Nematonereis sp. (?). One specimen (St. Vincent, probably from shore).
Eunice torquata, Quatrefages (?). One specimen (St. Vincent, probably from shore); obtained at no other locality by the Challenger. A widely-distributed species.
Notomastus agassizii, n.sp. One specimen (from sounding-line, off San Antonio); obtained also at Station 47.
Sabellaria (*Pallasia*) *johnstoni*, n.sp. (St. Vincent, littoral region); obtained at no other locality.
Loimia savignyi, n.sp. Two specimens (St. Vincent); obtained at no other locality.
Laonome haeckelii, n.sp. One specimen (St. Vincent); obtained at no other locality.

OSTRACODA (Brady, Zool. pt. 3).

Bairdia foveolata, Brady. (Off St. Vincent, 1070 to 1150 fathoms); for distribution see Station 33.
,, *milne-edwardsi*, Brady. (Off St. Vincent, 1070 to 1150 fathoms); obtained at no other locality by the Challenger. Recorded from St. Vincent.
,, *acanthigera*, Brady. (Off St. Vincent, 1070 to 1150 fathoms); obtained at no other locality by the Challenger. Recorded from English Channel.
Cythere speyeri, Brady. (Off St. Vincent, 1070 to 1150 fathoms); obtained also at Station 344, 420 fathoms. Recorded from Tenedos, Colon, New Providence, and St. Vincent.
Loxoconcha africana, n.sp. (Off St. Vincent, 1070 to 1150 fathoms); obtained at no other locality.
Xestoleberis variegata, n.sp. (Off St. Vincent, 1070 to 1150 fathoms); obtained also at Station 172, 18 fathoms.

COPEPODA (Brady, Zool. pt. 23).

Lepeophtheirus suhmi, n.sp. (St. Vincent, parasitic on *Scarus*); obtained at no other locality.
Pandarus zygænæ, n.sp. (St. Vincent, parasitic on *Zygæna malleus*); obtained at no other locality.

Alebion carchariæ, Krøyer. (St. Vincent, parasitic on *Zygæna malleus*); obtained at no other locality by the Challenger. CAPE VERDES.

Lernæa hemiramphi, Krøyer (?). (St. Vincent, parasitic on Cavalli); obtained at no other locality by the Challenger.

CIRRIPEDIA (Hoek, Zool. pt. 25).

Lepas hillii (Leach). Two young specimens (taken from screw at St. Vincent); obtained also from screw near Station 269.

Conchoderma virgatum (Spengler). Two specimens (taken from screw at St. Vincent); obtained at no other locality by the Challenger.

Balanus tintinnabulum (Linné), var. *communis*, Darwin. Two specimens (St. Vincent Harbour, 7 to 20 fathoms).

,, ,, ,, var. *spinosus*, Gmelin. Four specimens (from screw). The species obtained at no other locality by the Challenger.

Chthamalus dentatus, Krauss. Several specimens (St. Vincent Harbour, 7 to 20 fathoms—on *Balanus tintinnabulum*); obtained at no other locality by the Challenger.

STOMATOPODA (Brooks, Zool. pt. 45).

Protosquilla elongata n.g., n.sp. One specimen (St. Vincent); obtained at no other locality.

MACRURA (Spence Bate, Zool. pt. 52).

Ibaccus verdi, n.sp. (St. Vincent, 7 to 20 fathoms); obtained also at Station 200, 250 fathoms.

Arctus immaturus, n.sp. One specimen (off Cape Verdes); obtained also at Station VIIP.

Sicyonia sculpta, M.-Edwards. One specimen (off St. Vincent); obtained at no other locality by the Challenger. Recorded from Mediterranean.

Athanas veloculus, n.sp. Two specimens (Cape Verdes); obtained at no other locality.

Alpheus edwardsii (Audouin). Several specimens (off St. Vincent, 52 fathoms?); obtained at no other locality by the Challenger. Recorded from Europe and Red Sea.

,, *cristidigitus*, n.sp. Nineteen specimens (St. Vincent, 52 fathoms?); obtained at no other locality.

Atya sulcatipes, Newport. (San Antonio, fresh water); obtained at no other locality by the Challenger. Recorded from Cape Verdes.

Cape Verdes.

Atya serrata, n.sp. Two specimens (San Antonio, fresh water); obtained at no other locality.

Caridina typus, M.-Edwards. One specimen (San Antonio, fresh water); obtained at no other locality by the Challenger.

Anomura (Henderson, Zool. pt. 69).

Remipes scutellatus (Fabricius). Many specimens (St. Vincent); obtained also at Bermuda.

Pagurus calidus, Risso. Three specimens (St. Vincent); obtained also at Station VIIp.

Eupagurus excavatus (Herbst), var. *meticulosa*, Roux (?). One specimen (St. Vincent Harbour, 7 to 20 fathoms); obtained also at Madeira (?).

Pachycheles barbatus, M.-Edwards. One specimen (St. Vincent); obtained at no other locality by the Challenger. Recorded from Cape Verdes.

Galathea sp. (?). (St. Vincent); obtained also at Station 75.

Brachyura (Miers, Zool. pt. 49).

Leptopodia sagittaria (Fabricius). Several specimens (St. Vincent); obtained also at Station 122, Bahia, and Madeira.

Acanthonyx lunulatus (Risso). One specimen (St. Vincent); obtained at no other locality by the Challenger. Recorded from Madeira.

Herbstia rubra, M.-Edwards. One specimen (St. Vincent); obtained at no other locality by the Challenger. Recorded from Cape Verdes.

,, *violacea* (M.-Edwards). One specimen (St. Vincent); obtained at no other locality by the Challenger. Recorded from East Atlantic.

,, *ovata* (Stimpson). Several specimens (St. Vincent); obtained at no other locality by the Challenger. Recorded from Cape Verdes.

Lambrus (*Parthenolambrus*) *massena*, Roux. One specimen (St. Vincent); obtained also at Station 75.

,, (,,) *massena*, var. *atlanticus*, nov. Two specimens (St. Vincent); obtained at no other locality.

Xanthodes melanodactylus, M.-Edwards. Many specimens (St. Vincent); obtained also at Station 75 and Canaries.

Leptodius punctatus, Miers. Many specimens (St. Vincent); obtained at no other locality by the Challenger. Recorded from Senegambia.

Pilumnus africanus, M.-Edwards. Two specimens (St. Vincent); obtained at no other locality by the Challenger. Recorded from West Africa.

Portunus corrugatus (Pennant). One specimen (St. Vincent); obtained also at Stations 75, 161, and 162. CAPE VERDES.

Cardiosoma armatum, Herklots. One specimen (Porto Praya); obtained at no other locality by the Challenger. Recorded from West Africa.

Ocypoda cursor (Linné). Many specimens (St. Vincent and St. Iago); obtained at no other locality by the Challenger. A widely-distributed species.

Grapsus maculatus (Catesby). Four specimens (St. Vincent); obtained also at Bermuda, St. Paul's Rocks, Fernando Noronha, and Ascension.

Pachygrapsus transversus, Gibbes. Five specimens (St. Vincent); obtained also at Bermuda and Port Jackson.

Plagusia depressa (Fabricius). One specimen (St. Vincent); obtained at no other locality by the Challenger. A widely-distributed species.

Calappa gallus (Herbst). One specimen (St. Vincent); obtained also at Bermuda, Fernando Noronha, and Amboina.

Cryptosoma cristatum (Leach). Five specimens (St. Vincent); obtained at no other locality by the Challenger.

Cymopolia caronii, Roux. One specimen (St. Vincent); obtained at no other locality by the Challenger. Recorded from Mediterranean and Canaries.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Gastrochæna dubia (Pennant). One specimen (St. Vincent Harbour); obtained also at Canaries.

Psammobia intermedia, Deshayes. Several specimens (St. Vincent, 7 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from coast of Portugal.

Venus (*Anaitis*) *paphia*, Linné, var. (St. Vincent, 7 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from Cape Verdes.

Cardium (*Lævicardium*) *norvegicum*, Spengler, var. Several specimens (St. Vincent, 7 to 20 fathoms); obtained at no other locality by the Challenger.

Lucina columbella, Lamarck. One specimen (St. Vincent, 7 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from Canaries and Senegal.

Pectunculus formosus, Reeve. Several specimens (St. Vincent, 7 to 20 fathoms); obtained at no other locality by the Challenger.

Cape Verdes.

Arca (*Acar*) *domingensis*, Lamarck. (St. Vincent, 30 fathoms); obtained also at Station 36.

Pecten corallinoides, d'Orbigny. (St. Vincent, 7 to 20 fathoms); obtained also at Canaries.

Gasteropoda (Watson, Zool. pt. 42).

Pyrula morio (Linné). (St. Vincent Harbour, 7 to 25 fathoms); obtained at no other locality by the Challenger. Recorded from Atlantic.

Pisania (*Cantharus*) *lineata* (Gmelin). (St. Vincent Harbour, 7 to 25 fathoms); obtained at no other locality by the Challenger. Recorded from Atlantic.

Columbella rustica (Linné). (St. Vincent Harbour, 7 to 25 fathoms); obtained also at Station VIIp.

Triton nodifer, Lamarck. (St. Vincent Harbour); obtained at no other locality by the Challenger. A widely-distributed species.

Natica (*Mamma*) *porcellana*, d'Orbigny. (St. Vincent Harbour, 7 to 25 fathoms); obtained also at Station VIIp.

Crepidula fornicata (Linné). (St. Vincent Harbour, 7 to 25 fathoms); obtained at no other locality by the Challenger. Recorded from Atlantic.

Litorina punctata, Gmelin. (St. Vincent Harbour, 7 to 25 fathoms).

Philine aperta (Linné). (St. Vincent Harbour, 7 to 25 fathoms); obtained also at Station VIIp.

Umbrella mediterranea, Lamarck. (St. Vincent Harbour, 7 to 25 fathoms); obtained at no other locality by the Challenger. Recorded from Mediterranean and Madeira.

Lamellaria sp. (?). (St. Vincent Harbour, 7 to 25 fathoms).

Marseniadæ (Bergh, Zool. pt. 41).

Marsenia dubia, n.sp. One specimen (near St. Vincent); obtained at no other locality.

Cephalopoda (Hoyle, Zool. pt. 44).

Octopus granulatus, Lamarck. One specimen (St. Vincent, 15 to 20 fathoms); obtained also at Simon's Bay, Cape. A widely-distributed species.

Polyzoa (Busk, Zool. pts. 30 and 50; Waters, pt. 79).

Scrupocellaria macandrei, Busk. (St. Vincent, 1070 to 1150 fathoms); obtained also at St. Paul's Rocks. Recorded from coast of Spain.

Diachoris hirtissima, Heller. (St. Vincent, 10 fathoms); obtained at no other locality by the Challenger. Recorded from Adriatic. CAPE VERDES.

Retepora imperati, Busk. (Porto Praya, 100 to 120 fathoms); obtained also at Station 75. [Waters calls it *Retepora tesselata*, Hincks, var. *imperati*, Busk.]

Porella lævis, var. *subcompressa*, Hincks. (Porto Praya, 100 to 150 fathoms); obtained at no other locality by the Challenger. Recorded from northern seas.

Smittia jacobensis, n.sp. (Porto Praya, 100 to 120 fathoms); obtained also at Station 145, 50 to 75 fathoms.

Cupularia owenii (Gray). (St. Vincent, 11 fathoms); obtained at no other locality by the Challenger. Recorded from African coast and Canaries.

Crisia conferta, Busk. (St. Vincent, 10 fathoms); obtained also at Station 163, 150 fathoms. Recorded from Cape Verdes.

Hornera frondiculata, Lamouroux. (Porto Praya, 100 to 120 fathoms); obtained at no other locality by the Challenger. Recorded from Mediterranean. Fossil—Crag and Upper Tertiaries of Sicily, &c.

TUNICATA (Herdman, Zool. pt. 38).

Leptoclinum albidum, Verrill (?). Two colonies (St. Iago, 10 to 125 fathoms); obtained also at Station 209, 95 fathoms (var. *grande*, nov.), and Simon's Bay, Cape. Recorded from America.

FISHES (Günther, Zool. pt. 6).

Scorpæna scrofa, Linné. (St Vincent); obtained at no other locality by the Challenger.

Rhypticus saponaceus, Bl. Schn. (St. Vincent); obtained at no other locality by the Challenger.

Dactylopterus volitans, Linné. (St. Vincent); obtained at no other locality by the Challenger.

Lichia glauca, Linné. (St. Iago); obtained also at Ascension.

Caranx crumenophthalmus, Bl. (St. Iago); obtained also at Admiralty and Sandwich Islands.

Argyriosus setipinnis, Mitch. (Porto Praya); obtained at no other locality by the Challenger.

Galeoides polydactylus, Vahl. (St. Iago); obtained at no other locality by the Challenger.

Sphyræna vulgaris, C.V. (St. Iago); obtained at no other locality by the Challenger.

Mugil cephalus, Cuv. (St. Iago); obtained at no other locality by the Challenger.

Cape Verde.

Blennius sanguinolentus, Pall. (St. Vincent); obtained at no other locality by the Challenger.

Lepadogaster gouani, Barnev. (St. Vincent); obtained at no other locality by the Challenger.

Scarus chrysopterus, Bl. (St. Vincent); obtained at no other locality by the Challenger.

Rhomboidichthys podas, de la Roche. (St. Vincent); obtained at no other locality by the Challenger.

Hemirhamphus vittatus, Val. (St. Iago); obtained at no other locality by the Challenger.

Balistes forcipatus, Gm. (St. Vincent); obtained at no other locality by the Challenger.

Monacanthus setifer, Benn. (St. Vincent); obtained also at Japan.

In the foregoing list 151 species are enumerated, of which 38 are new to science, including representatives of 7 new genera; 31 of the new species and 3 new genera were not obtained elsewhere.

Organisms from Surface-Nets.

Surface Organisms.—The following species are recorded from the surface in the neighbourhood of the Cape Verde Islands:—

Ostracoda (Brady, Zool. pt. 3).

Halocypris brevirostris, Dana.

Copepoda (Brady, Zool. pt. 23).

Eucalanus setiger, n.sp.
Pleuromma abdominale (Lubbock).
Undina vulgaris, Dana.
Scolecithrix danæ (Lubbock).
Euchæta prestandreæ, Philippi.
Candace pectinata, Brady.
,, *pachydactyla*, Dana.
Temora dubia (Lubbock).
Pontella detruncata (Dana).
,, *acutifrons* (Dana).
,, *plumata* (Dana).
Corycæus pellucidus, Dana.
Oncæa obtusa (Dana).
Sapphirina ovalis, Dana.
,, *serrata*, n.sp.

Amphipoda (Stebbing, Zool. pt. 67).

Synopia schéeleana, Bovallius.
Gammaropsis atlantica, n.sp.
Dairella bovallii, n.sp.
Phronima megalodous, n.sp.
Hyperia schizogeneios, n.sp.
Brachyscelus mediterranea (Claus).
Lycæa vincentii, n.sp.

Stomatopoda (Brooks, Zool. pt. 45).

Alima gracilis, M.-Edwards [= larva of *Squilla*].

Macrura (Spence Bate, Zool. pt. 52).

Phyllosoma furcicaudatum, n.sp.
,, *verdense*, n.sp.
Sergestes edwardsii, Krøyer.
,, *dissimilis*, n.sp.
Diaphoropus longidorsalis, n.g., n.sp.

CAPE VERDES.

Oodeopus gibbosus, n.g., n.sp.
Hectarthropus tenuis, n.g., n.sp.
Eretmocaris stylorostris, n.g., n.sp.
,, *corniger*, n.g., n.sp.

NUDIBRANCHIATA (Bergh, Zool. pt. 26).
Phylliroë atlantica, Bergh.

PTEROPODA (Pelseneer, Zool. pts. 58 and 65).
Dexiobranchæa ciliata (Gegenbaur).
Limacina inflata (d'Orbigny).
,, *lesueuri* (d'Orbigny).
,, *bulimoides* (d'Orbigny)
Clio (*Creseis*) *virgula* (Rang).
,, (,,) *acicula* (Rang).

TUNICATA (Herdman, Zool. pt. 76).
Salpa cylindrica, Cuvier.
,, *runcinata-fusiformis*, Chamisso-Cuvier.
,, sp. (?).
Appendicularia sp. (?).

FISHES (Günther, Zool. pt. 78).
Scorpæna dactyloptera, de la Roche.
Young Pleuronectids.

STATION 95.

Station 95 (Sounding 166), St. Vincent to St. Paul's Rocks (see Chart 12 and Diagram 7).

August 10, 1873; lat. 13° 36′ N., long. 22° 49′ W.
Temperature of air at noon, 78°·0; mean for the day, 77°·2.
Temperature of water :—

	°		°
Surface,	79·0	800 fathoms,	39·7
10 fathoms	76·0	900 ,,	39·3
20 ,,	65·2	1000 ,,	38·9
100 ,,	52·5	1100 ,,	38·5
200 ,,	49·5	1200 ,,	38·1
300 ,,	46·4	1300 ,,	37·8
400 ,,	43·3	1400 ,,	37·6
500 ,,	41·1	1500 ,,	37·4
600 ,,	40·5	Bottom,	36·5
700 ,,	40·0		

Density at 60° F. at surface, 1·02680; bottom, 1·02605.
Depth, 2300 fathoms; deposit, Globigerina Ooze, containing 54·29 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 2 A.M. a meteor was observed bearing S.W., altitude 40′, deviation S.W. At 3.55 A.M. observed meteor bearing N.N.W. At 4 P.M. shortened and furled sails, and got up steam to sound. At 5 P.M. sounded in 2300 fathoms. Obtained a series of temperatures down to 1500 fathoms. Sent down water-bottle to obtain sample of water for analysis. At 6.50 P.M. completed temperatures, and at 7.20 P.M. made all plain sail.

STATION 95.

Distance at noon from St. Paul's Rocks, 870 miles. Made good 62 miles. Amount of current 7 miles, direction S. 27° W.

ORGANISMS FROM SURFACE.

Surface Organisms.—*Pyrosoma* abounded at the surface, as well as small Copepods.

STATION 96.

Station 96, St. Vincent to St. Paul's Rocks (see Chart 12).

August 11, 1873; lat. 12° 15′ N., long. 22° 28′ W.
Temperature of air at noon, 77°·8; mean for the day, 77°·1.
Temperature of water:—

	°		°
Surface,	78·7	175 fathoms,	49·8
10 fathoms,	70·5	200 „	49·1
20 „	62·8	250 „	47·5
25 „	60·2	300 „	45·9
50 „	54·2	350 „	44·4
75 „	53·0	400 „	42·9
100 „	52·2	450 „	41·4
125 „	51·4	500 „	39·9
150 „	50·6		

Density at 60° F.:—

Surface,	1·02651	100 fathoms,	1·02627
25 fathoms,	1·02655	200 „	1·02610
50 „	1·02630	300 „	1·02606

At 9.15 A.M. shortened and furled sails, and got up steam in three boilers. At 10.10 A.M. proceeded under steam. At 4.5 P.M. stopped to obtain a series of temperatures and specimens of water. At 5.40 P.M. made sail. After nightfall there was a magnificent display of phosphorescence, principally in the wake of the Challenger, caused by the presence of innumerable specimens of *Pyrosoma*, several of which were caught in a net, and when brought on deck continued to display a bright bluish light when touched by the fingers.

Distance at noon from St. Paul's Rocks, 801 miles. Made good 92 miles. Amount of current 16 miles, direction S. 37° W.

ORGANISMS FROM SURFACE NETS.

Surface Organisms.—Moseley writes: "At night the sea was full of specimens of *Pyrosoma* about 4 to 5 inches long. These are the cause of the large spots of persistent bluish light which I have so often watched going by the ship, and which contrast so strikingly with the momentary scintillations of the minute Crustacea, or

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sheets of light caused by *Noctiluca* [= *Pyrocystis*] or dead fish matter on the surface. When held in the hand, the specimens showed well the breaking out of light all over the body, from irritation, or rather considerable shock, as a blow from the finger, at one end ; the light shows first at the place struck." STATION 96.

Station 97 (Sounding 168), St. Vincent to St. Paul's Rocks (see Chart 12 and Diagram 7). STATION 97.

August 13, 1873 ; lat. 10° 25′ N., long. 20° 30′ W.
Temperature of air at noon, 81°·3 ; mean for the day, 78°·2.
Temperature of water :—

	°		°
Surface,	78·0	700 fathoms,	40·0
25 fathoms,	69·0	800 ,,	39·2
50 ,,	59·4	900 ,,	38·4
75 ,,	55·0	1000 ,,	38·0
100 ,,	53·2	1100 ,,	37·6
200 ,,	48·7	1200 ,,	37·2
300 ,,	45·0	1300 ,,	36·8
400 ,,	42·2	1400 ,,	36·7
500 ,,	40·5	1500 ,,	36·7
600 ,,	40·2	Bottom,	36·6

Density at 60° F. :—

Surface,	1·02610	300 fathoms,	1·02616
50 fathoms,	1·02633	Bottom,	1·02604
100 ,,	1·02625		

Depth, 2575 fathoms ; deposit, Globigerina Ooze, containing 30·15 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 9 A.M. shortened sails and stopped to sound. Sounded in 2575 fathoms. Took serial temperatures down to 1500 fathoms. Obtained sample of water from bottom for analysis. At 12.15 P.M. completed temperatures, and at 1.55 P.M. made all plain sail. In the evening the sea was remarkably phosphorescent.

Distance at noon from St. Paul's Rocks, 780 miles. Made good 102 miles. Amount of current 26 miles, direction S. 67° E.

Surface Organisms.—The following are recorded in the note-books :—*Pyrocystis*, *Squillerichthus*, Zoëæ, *Lucifer*, *Phylliroë atlantica* (brown with golden spots), *Pyrosoma*, and *Gonostoma* (?). ORGANISMS FROM SURFACE-NETS.

Station 97. Moseley writes: "At night the sea showed wonderful phosphorescence, being lighted up for miles around. Wherever the water broke a little on the surface, the white foam was brilliantly lighted up, and the water close to the ship, as viewed from above on the bridge, was full of small luminous points. As the water broke at the ship's side the lower studding sails were quite lighted up by the glow. The whole sea had a peculiar weird look. The water was found to be full of small Crustacea, larval crabs in the megalopus-stage being present in by far the greatest abundance, and the light must evidently be considered as due to them in part, but mostly to *Pyrocystis* [at first thought to be fish spawn, afterwards looked upon as an encysted form of *Noctiluca*], the specimens of which were of various sizes and showed phosphorescence when first caught and placed in a globe of water. The spectroscope used on the light under the stern allowed a very small portion of red, all the yellow, and a certain amount of green, to be seen, but the light was not strong enough to allow of exact determination."

Station 98. **Station 98** (Sounding 169), St. Vincent to St. Paul's Rocks (see Chart 12 and Diagram 7).

August 14, 1873; lat. 9° 21′ N., long. 18° 28′ W.

Temperature of air at noon, 79°·8; mean for the day, 77°·7.

Temperature of water:—

Surface,	78·2°	150 fathoms,	52·0°
20 fathoms,	66·5	200 "	49·7
50 "	59·3	300 "	45·2
75 "	55·5	400 "	42·0
100 "	54·2	500 "	41·2
125 "	53·1	Bottom,	36·7

Density at 60° F. at surface, 1·02605; bottom, 1·02605.

Depth, 1750 fathoms; deposit, Globigerina Ooze, containing 62·22 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 10 A.M. shortened and furled sails, and got up steam to sound. Sounded in 1750 fathoms, having approached the west coast of Africa, in order to make a haul with the dredge in shallower water. Took serial temperatures down to 500 fathoms. At 12.15 P.M. put over dredge, and veered 2500 fathoms. At 4 P.M. commenced heaving in the dredge, which came up at 5.15 P.M. containing a few specimens. At 5.40 P.M. made sail. In the evening there was a similar display of phosphorescence as on previous days.

Distance at noon in direct line from St. Paul's Rocks, 825 miles. Made good 136 miles. Amount of current 13 miles, direction S. 32° E.

The following species are recorded in the Zoological Reports from the dredge at this Station:— Station 98. Animals from Dredge.

Lamellibranchiata (Smith, Zool. pt. 35).

Neæra filocarinata, n.sp. Obtained at no other locality.
Semele (*Abra*) *profundorum*, n.sp. Obtained also at Stations 73, 85, and 244.

Fragments of Sponge and of *Echinus* are recorded also in the Station-book.

The following species of Foraminifera and Diatoms were observed in the deposit from this Station (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.):— Organisms from the Deposit.

Foraminifera (Brady, Zool. pt. 22).—The pelagic species, which make up about 88 per cent. of the carbonate of lime present in the deposit, are marked thus ×:—

Biloculina depressa, d'Orbigny.
„ „ var. *serrata* Brady.
Pelosina cylindrica, Brady.
Hyperammina elongata, Brady.
„ *ramosa*, Brady.
Rhabdammina abyssorum, Sars.
Aschemonella catenata (Norman).
Reophax distans, Brady.
„ *nodulosa*, Brady.
„ *pilulifera*, Brady.
„ *scorpiurus*, Montfort.
Haplophragmium globigeriniforme (Parker and Jones).
„ *latidorsatum* (Bornemann).
Thurammina papillata, Brady.
Hormosina carpenteri, Brady.
„ *globulifera*, Brady.
Ammodiscus charoides (Jones and Parker).
Trochammina ringens, Brady.
Webbina clavata, Jones and Parker.
Verneuilina propinqua, Brady.
Gaudryina pupoides, d'Orbigny.
Virgulina squamosa, d'Orbigny.
Cassidulina crassa, d'Orbigny.
Lagena hispida, Reuss.
„ *longispina*, Brady.
Lagena marginata (Walker and Boys).
„ „ var. *semimarginata*, Reuss.
„ *seminiformis*, Schwager.
Nodosaria mucronata (Neugeboren).
„ *obliqua* (Linné).
Marginulina glabra, d'Orbigny.
Uvigerina asperula, Czjzek.
× *Globigerina bulloides*, d'Orbigny.
× „ *conglobata*, Brady.
× „ *dubia*, Egger.
× „ *rubra*, d'Orbigny.
× „ *sacculifera*, Brady.
× *Orbulina universa*, d'Orbigny.
× *Pullenia obliquiloculata*, Parker and Jones.
Sphæroidina bulloides, d'Orbigny.
× „ *dehiscens*, Parker and Jones.
Truncatulina ungeriana (d'Orbigny).
„ *wuellerstorfi* (Schwager).
× *Pulvinulina crassa* (d'Orbigny).
× „ *menardii* (d'Orbigny).
× „ „ var. *fimbriata*, Brady.
„ *partschiana* (d'Orbigny).
„ *pauperata*, Parker and Jones.
× „ *tumida*, Brady.
Rotalia soldanii, d'Orbigny.
Amphistegina lessonii, d'Orbigny.

Diatomaceæ.—The following species of Diatoms were observed by Mr. Comber:—

Nitzschia marina, Grunow.
Coscinodiscus excentricus, Ehrenberg.
„ *lineatus*, Ehrenberg.
„ *curvatulus*, Grunow.
„ *nodulifer*, Janisch.
Coscinodiscus radiatus, Ehrenberg.
Stephanopyxis turris, Ralfs.
Cyclotella striata, Grunow.
Hemidiscus cuneiformis, Wallich.
Asteromphalus arachne, Ralfs.

Station 98. Organisms from Surface-Net.

Surface Organisms.—The following species are recorded from the surface at this Station :—

PELAGIC HEMIPTERA (White, Zool. pt. 19).

Halobates wüllerstorffi, Frauenfeld.

FISHES (Günther, Zool. pt. 78).

Exocoetus obtusirostris, Günther, or *Exocoetus evolans*, Linné (young).

Besides the organisms mentioned yesterday, the following are recorded in the note-books :—*Diphyes*, *Sagitta*, *Planaria*, *Mysis*, *Phyllosoma*, *Halobates*, *Pneumonoderma*-like Pteropod, *Cranchia*, *Salpa*, and young Pleuronectids.

Willemoes-Suhm writes : "At night the sea was very phosphorescent, and as the ship was making only 3 or 4 knots several good hauls of the tow-net were obtained. At 12.30 A.M. a great many animals were in the net, but an hour later very little was procured ; a squall was expected, and the sea might have been somewhat rougher, but not much. Several Pleuronectids in different stages of growth, the largest an inch, smaller ones 12 to 13 mm. in length, were obtained ; they were perfectly symmetrical and homocercal, and the largest specimen had some reddish spots, but genitals were not observed. There was a large *Phyllosoma* measuring $4\frac{1}{2}$ inches between the tips of the legs."

Moseley writes : "Two large porpoise-like Cetacea were seen alongside. A pelagic Cephalopod, apparently of the genus *Cranchia*, was taken ; it was perfectly transparent, which allowed the structure and movements of organs to be seen."

Station 99.

Station 99 (Sounding 170), St. Vincent to St. Paul's Rocks (see Chart 12).

August 15, 1873 ; lat. 7° 53′ N., long. 17° 26′ W.

Temperature of air at noon, 76°·3 ; mean for the day, 76°·1.

Temperature of water :—

	°		°
Surface,	78·0	300 fathoms,	45·8
50 fathoms,	63·2	400 ,,	42·2
100 ,,	56·2	500 ,,	41·4
200 ,,	49·8		

Density at 60° F. at surface, 1·02600.

At 9 A.M. got up steam, and at 10 A.M. shortened and furled sails, and proceeded under steam. At 4 P.M. stopped to take a series of temperatures down to 500 fathoms. At 5.15 P.M. completed temperature observations, and made sail. Sea phosphorescent.

Distance at noon from St. Paul's Rocks, 816 miles. Made good 62 miles. Amount of current 27 miles, direction S. 45° E. STATION 99.

Surface Organisms.—The following species is recorded from the surface at this Station:— ORGANISMS FROM SURFACE-NETS.

COPEPODA (Brady, Zool. pt. 23).

Miracia efferata, Dana.

Willemoes-Suhm writes: "Very successful hauls with the tow-net were taken up till 9.30 P.M., but after that hour very little was obtained, though the sea all around continued to be highly phosphorescent. Besides the small Crustacea, the phosphorescence was due to innumerable specimens of *Pyrocystis* floating everywhere in the water. There were young Pleuronectids somewhat larger than those got yesterday; in one of the specimens one eye is more prominent than the other, though not to be called asymmetrical. In addition there were large numbers of Copepods, many larvæ of Squillids, *Lucifer*, Zoëæ, *Pneumonoderma*, and *Cranchia*."

Station 100 (Sounding 171), St. Vincent to St. Paul's Rocks (see Chart 12 and Diagram 7). STATION 100.

August 16, 1873; lat. 7° 1′ N., long. 15° 55′ W.

Temperature of air at noon, 78°·8; mean for the day, 77°·8.

Temperature of water:—

	°		°
Surface,	79·0	500 fathoms,	40·4
10 fathoms,	79·0	600 ,,	39·7
20 ,,	78·0	700 ,,	39·4
30 ,,	73·4	800 ,,	39·1
40 ,,	64·2	900 ,,	38·8
50 ,,	60·8	1000 ,,	38·5
75 ,,	56·8	1100 ,,	38·2
100 ,,	55·2	1200 ,,	38·0
200 ,,	49·5	1300 ,,	37·8
300 ,,	45·0	1400 ,,	37·6
400 ,,	42·0	1500 ,,	37·4

Density at 60° F.:—

Surface,	1·02612	100 fathoms,	1·02626
40 fathoms,	1·02652	200 ,,	1·02597

Depth, 2425 fathoms.

STATION 100. At 1.30 P.M. shortened and furled sails, and got up steam to sound. Sounded in 2425 fathoms. Attached dingey by line, and sent cutter away to try current, which was running at the surface at the rate of half a mile per hour eastward. At 3 P.M. obtained serial temperatures down to 1500 fathoms. The carbonic acid was determined in the surface water, and amounted to 43·2 milligrammes per litre. At 4.30 P.M. picked up line from dingey; line carried away in heaving in, and a thermometer was lost. At 5 P.M. cutter returned. At 6.20 P.M. completed temperature observations, and at 6.30 P.M. made all plain sail. At night sea phosphorescent.

Distance at noon from St. Paul's Rocks, 879 miles. Made good 145 miles. Amount of current 28 miles, direction S. 45° E.

ORGANISMS FROM SURFACE-NETS. Surface Organisms.—The following species are recorded from the surface in this locality:—

SCHIZOPODA (Sars, Zool. pt. 37).

Euphausia pellucida, Dana.
,, *gracilis*, Dana.

NUDIBRANCHIATA (Bergh, Zool. pt. 26).

Phylliroë atlantica, Bergh.
Acura pelagica, Adams.

PTEROPODA (Pelseneer, Zool. pt. 65).

Cavolinia uncinata (Rang).

TUNICATA (Herdman, Zool. pt. 76).

Pyrosoma atlanticum, Péron.
,, *giganteum*, Lesueur.

FISHES (Günther, Zool. pt. 78).

Young Pleuronectids.
Leptocephalus morrisii (young).

Willemoes-Suhm writes: "The sea was more luminous than ever, due chiefly to the presence of innumerable specimens of *Pyrocystis*, which made the water quite yellow. Foraminifera were also very abundant, and *Peridinium* (*tripos* and another species), which is known to cause phosphorescence when in great quantities, was present. Copepods, *Squillerichthus*, and various other Crustacea, were taken in the tow-net, making it quite slimy when hauled in. I think that *Corycæus*, *Acura*, *Pneumonoderma*, *Cranchia*, and the Pleuronectids do not belong to the North Atlantic surface-fauna, but that we have now entered within the limits of the South Atlantic fauna."

August 16, 1873.

The phosphorescence was not so brilliant, and the tow-net procured only some *Pyrocystis*, Foraminifera, and a few Crustacea. Some large sea-birds with white plumage (*Sula fusca*) were soaring about, keeping very close to the water; they were not following the ship, but fishing.

Station 101 (Sounding 172), St. Vincent to St. Paul's Rocks (see Chart 12 and Diagram 7). STATION 101.

August 19, 1873; lat. 5° 48′ N., long. 14° 20′ W.

Temperature of air at noon, 80°·8; mean for the day, 78°·5.

Temperature of water:—

Surface,	79·2°	300 fathoms,	43·3°
25 fathoms.	72·6	400 "	40·8
50 "	62·5	500 "	39·7
75 "	58·8	600 "	39·5
100 "	56·2	700 "	39·4
125 "	54·1	800 "	39·3
150 "	52·2	Bottom,	36·4
200 "	48·3		

Density at 60° F. at surface, 1·02635.

Depth, 2500 fathoms; deposit, Blue Mud, containing 6·22 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.30 A.M. shortened and furled sails, and got up steam to trawl. At 7 A.M. put trawl over. At 9 A.M. sounded in 2500 fathoms. At 1.30 P.M. lowered cutter to ascertain surface current. Obtained serial temperatures down to 800 fathoms. The carbonic acid was determined in the surface water, and amounted to 45·5 milligrammes per litre. At 3.30 P.M. cutter returned. At 4 P.M. commenced heaving in trawl, which came up at 5 P.M. with a number of specimens. At 5.10 P.M. proceeded as requisite, obtaining error of Fox dipping-needle. At 7 P.M. proceeded under steam.

St. Paul's Rocks distant at noon, 952 miles. Made good 99 miles. Amount of current 33 miles, direction N. 44° E.

The following species are recorded in the Zoological Reports from the trawl at this Station:— ANIMALS FROM TRAWL.

HYDROIDA (Allman, Zool. pt. 70).

Cryptolaria diffusa, n.sp. Obtained at no other locality.

HOLOTHURIOIDEA (Théel, Zool. pt. 13).

Psychropotes semperiana, n.g., n.sp. One injured specimen; obtained also at Station 133, 1900 fathoms.

ANNELIDA (M'Intosh, Zool. pt. 34).

Buskiella abyssorum, n.g., n.sp. Several fragmentary specimens; obtained also at Stations 106 and 333, 1850 and 2025 fathoms. Only species of the genus.

Station 101. Amphipoda (Stebbing, Zool. pt. 67).

Cystisoma spinosum (Fabricius). Two specimens; for distribution see Station V.

Macrura (Spence Bate, Zool. pt. 52).

Gennadas parvus, n.g., n.sp. One specimen; for distribution see Station 45.

Polyzoa (Busk, Zool. pt. 30).

Bugula reticulata, n.sp., var. *unicornis*, nov. Many specimens; for distribution see Station 68.

Fishes (Günther, Zool. pt. 57).

Sternoptyx diaphana (Herm.). One specimen (probably from near the surface); obtained also at Stations 106, 107, 159, 171, 214, 218, and 235, 500 to 2150 fathoms. A widely-distributed species.

Gonostoma microdon, n.sp. Two specimens; for distribution see Station 23.

Astronesthes niger, Rich. Two specimens (probably from near the surface); obtained also April 28, 1876, in the North Atlantic. A common pelagic form in the Atlantic and Indian Oceans.

Nemichthys infans, n.sp. One specimen; obtained also at Station 121, 500 fathoms. Recorded subsequently from West Indies. In the stomach of this specimen was a red deep-sea prawn.

In addition to the foregoing, the following are recorded in the Station-book :—Fragment of Sponge, many worm-tubes, *Sipunculus*, anterior part of large *Balanoglossus*, Caridid shrimp and five species of Peneid shrimps, one with parasitic worm (only one shrimp reported above).

Excluding Protozoa, about 70 specimens of invertebrates and fishes were obtained at this Station, belonging to about 20 species, of which 8 are new to science, including representatives of 4 new genera; 1 of the new species was not obtained elsewhere.

Willemoes-Suhm writes: "The trawl brought up a fine lot of animals, among which the shrimps were the most conspicuous, some being of a fine red colour and considerable size. There were in all nine individuals belonging to six species, one a true Caridid, the others belonging to the Peneid family. One of the specimens had been attacked by a long worm, which was very lively when I first saw it, and was rolled up in the shrimp like a *Gordius* in a *Locusta*. As the worm was afterwards seen to separate from the shrimp, it had probably only attacked the shrimp after death. Among the worms was a fragment of *Balanoglossus*, which had probably been of considerable length, but owing to the extreme softness of the tissues, only the anterior part came into our hands. It was distinguished by very lively colours, the head being yellow, the collar-like ring bright red, and the body yellowish red. Two longitudinal folds of the body are the outer walls of the branchial apparatus, and between them the so-called median vessel, while the lower part contained the beginning of the ovary. *Balanoglossus* is likely to turn up often in deep-sea dredgings; the shallow-water species always appear to inhabit the deepest places in the locality and are true mud-animals. Annelids in tubes were abundant, and there was a very fine and soft animal [= *Buskiella abyssorum*] with tentacles on the head, and long white bristles which are very clearly jointed, a condition unknown, as far as I am aware, among other animals." STATION 101.

Surface Organisms.—The following are recorded in the note-books:—During the day: a few *Pyrocystis*, Foraminifera, Radiolaria, *Sagitta*, Planarians, *Saphirina*, *Corycæus*, *Lucifer*. From net sent down to 100 fathoms: *Corycæus* and the *Distomum* which lives on the Copepods. At night: *Pyrocystis* present but not in great quantities; many *Globigerinæ*; *Corycæus*, *Squilla* larvæ, and *Phylliroë* very common. ORGANISMS FROM SURFACE.

Moseley writes: "At noon a shoal of dolphins (apparently *Delphinus delphis*) accompanied the ship. The tip of the snout was white, and pig-like in shape; the dorsal fin was somewhat behind the centre of the back. The body was dark brownish, except on the ventral surface, which was white; some specimens were somewhat mottled on the belly. I saw several turn right over, so as to fall tail first. They were to be seen constantly swimming four or five, or sometimes as many as ten, close side by side, their bodies touching and snouts in line, their motions being performed together, heads coming out and tails disappearing all together. Some parties remained thus jammed together for an hour at least."

Station 102 (Sounding 173), St. Vincent to St. Paul's Rocks (see Chart 12, and Diagrams 4 and 7). STATION 102.

August 21, 1873; lat. 3° 8′ N., long. 14° 49′ W.

Temperature of air at noon, 77°·8; mean for the day, 76°·1.

Temperature of water:—

	°		°
Surface,	78·0	500 fathoms,	39·9
10 fathoms,	78·5	600 ,,	39·4
20 ,,	76·2	700 ,,	39·0
30 ,,	73·5	800 ,,	38·7
40 ,,	70·5	900 ,,	38·4
50 ,,	67·8	1000 ,,	38·1
60 ,,	65·0	1100 ,,	37·8
75 ,,	61·0	1200 ,,	37·6
100 ,,	57·0	1300 ,,	37·4
150 ,,	51·3	1400 ,,	37·2
200 ,,	46·8	1500 ,,	37·0
300 ,,	41·8	Bottom,	36·5
400 ,,	40·6		

Station 102.

Density at 60° F.:—

Surface,	1·02589	300 fathoms,	1·02609
50 fathoms,	1·02661	400 „	1·02633
100 „	1·02645	Bottom,	1·02595
200 „	1·02619		

Depth, 2450 fathoms; deposit, Globigerina Ooze, containing 66·27 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.15 A.M. stopped to sound, and sounded in 2450 fathoms. At 9 A.M. obtained serial temperatures down to 1500 fathoms. Obtained samples of water from various depths for analysis. The carbonic acid was determined in water from 300 fathoms, and amounted to 53·6 milligrammes per litre. At 11.30 A.M. completed temperatures, and at 11.55 A.M. made all plain sail. Some terns were observed about the ship at night.

St. Paul's Rocks distant at noon, 884 miles. Made good 99 miles. Amount of current 9 miles, direction S. 72° W.

Organisms from the Surface

Surface Organisms.—Since passing out of the Guinea Current, *Pyrocystis* was not so abundant, and the phosphorescence was less marked.

Willemoes-Suhm writes: "A shark was caught this morning, in the valvular intestine of which an *Anthobothrium*, and in the duodenum a *Tetrarhynchus* with very big head, were found in abundance. On its skin *Caligus* (perhaps two species) was found."

Station 103.

Station 103 (Sounding 174), St. Vincent to St. Paul's Rocks (see Chart 12 and Diagram 4).

August 22, 1873; lat. 2° 52′ N., long. 17° 0′ W.

Temperature of air at noon, 77°·8; mean for the day, 76°·0.

Temperature of water:—

Surface,	77·0°	90 fathoms,	57·9°
20 fathoms,	76·5	100 „	56·4
30 „	74·7	150 „	51·5
40 „	70·5	200 „	47·5
50 „	63·8	300 „	43·0
60 „	62·2	400 „	40·6
70 „	60·8	500 „	40·2
80 „	59·4	Bottom,	36·0

Density at 60° F. at surface, 1·02622.

Depth, 2475 fathoms; deposit, Globigerina Ooze.

At 6.45 A.M. shortened and furled sails, and got up steam to sound. At 7.30 A.M. sounded in 2475 fathoms. At 9 A.M. took a series of temperatures down to 500 fathoms. At 10.15 A.M. completed observations, and made all plain sail. STATION 103.

St. Paul's Rocks distant at noon, 738 miles. Made good 145 miles. Amount of current 23 miles, direction N. 38° W.

Surface Organisms.—The following species are recorded from the surface-net sent down to 100 fathoms :— ORGANISMS FROM SURFACE-NETS.

AMPHIPODA (Stebbing, Zool. pt. 67).	MACRURA (Spence Bate, Zool. pt. 52).
Phronima pacifica, Streets.	*Sergestes oculatus*, Krøyer.

During the day the tow-net was sent down to a depth of from 80 to 100 fathoms, and, though it could only have been at that depth for a short time, a great many animals were obtained which were not to be found in the surface water. There was a great abundance of *Globigerinæ*, a few *Pulvinulinæ*, many species of Radiolaria, *Peridinium*, small Medusa, *Sagitta*, *Hydrophanes* (for the first time), *Saphirina* and other Copepods, *Hyperia*, *Pterotrachea*, Pteropods, *Cranchia*, young *Pyrosoma*, *Appendicularia*, *Fritillaria*, *Doliolum*.

Willemoes-Suhm writes: " From a depth of 100 fathoms the tow-net, after having been out only a very short time, brought up a quantity of those animals taken at the surface only at night, while the tow-net dragged at the surface for a considerable time brought in very little. This shows clearly that certain animals live during the day at a depth of 100 fathoms, and come to the surface only at night. Other forms, however, not taken to-day, but which have been taken in abundance at night, must live during the day probably at still greater depths. Among the worms was a very transparent *Hydrophanes*, hitherto observed only a few times by Krohn and Claparède ; the latter has given an excellent figure of the Mediterranean species, *Hydrophanes krohnii*, from which the species taken to-day differs somewhat in the form of the bristles of the antennæ, is somewhat older, and is possibly only a variety or the opposite sex. The worm is interesting as being a connecting link between the Phyllodoceans and the Alciopeans ; it is an *Alciopa* with simple eyes, or one might say that *Alciopa* is only a *Phyllodoce* with very big eyes, and that it is quite unnatural to make a separate family for it. Anyhow it is very interesting to find a *Phyllodoce* with ordinary eyes deviating from all the other bottom-living members of the family in the extreme transparency of its tissues and glands at the base of the feet. The genus *Hydrophanes* is besides distinguished by immense bacilliparous glands opening, as I have found to-day, into the pharynx, and by two ciliatory sacs on each side of the head, which can be inverted and then look like ciliated tentacles. Such retractile ciliated organs are known in several Annelids, and I have recently shown their presence in *Glycera alba*. They may perhaps be compared physiologically with

STATION 103. those strange organs protuded by certain caterpillars from the head, and by the beetle-genus *Staphylinus* from the tail. *Fritillaria* was also present to-day. This remarkable genus of Appendicularians was first found at Messina by Fol; it has a very elongated transparent body, in which testis and ovary are well separated from each other and from the digestive and branchial apparatus, so that from this genus a good view of the complicated anatomy of *Appendicularia* can be easily obtained."

STATION 104. Station 104 (Sounding 175), St. Vincent to St. Paul's Rocks (see Chart 12 and Diagram 4).

August 23, 1873; lat. 2° 25′ N., long. 20° 1′ W.

Temperature of air at noon, 78°·3; mean for the day, 76°·6.

Temperature of water:—

Surface,	78·0	600 fathoms,	39·7
10 fathoms,	78·4	700 ,,	39·2
20 ,,	77·8	800 ,,	38·9
30 ,,	76·0	900 ,,	38·6
40 ,,	68·8	1000 ,,	38·2
50 ,,	63·8	1100 ,,	37·9
60 ,,	60·5	1200 ,,	37·6
100 ,,	55·0	1300 ,,	37·3
200 ,,	49·0	1400 ,,	37·0
300 ,,	45·0	1500 ,,	36·7
400 ,,	42·4	Bottom,	36·6
500 ,,	40·7		

Density at 60° F. at surface, 1·02602; bottom, 1·02601.

Depth, 2500 fathoms; deposit, Globigerina Ooze, containing 71·70 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 8 A.M. shortened and furled sails, and got up steam to sound and trawl. At 9 A.M. put trawl over. At 9.20 A.M. brought ship to wind, and sounded in 2500 fathoms. At 1 P.M. lowered cutter to ascertain surface current. At 2 P.M. obtained serial temperatures down to 1500 fathoms. At 5.30 P.M. trawl came up with several specimens.

St. Paul's Rocks distant at noon, 568 miles. Made good 170 miles. Amount of current 20 miles, direction N. 75° W.

ANIMALS FROM TRAWL. The following species are recorded in the Zoological Reports from the trawl at this Station:—

HOLOTHURIOIDEA (Théel, Zool. pt. 13).

Peniagone lugubris, n.g., n.sp. One fragmentary specimen; obtained at no other locality.

SCHIZOPODA (Sars, Zool. pt. 37). STATION 104.

Petalophthalmus armiger, Willemoes-Suhm, n.g., n.sp. One specimen; obtained at no other locality. Only species of the genus.

MACRURA (Spence Bate, Zool. pt. 52).

Haliporus lævis, n.g., n.sp. Two specimens; obtained also at Stations 106 and 205, 1850 and 1050 fathoms.

Acanthephyra kingsleyi, n.sp. One specimen; obtained at no other locality.

Hymenodora mollicutis, n.sp. One specimen; obtained also at Stations 87, 133, 156, 157, and 318.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Lima (*Limatula*) n.sp. (?). One damaged specimen.

GASTEROPODA (Watson, Zool. pt. 42).

Clathurella (*Daphnella*) *monoceros*, n.sp. Obtained at no other locality.

POLYZOA (Busk, Zool. pt. 30).

Bugula reticulata, n.sp., var. *unicornis*, nov. For distribution see Station 68.

FISHES (Günther, Zool. pt. 57).

Mixonus laticeps, n.g., n.sp. One specimen; obtained at no other locality. Only species of the genus.

Bathyonus tænia, n.sp. One specimen; obtained at no other locality.

Chauliodus sloanii, Bl. Schn. One specimen; for distribution see Station 60. The spots on the lateral line were observed to be phosphorescent.

In addition to the foregoing, the following are recorded in the Station-book:—Two specimens of *Ophioglypha bullata*, three Annelid-tubes, and *Scalpellum* on spicule of *Hyalonema*.

Excluding Protozoa, about 20 specimens of invertebrates and fishes were obtained at this Station, belonging to about 15 species, of which 10 are new to science, including representatives of 4 new genera; 6 of the new species and 2 new genera were not obtained elsewhere.

ORGANISMS FROM THE DEPOSIT.

HETEROPODA (Smith, Zool. pt. 72).—The following species was observed in the deposit from this Station (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.):—

Atlanta inflata, Eydoux and Souleyet.

STATION 104. ORGANISMS FROM SURFACE-NETS.

Surface Organisms.—The following species are recorded from the tow-nets sent down to 100 fathoms :—

COPEPODA (Brady, Zool. pt. 23).
Saphirina metallina, Dana.

AMPHIPODA (Stebbing, Zool. pt. 67).
Oxycephalus clausi, Bovallius.

SCHIZOPODA (Sars, Zool. pt. 37).
Thysanopoda tricuspidata, M.-Edwards (larval form).

Two or three hauls of the tow-net were taken at about 100 fathoms, and the net was full of pelagic animals, while at the same time almost nothing was got at the surface. In addition to the animals noted yesterday, *Lucifer* was present in abundance, young specimens of *Tomopteris*, several specimens of *Alciopa*, and a Copepod with feathered setæ on the furca.

Moseley writes : "Yesterday and to-day Murray put down the surface-net to 100 fathoms. The result was most satisfactory, for the net was full of animals such as are caught on the surface at night, while a similar net on the actual surface yielded next to nothing. The water was perfectly swarming with living animals. It is a great step to have discovered where the surface animals that one catches occasionally at night are to be obtained, and where they live constantly, during the day."

STATION 105.

Station 105 (Sounding 176), St. Vincent to St. Paul's Rocks (see Chart 12 and Diagram 4).

August 24, 1873 ; lat. 2° 6′ N., long. 22° 53′ W.
Temperature of air at noon, 77°·5 ; mean for the day, 76°·2.
Temperature of water :—

	°		°
Surface,	78·0	400 fathoms,	41·0
100 fathoms	56·0	500 „	40·4
200 „	46·0	Bottom,	36·0
300 „	42·8		

Density at 60° F. at surface, 1·02604.
Depth, 2275 fathoms ; deposit, Globigerina Ooze.

At 4.5 P.M. shortened and furled sails, and got up steam to sound. At 5 P.M. sounded in 2275 fathoms. Tried a new disengaging apparatus—working by means of a slot without spring—but it failed to disengage the weights, which were brought to the surface.

Obtained serial temperatures down to 500 fathoms. At 7.30 P.M. completed observations, and made all plain sail. STATION 105.

Distance at noon from St. Paul's Rocks, 428 miles. Made good 140 miles. Amount of current 17 miles, direction N. 45° W.

Station 106 (Sounding 177), St. Vincent to St. Paul's Rocks (see Chart 12 and Diagram 4). STATION 106.

August 25, 1873 ; lat. 1° 47′ N., long. 24° 26′ W.

Temperature of air at noon, 77°·8 ; mean for the day, 76°·9.

Temperature of water :—

	°		°
Surface,	78·8	500 fathoms,	40·3
10 fathoms,	78·6	600 „	40·2
20 „	78·4	700 „	40·1
30 „	78·2	800 „	40·0
40 „	76·2	900 „	39·6
50 „	62·4	1000 „	39·2
60 „	59·0	1100 „	38·8
70 „	58·0	1200 „	38·3
100 „	55·0	1300 „	37·9
200 „	45·0	1400 „	37·5
300 „	40·7	1500 „	37·0
400 „	40·5	Bottom,	36·6

Density at 60° F. at surface, 1·02615.

Depth, 1850 fathoms ; deposit, Globigerina Ooze, containing 89·47 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 5.20 A.M. got up steam. At 7 A.M. shortened and furled sails, and put trawl over, veering 2500 fathoms. At 9.15 A.M. sounded in 1850 fathoms. Lowered cutter to try current. Took serial temperatures down to 1500 fathoms. The carbonic acid was determined in surface water, and amounted to 42·6 milligrammes per litre. At 4.30 P.M. trawl came up with a number of highly interesting specimens.

Distance at noon from St. Paul's Rocks, 301 miles. Made good 128 miles. Amount of current 26 miles, direction N. 76° W.

The following species are recorded in the Zoological Reports from the trawl at this Station :— ANIMALS FROM TRAWL.

TETRACTINELLIDA (Sollas, Zool. pt. 63).

Thenea fenestrata (Schmidt). Four or five specimens ; obtained also at Station 124, 1600 fathoms. Recorded from Bequia and West Indies.

Station 106. PENNATULIDA (Kölliker, Zool. pt. 2).

Umbellula güntheri, n.sp. One imperfect specimen ; obtained at no other locality.

CRINOIDEA (Carpenter, Zool. pt. 32).

Hyocrinus bethellianus, Wyville Thomson, n.g., n.sp. Stem fragments ; obtained also at Stations 147 and 223, 1600 and 2325 fathoms. Only species of the genus.

Bathycrinus campbellianus, n.sp. One incomplete specimen ; obtained at no other locality.

ASTEROIDEA (Sladen, Zool. pt. 51).

Paragonaster cylindratus, n.g., n.sp. Two specimens ; obtained at no other locality. The only other species of the genus (*Paragonaster ctenipes*) was obtained at Station 192, 140 fathoms.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophioglypha inornata, n.sp. Obtained at no other locality.

Ophiomusium armigerum, n.sp. Obtained also at Stations 83, 299 (?), and 332.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Salenia hastigera, n.sp. Two specimens ; obtained also at Stations 124, 170, 171, 195, 209, 335, and coast of Portugal, 100 to 1600 fathoms.

ANNELIDA (M'Intosh, Zool. pt. 34).

Lagisca (*Agnodice*) *moseleyi*, n.sp. One fragmentary specimen ; obtained at no other locality.

Buskiella abyssorum, n.g., n.sp. Several fragmentary specimens ; obtained also at Stations 101 and 333. Only species of the genus.

AMPHIPODA (Stebbing, Zool. pt. 67).

Stenopleura atlantica, n.g., n.sp. One specimen (doubtful whether from surface or bottom) ; obtained also at Station 133. Only species of the genus.

Lanceola æstiva, n.sp. (?). One specimen ; obtained also at Station 120, 675 fathoms.

SCHIZOPODA (Sars, Zool. pt. 37).

Gnathophausia zoëa, Willemoes-Suhm, n.g., n.sp. One specimen ; obtained also at Stations 73, 126, and 171.

MACRURA (Spence Bate, Zool. pt. 52).

Haliporus lævis, n.g., n.sp. One injured specimen ; obtained also at Stations 104 and 205.

Gennadas intermedius, n.g., n.sp. One specimen; obtained also at the surface between Bermuda and Azores and at Station 137. STATION 106.

Acanthephyra acanthitelsonis, n.sp. One specimen; obtained also at Station 107, 1500 fathoms.

ANOMURA (Henderson, Zool. pt. 69).

Parapagurus abyssorum, M.-Edwards. Several specimens in shells of *Pleurotoma* and *Dentalium*; for distribution see Station 56.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Lyonsiella jeffreysii, n.sp. Obtained at no other locality.

Verticordia tornata (Jeffreys). One specimen; obtained also at Station 70.

Limopsis pelagica, n.sp. Several specimens; obtained also at Station 232, 345 fathoms.

SCAPHOPODA and GASTEROPODA (Watson, Zool. pt. 42).

Dentalium, new species but unrecognisable.

Pleurotoma (*Bela*) *climakis*, n.sp. Obtained at no other locality.

„ (*Pleurotomella*) *brychia*, n.sp. Obtained at no other locality.

Clathurella homæotata, n.sp. Obtained at no other locality.

„ *phyxanor*, n.sp. Obtained at no other locality.

Oocorys sulcata, Fischer. One specimen; obtained at no other locality by the Challenger. Recorded from North Atlantic.

CEPHALOPODA (Hoyle, Zool. pt. 44).

Cranchia (*Liocranchia*) *reinhardtii*, Steenstrup. Two specimens (probably from the surface); obtained at no other locality by the Challenger Recorded from Atlantic.

POLYZOA (Busk, Zool. pt. 32).

Bugula reticulata, n.sp., var. *unicornis*, nov. For distribution see Station 68.

Farciminaria delicatissima, n.sp. For distribution see Station 13.

BRACHIOPODA (Davidson, Zool. pt. 1).

Megerlia (?) *incerta*, n.sp. Three or four specimens (one young specimen attached to *Limopsis*); obtained at no other locality.

Discina atlantica, King. Three specimens attached to *Limopsis*; obtained also at Stations 184, 194, 237, 246, 271, and 300, 200 to 2425 fathoms. Recorded from Arctic and North Atlantic (" Valorous " and " Porcupine "). Fossil—Crag of England.

STATION 106.

FISHES (Günther, Zool. pt. 57).

Melamphaës robustus, n.sp. One injured specimen; obtained at no other locality.

Melanocetus murrayi, n.sp. One specimen; obtained also at Station 348, 2450 fathoms.

Sternoptyx diaphana (Herm.). One specimen (probably from near the surface); for distribution see Station 101.

Gonostoma microdon, n.sp. Two specimens; for distribution see Station 23.

In addition to the foregoing, the following are recorded in the Station-book:—Branched Rhizopods, two red fragments of *Balanoglossus*, which show that the whole animal must have been at least half a foot in length, many specimens of *Chalaraspis ungnifer* [= *Eucopia australis*, Dana], and many Hydroids attached to the spines of *Salenia*.

Excluding Protozoa, about 100 specimens of invertebrates and fishes were obtained at this Station, belonging to about 38 species, of which 28 are new to science, including representatives of 7 new genera; 13 of the new species were not obtained elsewhere.

ORGANISMS FROM SURFACE NETS.

Surface Organisms.—The following species are recorded from the tow-nets sent down to 40 fathoms:—

COPEPODA (Brady, Zool. pt. 23).

Undina vulgaris, Dana.
Euchæta prestandreæ, Philippi.
Corycæus speciosus, Dana.

AMPHIPODA (Stebbing, Zool. pt. 67).

Phronimella elongata, Claus.
Platyscelus serratulus, n.n.
Thyropus danæ, n.sp.
Eupronoë intermedia, n.sp.
Oxycephalus porcellus, Claus.

MACRURA (Spence Bate, Zool. pt. 52).

Sergestes longispinus, n.sp.
,, *oculatus*, Krøyer.

PTEROPODA (Pelseneer, Zool. pt. 65).

Clio (*Creseis*) *virgula* (Rang).
Cavolinia longirostris (Lesueur).

On August 25 to 27, hauls were taken each day with the tow-net in depths of 40 to 100 fathoms, always with good results, and specimens obtained of Oscillatoriaceæ Diatoms, *Vorticellæ* on Diatoms, Coccospheres, *Pyrocystis*, *Peridinium*, Foraminifera (*Pulvinulina*, *Orbulina*, *Sphæroidina*, *Globigerina*, *Pullenia*), Radiolaria, Siphonophoræ (including three species not previously observed), *Brachiolaria*, *Alciopa*, *Tomopteris*, *Hydrophanes*, *Sapphirina* and other Copepods, *Typhis*, *Oxycephalus*, *Phronimella*, *Phronima* (young; the adults probably live in deeper water as they always came up in the trawl, seldom in the tow-net), *Lucifer*, *Pterotrachea*, *Oxygyrus*, and *Cranchia*.

Station 107 (Sounding 178), St. Vincent to St. Paul's Rocks (see Chart 12 and Diagram 4). STATION 107.

August 26, 1873; lat. 1° 22′ N., long. 27° 36′ W.
Temperature of air at noon, 78°·3; mean for the day, 77°·4.
Temperature of water at surface, 78°·8; bottom, 37°·9.
Density at 60° F.:—

Surface,	1·02613	200 fathoms,	1·02606
25 fathoms,	1·02598	300 „	1·02617
50 „	1·02631	400 „	1·02567
90 „	1·02629		

Depth, 1500 fathoms; deposit, Globigerina Ooze, containing 80·47 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 10.30 A.M. shortened and furled sails, and got up steam to trawl and sound. Put trawl over, and veered 2000 fathoms. Lowered cutter to try current. At 12.30 P.M. sounded in 1500 fathoms. At 3.30 P.M. cutter returned; found current running W.N.W. at the rate of 1½ miles per hour. At 4 P.M. commenced heaving in trawl, which came up at 5.30 P.M. with several specimens. The carbonic acid was determined in water from 50 fathoms, and amounted to 53·3 milligrammes per litre. At 5.40 P.M. made sail, and proceeded towards St. Paul's Rocks.

Distance at noon from St. Paul's Rocks, 169 miles. Made good 132 miles. Amount of current 21 miles, direction N. 84° W.

The following species are recorded in the Zoological Reports from the trawl at this Station:— ANIMALS FROM TRAWL.

AMPHIPODA (Stebbing, Zool. pt. 67).

Cystisoma spinosum (Fabricius). One specimen; for distribution see Station V.

SCHIZOPODA (Sars, Zool. pt. 37).

Gnathophausia affinis, n.g., n.sp. One specimen; obtained at no other locality.

„ *gracilis*, Willemoes-Suhm, n.g., n.sp. One specimen; obtained at no other locality. Recorded subsequently from Indian Ocean ("Investigator").

Eucopia australis, Dana. For distribution see Station 50.

Bentheuphausia amblyops, n.g., n.sp. One specimen; obtained also at Stations 135 and 158, 1000 and 1800 fathoms.

MACRURA (Spence Bate, Zool. pt. 52).

Acanthephyra acanthitelsonis, n.sp. One specimen; obtained also at Station 106.
,, *brevirostris*, n.sp. Two specimens; obtained at no other locality.

FISHES (Günther, Zool. pt. 57).

Melamphaës crassiceps, n.sp. One specimen; obtained also at Stations 120, 146, and 220, 675 to 1375 fathoms.
Chiasmodus niger, Johnson. One specimen; obtained at no other locality by the Challenger. Recorded from North Atlantic.
Bathyonus compressus, n.sp. One specimen; obtained also at Stations 184 and 205, 1400 and 1050 fathoms.
Sternoptyx diaphana (Herm.). Two specimens (probably from near the surface); for distribution see Station 101.
Platytroctes apus, n.g., n.sp. One specimen; obtained at no other locality. Only species of the genus. Recorded subsequently from Indian Ocean ("Investigator").

In addition to the foregoing, the following are recorded from the Station-book:—Portion of Hexactinellid Sponge, *Halichondria*, and male specimen of *Petalophthalmus armiger*.

Excluding Protozoa, about 20 specimens of invertebrates and fishes were obtained at this Station, belonging to about 15 species, of which 8 are new to science, including representatives of 3 new genera; 4 new species and 1 new genus were not obtained elsewhere.

Willemoes-Suhm writes: "In to-day's haul I got the male of the curious Mysid taken on the 23rd, which presents very extraordinary characters. From the coast of Portugal down to the equator we got on three different occasions males and a female of a very large Amphipod, which I have described under the name of *Thaumops pellucida* [= *Cystisoma spinosum*]. Most of the specimens were taken by the trawl when hauled up from deep water, and we did not know whether the animal lived only at great depths, or whether, like *Phronima*, it came to the surface, until one night a specimen was taken in the tow-net behind the ship. This shows clearly, as might be expected from its transparency, that *Cystisoma* is a pelagic animal living during the day probably at a considerable depth, but coming occasionally at night to the very surface of the water. The eggs are very large and few in number; I have described them as being suspended from the first pair of ambulatory legs, but am not now quite sure whether that was only a casual incident, and that they are in reality contained simply within the breeding lamellæ."

Station 108 (Sounding 179), St. Vincent to St. Paul's Rocks (see Chart 12 and Diagram 4). STATION 108.

August 27, 1873 ; lat. 1° 10′ N., long. 28° 23′ W.
Temperature of air at noon, 80°·0 ; mean for the day, 77°·6.
Temperature of water at surface, 78°·0 ; bottom, 36°·8.
Density at 60° F. at surface, 1·02641.
Depth, 1900 fathoms; deposit, Globigerina Ooze, containing 84·90 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.30 A.M. shortened and furled sails, and got up steam to sound. At 7 A.M. sounded in 1900 fathoms. At 8.20 A.M. completed sounding, and made sail. At 2 P.M. observed St. Paul's Rocks to W.S.W.—a group of low rocks, apparently barely projecting above the surface of the ocean. The two most prominent rocks are not more than between 60 and 70 feet high. Got up steam, and at 2.15 P.M. proceeded under steam. At 3.45 P.M. shortened and furled sails, and at 4 P.M. stopped to leeward of St. Paul's Rocks. Lowered cutter and jolly-boat, and sent officers and members of civilian scientific staff on shore to examine rocks. At 5 P.M. secured ship with hawser to the point on N.E. side of cove, at three-quarter hawser length, the ship's bow being then in 104 fathoms.

Distance at noon from St. Paul's Rocks, 37 miles. Made good 133 miles. Amount of current 39 miles, direction N. 79° W.

Surface Organisms.—The following species are recorded from the surface at this Station :— ORGANISMS FROM SURFACE-NETS.

AMPHIPODA (Stebbing, Zool. pt. 67).
Phronimella elongata, Claus.
Lycæopsis pauli, n.sp.
Platyscelus serratulus, n.n.
Lycæa pauli, n.sp.

SCHIZOPODA (Sars, Zool. pt. 37).
Nematoscelis rostrata, n.g., n.sp.

Moseley writes : "Two large specimens of *Albacore*, 60 or 70 lbs. in weight, were swimming round the ship."

The Challenger remained secured to St. Paul's Rocks from 5 P.M. on August 27 till 7 A.M. on August 29 (for description of St. Paul's Rocks, see *Narr. Chall. Exp.*, vol. i. pp. 201–209). AT ST. PAUL'S ROCKS.

STATION 109.

Station 109 (Sounding 180), off St. Paul's Rocks (see Chart 13).

August 28, 1873; lat. 0° 55′ 38″ N., long. 29° 22′ 35″ W.
Temperature of air at noon, 81°·0; mean for the day, 78°·5.
Temperature of water at surface, 77°·7.
Depth, 104 fathoms; deposit, Hard Ground.

At 9 A.M. officers and men on shore fishing, exploring rocks for natural history specimens, surveying, and making magnetic observations. On board ship employed a new mode of dredging by sending out dredge in a boat, and after a time heaving it in to the ship with the aid of the donkey-engine. The small dredge was used on this occasion, with the swabs attached, and brought up several specimens.

ANIMALS FROM ST. PAUL'S ROCKS.

The following species are recorded in the Zoological Reports from St. Paul's Rocks, from shore, shallow water, and down to a depth of about 100 fathoms:—

TETRACTINELLIDA (Sollas, Zool. pt. 63).

Pilochrota gigas, n.g., n.sp. One specimen (taken by fishing line from shore); obtained at no other locality.

ALCYONARIA (Wright and Studer, Zool. pt. 64).

Paramuricea æquatorialis, n.sp. (80 fathoms); obtained at no other locality.
Placogorgia atlantica, n.g., n.sp. (80 fathoms); obtained at no other locality. Only species of the genus.

ANTIPATHARIA (Brook, Zool. pt. 80).

Pteropathes fragilis, n.g., n.sp. (10 to 80 fathoms); obtained at no other locality. Only species of the genus.

CORALS (Moseley, Zool. pt. 7).

Lophohelia prolifera, M.-Edwards and Haime. Dead fragment (100 fathoms); for distribution see Station 23.

CRINOIDEA (Carpenter, Zool. pt. 60).

Actinometra pulchella (Pourtalès). One specimen (10 to 80 fathoms); obtained also at Station 192 (?), 140 fathoms. Recorded from North Atlantic ("Porcupine," "Dacia," and "Talisman"), and Caribbean Sea.

Ophiuroidea (Lyman, Zool. pt. 14).

Ophiomyxa australis, Lütken. (100 fathoms); obtained also at Stations 161, 162, 163, 167, 172, 173, 201, and Amboina, 18 to 515 fathoms.

Echinoidea (Agassiz, Zool. pt. 9).

Dorocidaris (*Cidaris*) *papillata* (Leske). (70 to 80 fathoms); for distribution see Station 24.

Anomura (Henderson, Zool. pt. 69).

Munida sancti-pauli, n.sp. Two specimens (10 to 60 fathoms); obtained at no other locality.

Brachyura (Miers, Zool. pt. 49).

Stenorhynchus spinifer, n.sp. One injured specimen (10 to 80 fathoms); obtained at no other locality.

Grapsus maculatus (Catesby). Numerous specimens (shore); obtained also at Bermuda, Ascension, Fernando Noronha, and Cape Verdes.

Lamellibranchiata (Smith, Zool. pt. 35).

Lima lata, n.sp. One specimen (104 fathoms); obtained also at Station 201, 82 fathoms.

Polyzoa (Busk, Zool. pts. 30 and 50).

Catenaria diaphana, Busk. (Shallow water); obtained at no other locality by the Challenger. Recorded from Madeira.

Scrupocellaria macandrei, Busk. (Shallow water); obtained also at Cape Verdes. Recorded from coast of Spain.

Tubucellaria opuntioides, Pallas. (Shallow water); obtained at no other locality by the Challenger. Recorded from John Adam's Bank.

Crisia denticulata (Lamarck). (Shallow water); obtained also at Stations 135 and 186, 8 to 90 fathoms. Recorded from Arctic, North Atlantic, and Mediterranean.

A Sipunculid is also recorded in the Station-book.

In the foregoing list 16 species are enumerated, of which 7 are new to science, including representatives of 3 new genera; 6 of the new species and 2 new genera were not obtained elsewhere.

St. Paul's Rocks. Organisms from the Surface.

Surface Organisms.—The following species are recorded from the surface :—

Macrura (Spence Bate, Zool. pt. 52).

Panulirus guttatus (Latreille), var.
Sergestes oculatus, Kroyer.
Lucifer typus, Thompson.
,, *reynaudii*, M.-Edwards.
Alpheus minus, Say.

Fishes (Günther, Zool. pt. 6).

Holocentrum sancti-pauli, n.sp.
Caranx ascensionis, Forst.
Glyphidodon saxatilis, Linné.
Cossyphus rufus, Linné.
Platyglossus cyanostigma, C.V.
Enchelycore nigricans, Bonnat.
Balistes buniva, Lac.

Station 109A to 109D.

Stations 109A to 109D (Soundings 181 to 184), off St. Paul's Rocks (see Chart 13).

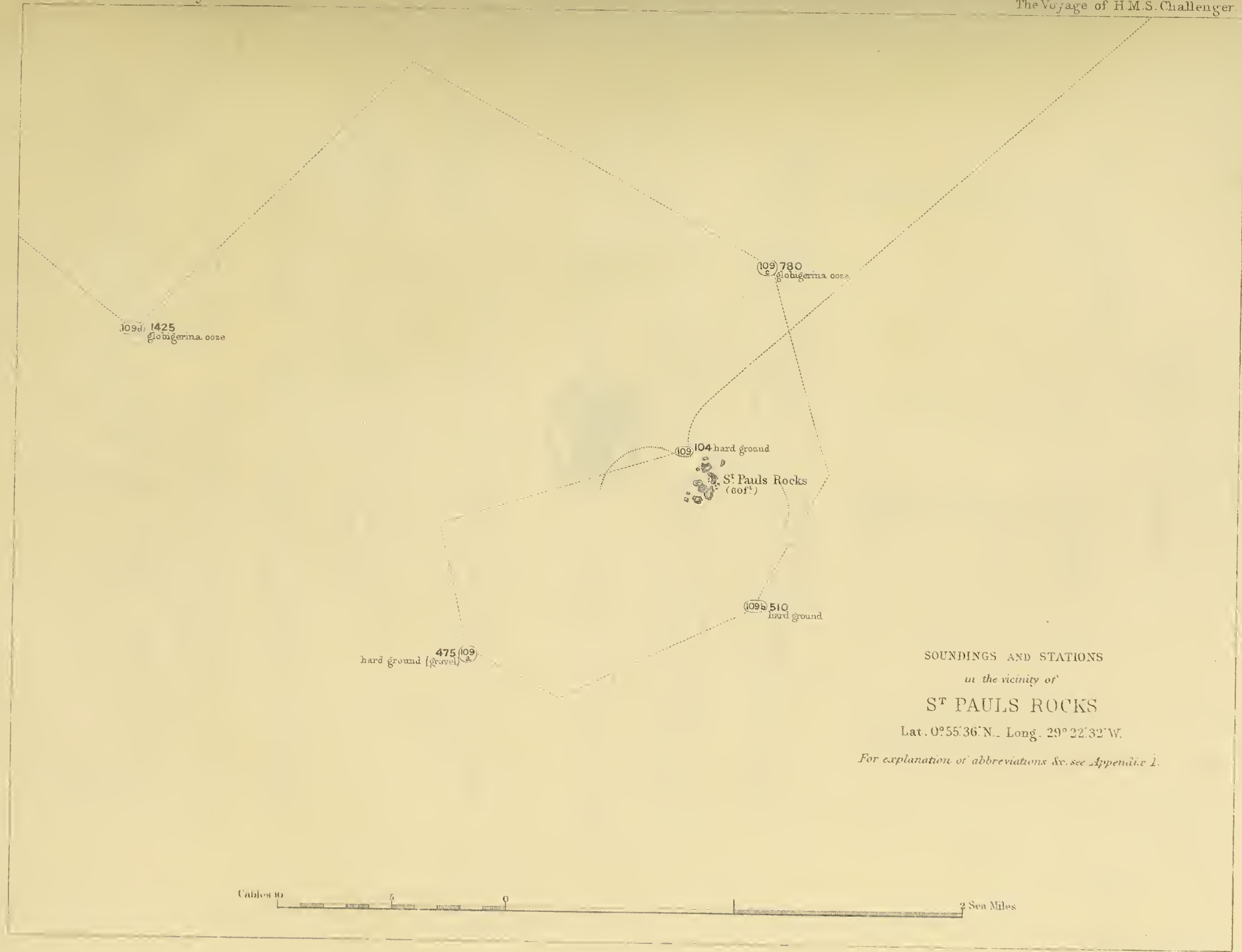
August 29, 1873.
Temperature of air at noon, 78°·5 ; mean for the day, 77°·5.
Temperature of water at surface, 78°·0.

At 6 A.M. got up steam. At 7 A.M. landed naturalists and fishing party. Cast off hawser, and proceeded under steam round St. Paul's Rocks to take soundings. Shaped course as requisite for obtaining the errors of the Fox dipping-needle. At 8 A.M. sounded in 475 fathoms, Hard Ground, gravel (Station 109A); distance from St. Paul's Rocks 1·25 miles. At 9.45 A.M. sounded in 510 fathoms, Hard Ground (Station 109B); distance from the Rocks 0·58 mile. At 10.45 A.M. sounded in 780 fathoms, deposit Globigerina Ooze, containing 57·34 per cent. of carbonate of lime (Station 109C); distance from the Rocks 0·98 mile. At 11 A.M. steamed as requisite to ascertain error of dipping-needle. At 1 P.M. sounded in 1425 fathoms, deposit Globigerina Ooze, containing 72·77 per cent. of carbonate of lime (Station 109D); distance from the Rocks 2·6 miles. At 2 P.M. proceeded towards the Rocks and recalled boats. At 3 P.M. boats returned and the ship proceeded N.W. for magnetic observations and swinging ship for errors of compasses. At 6.10 P.M. completed the observations, and at 6.15 P.M. made all plain sail, and proceeded towards Fernando Noronha.

Station 110.

Station 110 (Sounding 185), St. Paul's Rocks to Fernando Noronha (see Chart 12 and Diagram 4).

August 30, 1873; lat. 0° 9′ N., long. 30° 18′ W.
Temperature of air at noon, 79°·3; mean for the day, 77°·3.



SOUNDINGS AND STATIONS

in the vicinity of

ST PAULS ROCKS

Lat. 0°55′36″N., Long. 29°22′32″W.

For explanation of abbreviations &c. see Appendix I.

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Temperature of water :— STATION 110.

Surface,	77°·5	500 fathoms,	39°·8
10 fathoms,	77·4	600 „	39·6
20 „	77·2	700 „	39·4
30 „	77·0	800 „	39·2
40 „	71·8	900 „	38·8
50 „	67·0	1000 „	38·4
60 „	62·7	1100 „	38·0
75 „	59·8	1200 „	37·6
100 „	56·2	1300 „	37·3
200 „	46·8	1400 „	37·0
300 „	42·0	1500 „	36·8
400 „	40·0	Bottom,	34·8

Density at 60° F. at surface, 1·02667 ; bottom, 1·02602.

Depth, 2275 fathoms; deposit, Globigerina Ooze, containing 72·93 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.45 A.M. shortened and furled sails, and got up steam to sound. At 8 A.M. sounded in 2275 fathoms. Obtained serial temperatures down to 1500 fathoms. At 10.40 A.M. completed temperature observations, and made all plain sail. Shortly after noon crossed the Equator.

Distance at noon from Fernando Noronha, 265 miles. Made good 70 miles. Amount of current 29 miles, direction N. 69° W.

Station 111 (Sounding 186), St. Paul's Rocks to Fernando Noronha (see Chart 12 and Diagram 4). STATION 111.

August 31, 1873 ; lat. 1° 45′ S., long. 30° 58′ W.

Temperature of air at noon, 80°·8 ; mean for the day, 77°·9.

Temperature of water at surface, 78°·0 ; bottom, 33°·7.

Density at 60° F. at surface, 1·02667.

Depth, 2475 fathoms; deposit, Globigerina Ooze, containing 36·06 per cent of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.30 A.M. shortened and furled sails, and got up steam to sound. At 8 A.M. sounded in 2475 fathoms. At 8.40 A.M. completed sounding and made all plain sail.

Distance at noon from Fernando Noronha, 132 miles. Made good 138 miles. Amount of current 25 miles, direction S. 55° W.

Station 111
Organisms from the Deposit.

Foraminifera (Brady, Zool. pt. 22).—The following species of Foraminifera were observed in the deposit from this Station; the pelagic species, which make up about 89 per cent. of the carbonate of lime present in the deposit, are marked thus × :—

Biloculina depressa, d'Orbigny.
Spiroloculina tenuis (Czjzek).
Miliolina seminulum (Linné).
,, *venusta* (Karrer).
Haplophragmium latidorsatum (Bornemann).
Ammodiscus gordialis (Jones and Parker).
Textularia concava (Karrer).
Verneuilina pygmæa (Egger).
Virgulina schreibersiana, Czjzek.
Lagena globosa (Montagu).
,, *gracilis*, Williamson.
,, *lævigata* (Reuss).
,, *lævis* (Montagu).
,, *marginata* (Walker and Boys).
,, *orbignyana* (Seguenza).
,, *sulcata* (Walker and Jacob).
Nodosaria communis, d'Orbigny.
× *Globigerina bulloides*, d'Orbigny.
× *Globigerina conglobata*, Brady.
× ,, *dubia*, Egger.
× ,, *helicina*, d'Orbigny.
× ,, *inflata*, d'Orbigny.
× ,, *sacculifera*, Brady.
× *Pullenia obliquiloculata*, Parker and Jones.
,, *sphæroides* (d'Orbigny).
Truncatulina lobatula (Walker and Jacob).
,, *pygmæa*, Hantken.
× *Pulvinulina crassa* (d'Orbigny).
,, *exigua*, Brady.
× ,, *menardii* (d'Orbigny).
× ,, *micheliniana* (d'Orbigny).
× ,, *patagonica* (d'Orbigny).
× ,, *tumida*, Brady.
,, *umbonata*, Reuss.
Rotalia soldanii, d'Orbigny.
Nonionina umbilicatula (Montagu).

Stations 112 to 113A.

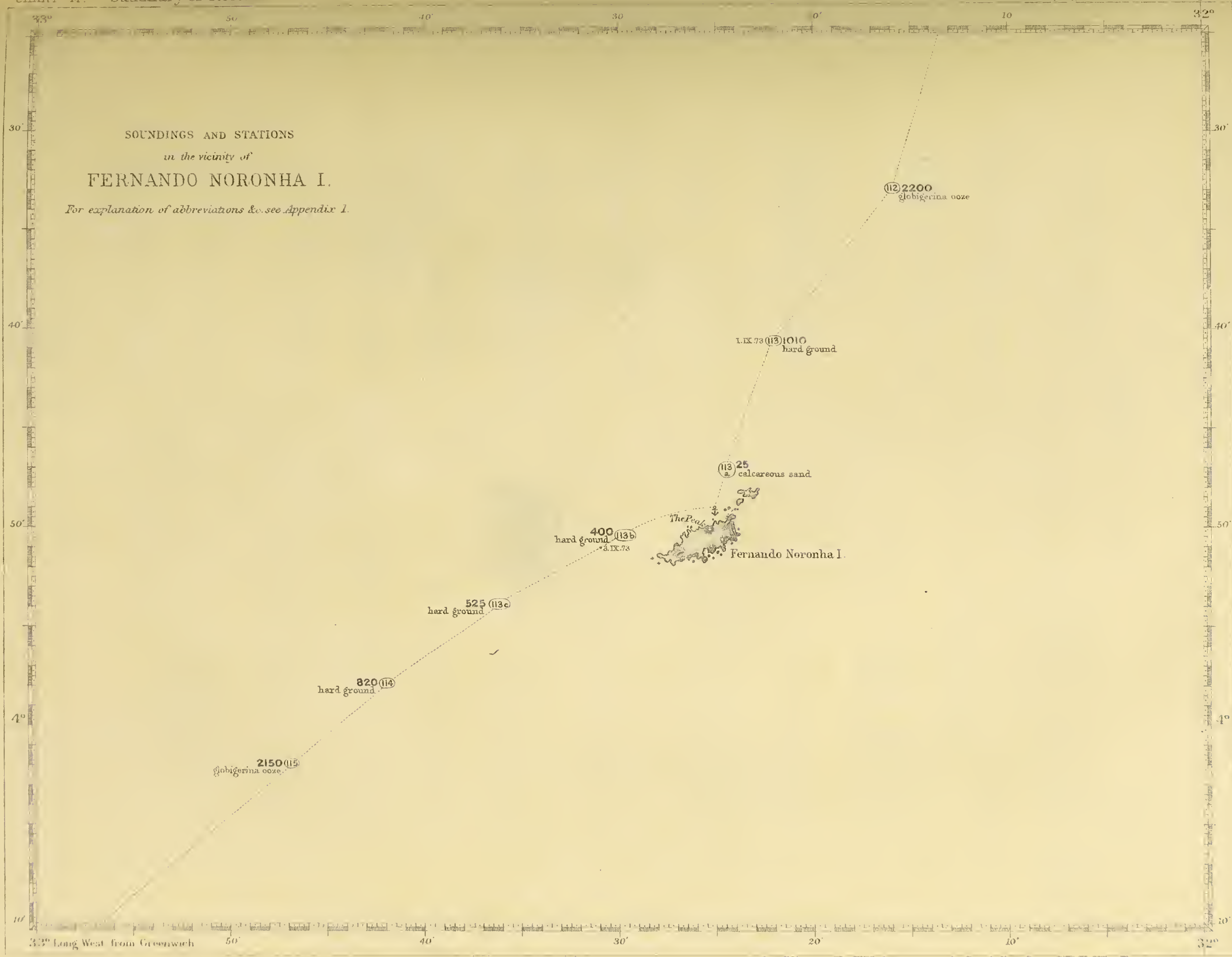
Stations 112 to 113A (Soundings 187 to 189), St. Paul's Rocks to Fernando Noronha (see Charts 12 and 14, and Diagram 4).

September 1, 1873; lat. 3° 33′ S., long. 32° 16′ W.
Temperature of air at noon, 78°·8; mean for the day, 78°·5.
Temperature of water :—

Surface,	78°·0	500 fathoms,	39°·7
10 fathoms,	78·0	600 ,,	39·7
20 ,,	78·0	700 ,,	39·7
30 ,,	77·5	800 ,,	39·7
40 ,,	73·3	900 ,,	38·6
50 ,,	63·2	1000 ,,	38·1
60 ,,	59·0	1100 ,,	37·9
75 ,,	56·5	1200 ,,	37·8
100 ,,	54·4	1300 ,,	37·7
200 ,,	46·8	1400 ,,	37·6
300 ,,	42·0	1500 ,,	37·5
400 ,,	40·0	Bottom,	34·0

Density at 60° F. at surface, 1·02669; bottom, 1·02607.

Depth, 2200 fathoms; deposit, Globigerina Ooze, containing 81·27 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).



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Stomatella (Gena) nigra, Quoy and Gaimard (?). One specimen; obtained also at Port Jackson, 2 to 10 fathoms. Recorded from Tongatabu, Sandwich Islands, and West Africa. FERNANDO NORONHA.

Phasianella sp. (?).

Nerita ascensionis, Gmelin. (St. Michael's Rocks); obtained at no other locality by the Challenger. Recorded from Ascension.

Solarium sp. (?).

Scalaria (Cirsotrema) hellenica, Forbes. Obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil — Austrian Miocene and Piedmontese Pliocene.

Nassa (Hima) capillaris, n.sp. Obtained at no other locality.

Oliva (Olivella) fulgida, Reeve. Obtained at no other locality by the Challenger. Recorded from West Indies.

,, (,,) *pulchella*, Duclos (?). Two fragments; obtained at no other locality by the Challenger. Recorded from West Indies.

Columbella mercatoria (Linné). Obtained also at the Cape. Recorded from North Atlantic.

,, sp. (?).

Marginella (Persicula) sagittata, Hinds. Obtained at no other locality by the Challenger. Recorded from Brazil, Bahamas, Caribbean Sea, and Australia.

Cypræa spurca, Linné. Obtained also at Stations VIIP. and 122.

Mitrularia uncinata (Reeve) (?). Obtained also at Station 122, 350 fathoms, and North Atlantic, deep water. Recorded from West Indies and Philippines.

Xenophora corrugata (Reeve). Obtained at no other locality by the Challenger. Recorded from Indian Ocean, Japan, and China seas.

Cerithiopsis sp. (?).

Litorina (Hamus) nodulosa, d'Orbigny. (St. Michael's Rocks); obtained at no other locality by the Challenger. Recorded from West Indies.

Fossarus ambiguus (Linné). Obtained also at Station 122, 350 fathoms. Recorded from North Atlantic and Mediterranean. Fossil—Post-Tertiary of Sicily.

Rissoa sp. (?).

Utriculus (Tornatina) canaliculatus (Say). Obtained at no other locality by the Challenger. Recorded from United States coast.

Cylichna noronyensis, n.sp. Obtained at no other locality.

Vanikoro (?) sp.

Fernando Noronha

Polyplacophora (Haddon, Zool. pt. 43).

Ischnochiton boogii, n.n. One specimen; obtained at no other locality by the Challenger. Recorded from Plata Island, West Columbia (?).

Fishes (Günther, Zool. pt. 6).

Hæmulon chrysargyreum, Günther. Obtained at no other locality by the Challenger.

In addition to the foregoing, the following are recorded in the Station-book :—*Alcyonium* covered with Polyzoa, *Squilla*, *Pagurus*, and Nudibranch.

Excluding Protozoa, about 55 species were taken at Fernando Noronha, of which 9 are new to science, including representatives of 2 new genera; 5 of the new species were not obtained elsewhere.

Willemoes-Suhm remarks regarding these dredgings by Thomson and Murray in shallow water around Fernando Noronha, that the zoological material obtained was so scanty as not to allow any general conclusions to be drawn.

Stations 113B to 115

Stations 113B to 115 (Soundings 190 to 193), off Fernando Noronha (see Chart 14 and Diagram 4).

September 3, 1873.
Temperature of air at noon, 75°·3; mean for the day, 76°·1.
Temperature of water at surface, 78°·0.

At 8 A.M. got up steam. At 9.30 A.M. weighed anchor and proceeded westward under steam, sounding. Set fore and aft sails. At 10.20 A.M. discontinued sounding, unable to see marks on shore owing to rain. At 11.40 A.M. sounded in 400 fathoms, Hard Ground (Station 113B). At 1.20 P.M. stopped and sounded, about $6\frac{1}{2}$ miles from shore, in 525 fathoms, Hard Ground (Station 113C). At 3 P.M. stopped and sounded, about 13 miles S.W. of Fernando Noronha, in 820 fathoms, Hard Ground (Station 114). At 4.40 P.M. stopped and sounded, about 20 miles S.W. of Fernando Noronha, in 2150 fathoms, deposit, Globigerina Ooze, containing 79·30 per cent. of carbonate of lime (Station 115). At 6.15 P.M. made all plain sail.

Station 116

Station 116 (Sounding 194), Fernando Noronha to Pernambuco (see Chart 12 and Diagram 4).

September 4, 1873; lat. 5° 1′ S., long. 33° 50′ W.
Temperature of air at noon, 75°·3; mean for the day, 76°·0.

At 5.50 A.M. shortened and furled sails, and got up steam to sound. At 6 A.M. observed Fernando Noronha Island bearing S. 42° W. At 8 A.M. sounded in 2200 fathoms (Station 112); distance from Fernando Noronha 21 miles. At 9 A.M. obtained serial temperatures down to 1500 fathoms, and at 9.50 A.M. made all plain sail. At 11 A.M. shortened sail and proceeded under steam. At 12.30 P.M. stopped and sounded in 1010 fathoms, Hard Ground, bottom temperature 37°·5 (Station 113); distance from the island about 6 miles. At 2 P.M. stopped and sounded in 25 fathoms, deposit Calcareous Sand, containing 92·28 per cent. of carbonate of lime (Station 113A). Proceeded towards the anchorage in San Antonio Bay, and at 3 P.M. came to in 10 fathoms. STATION 112.

AT FERNANDO NORONHA.

The Challenger remained at Fernando Noronha till 8 A.M. on September 3 (for description of Fernando Noronha, see *Narr. Chall. Exp.*, vol. i. pp. 210–214). On September 2 the steam pinnace dredged round the island in depths of 7 to 25 fathoms. The following species are recorded in the Zoological Reports from the vicinity :—

ANIMALS FROM FERNANDO NORONHA.

MONAXONIDA (Ridley and Dendy, Zool. pt. 59).

Suberites carnosus (Johnston). One specimen ; obtained also at Station 75 and Port Jackson.

CORALS (Moseley, Zool. pt. 7).

Madracis asperula, M.-Edwards and Haime. Many specimens ; obtained also at Station 36 and Cape Verdes.

ASTEROIDEA (Sladen, Zool. pt. 51).

Astropecten brasiliensis, Müller and Troschel. Five specimens ; obtained also at Bahia, 7 to 20 fathoms.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophiothrix angulata, Ayres (?). Two specimens ; obtained also at Station 36 and Bahia.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Cidaris tribuloides (Lamarck). Obtained also at Bahia and Cape Verdes, 7 to 20 fathoms.

ANNELIDA (M'Intosh, Zool. pt. 34).

Nereis (Platynereis) eatoni, M'Intosh. One injured specimen ; obtained also at Stations 144A, 149, and Falkland Islands, 5 to 69 fathoms.

MACRURA (Spence Bate, Zool. pt. 52).

Artemesia longinaris, n.g., n.sp. (?). Fragment of pleon ; obtained also at Station 321, 13 fathoms. Only species of the genus.

Alpheus minus, Say. One specimen ; obtained also at St. Paul's Rocks and Bahia.

FERNANDO NORONHA

ANOMURA (Henderson, Zool. pt. 69).

Munida spinifrons, n.sp. One specimen; obtained at no other locality.

BRACHYURA (Miers, Zool. pt. 49).

Apocremnus septemspinosus, M.-Edwards (?). One specimen; obtained at no other locality by the Challenger.

Picroceroides tubularis, n.g., n.sp. Three specimens; obtained also at Bahia. Only species of the genus.

Macrocœloma concava, n.sp. Four specimens; obtained also at Bahia.

Mithrax forceps (M.-Edwards) (?). Several small specimens; obtained also at Bermuda and Bahia.

" *coronatus* (Herbst). Two specimens; obtained at no other locality by the Challenger.

" sp. (?). One specimen.

" (*Mithraculus*) *sculptus* (Lamarck). Several small specimens; obtained at no other locality by the Challenger. Recorded from West Indies.

Grapsus maculatus (Catesby). Four specimens (St. Michael's Rocks); obtained also at Bermuda, St. Paul's Rocks, Ascension, and Cape Verdes.

Calappa gallus (Herbst) (?). Two specimens; obtained also at Bermuda, Cape Verdes, and Amboina (?).

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Ervilia subcancellata, n.sp. Obtained also at Stations 33 and 120.

Cardium (*Fragum*) *medium*, Linné. Obtained at no other locality by the Challenger. Recorded from West Indies.

Lucina (*Codakia*) *pecten*, Lamarck. Obtained also at Station 33.

Pectunculus pectinatus (Gmelin). Several specimens (stated in Report to be from Station 113, 1010 fathoms, which is probably an error); obtained at no other locality by the Challenger.

Arca imbricata, Bruguière. Obtained also at Station 187, 6 fathoms.

Mytilus exustus (Lamarck), Reeve. (St. Michael's Rocks); obtained also at Station 122, 350 fathoms.

Pecten noronhensis, n.sp. Several specimens; obtained at no other locality.

SCAPHOPODA and GASTEROPODA (Watson, Zool. pt. 42).

Siphodentalium tetraschistum, n.sp. Obtained at no other locality.

Acmæa sp. (?). (St. Michael's Rocks.)

Temperature of water :— STATION 116.

Surface,	78·0	900 fathoms,	38·3
100 fathoms,	54·5	1000 „	38·1
200 „	45·4	1100 „	37·9
300 „	41·9	1200 „	37·7
400 „	40·0	1300 „	37·5
500 „	39·3	1400 „	37·2
600 „	39·0	1500 „	37·0
700 „	38·7	Bottom,	34·3
800 „	38·5		

Density at 60° F. at surface, 1·02628 ; bottom, 1·02609.

Depth, 2275 fathoms ; deposit, Globigerina Ooze, containing 65·04 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 9.20 A.M. shortened and furled sails, and got up steam to sound. Sounded in 2275 fathoms, obtained serial temperatures at intervals of 100 fathoms down to 1500 fathoms, and sample of bottom water for analysis. At 1.10 P.M. completed observations, and at 1.40 P.M. made all plain sail.

Distance at noon from Cape St. Roque, 90 miles ; from Pernambuco, 192 miles ; from Bahia, 556 miles. Made good 107 miles. Amount of current 30 miles, direction N. 75° W.

DIATOMACEÆ.—The following three species of Diatoms were observed by Mr. Comber in the deposit from this Station :— ORGANISMS FROM THE DEPOSIT.

Hemidiscus cuneiformis, Wallich.

Coscinodiscus radiatus, Ehrenberg.
„ *nodulifer*, Janisch.

Stations 117 and 117A (Soundings 195 and 196), Fernando Noronha to Pernambuco (see Chart 12). STATIONS 117 AND 117A.

September 6, 1873 ; lat. 5° 56′ S., long. 34° 45′ W.

Temperature of air at noon, 77°·8 ; mean for the day, 76°·7.

Temperature of water at surface, 78°·0.

Density at 60° F. at surface, 1·02673.

Depth, 1375 fathoms ; deposit, Globigerina Ooze, containing 56·59 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 10 A.M. got up steam, and at 11.30 A.M. shortened and furled square sails. At noon, proceeded under steam and fore and aft sails. Descried South American shore from

STATION 117 masthead. At 12.40 P.M. stopped and sounded in 1375 fathoms (Station 117), and at 2.15 P.M. proceeded. At 4.10 P.M. stopped and sounded in 500 fathoms, deposit Red Mud, containing 60·79 per cent. of carbonate of lime (Station 117A). Proceeded under steam for the rest of the day.

Distance at noon from Cape St. Roque, 46 miles; from Pernambuco, 130 miles; from Bahia, 484 miles. Made good 115 miles. Amount of current 26 miles, direction N. 83° W.

ORGANISMS FROM SURFACE-NETS.

Surface Organisms.—The following species is recorded from the surface near Cape St. Roque:—

STOMATOPODA (Brooks, Zool. pt. 45).

Gonodactylus chiragra, Latreille, var. *minutus*, nov.

Willemoes-Suhm writes: "I found in the tow-net sent down to a depth of 40 fathoms, while sounding in 500 fathoms, *Lucifer*, small Cephalopod, and Decapod larva; another specimen of the Decapod larva was taken next day."

Moseley writes: "A piece of *Sargassum*, caught in the patent log, was covered with Hydrozoa, *Spirorbis*, and *Flustra*; I also found on it an Annelid larva with three sets of hooks. The sea-weed was covered with fructification, though apparently it had been floating some time in the water."

September 7, 1873.

At 4 P.M. sounded in 16 fathoms, nearly due east of the tower at Fort Cabadello. Some sperm whales were seen.

STATION 118

Station 118 (Sounding 197), Fernando Noronha to Pernambuco (see Charts 12 and 15, and Diagram 4).

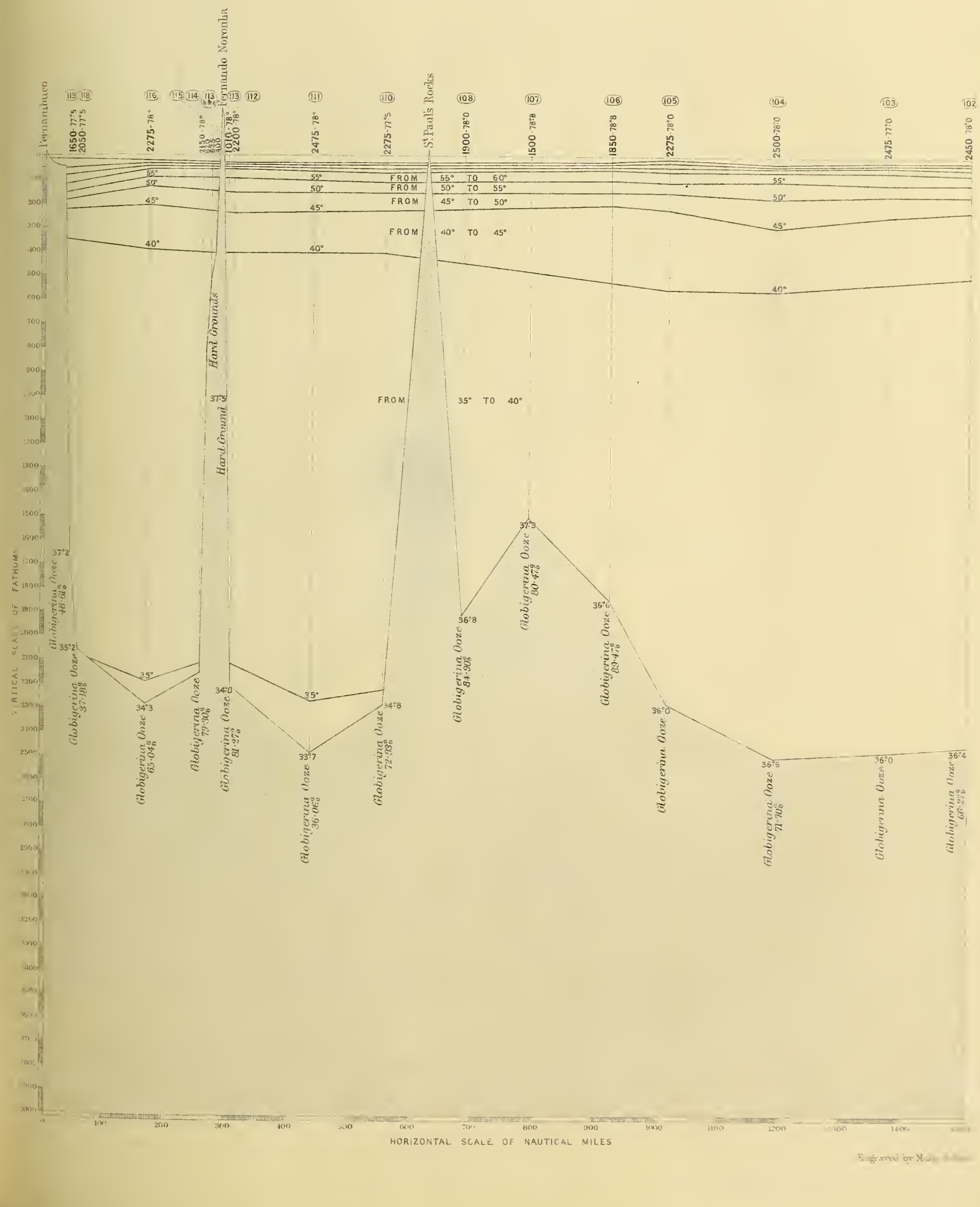
September 8, 1873; lat. 7° 28′ S., long. 34° 2′ W.
Temperature of air at noon, 78°·8; mean for the day, 77°·0.
Temperature of water at surface, 77°·5; bottom, 35°·2.
Depth, 2050 fathoms; deposit, Globigerina Ooze, containing 37·18 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

Under steam all night. At 5.45 A.M. stopped and sounded in 2050 fathoms. At 7.30 A.M. proceeded south-west under sail and steam.

ATLANTIC OCEAN

Longitudinal Temperature Section. From a position in Lat. 3°8′N., Long. 14°39′W. to Pernambuco.

For explanation of Symbols see Appendix 1.



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Station 119 (Sounding 198), Fernando Noronha to Pernambuco (see Charts 12 and 15, and Diagram 4). STATION 119.

September 8, 1873; lat. 7° 39′ S., long. 34° 12′ W.

Temperature of water:—

	°		°
Surface,	77·5	400 fathoms,	39·5
100 fathoms,	62·2	500 ,,	39·0
200 ,,	47·2	Bottom,	37·2
300 ,,	41·0		

Density at 60° F. at surface, 1·02745.

Depth, 1650 fathoms; deposit, Globigerina Ooze, containing 48·61 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 10 A.M. shortened sail, stopped and sounded in 1650 fathoms. At 11.45 A.M. completed sounding. Obtained a series of temperatures at intervals of 100 fathoms down to 500 fathoms. At 4 P.M. observed land on starboard beam. At 5.45 P.M. shortened and furled square sails, got up steam, and at 6 P.M. sounded in 22 fathoms. At 6.30 P.M. proceeded under steam. Observed Pernambuco and Olinda lights on starboard beam. At 9 P.M. altered course and sounded in 22 fathoms. At 10 P.M. sounded in 22 fathoms, and at 10.30 P.M. lost sight of lights. At 11 P.M. sounded in 26 fathoms, and at midnight in 40 fathoms, no bottom. *Sargassum* floated by the ship in considerable quantities, but not in patches.

Distance at noon from Pernambuco, 47 miles. Made good 65 miles. Amount of current 20 miles, direction N. 37° W.

Stations 120 and 121 (Soundings 199 and 200), between Pernambuco and Bahia (see Charts 12 and 15). STATIONS 120 AND 121.

September 9, 1873; lat. 8° 37′ S., long 34° 28′ W.

Temperature of air at noon, 79°·3; mean for the day, 77°·1.

Temperature of water at surface, 78°·0.

Density at 60° F. at surface, 1·02740.

Depth, 675 fathoms; deposit, Red Mud, containing 38·93 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 4.40 A.M. stopped and sounded in 675 fathoms (Station 120). At 5.20 A.M. proceeded S.S.W. At 6 A.M. stopped, put dredge over, and lowered cutter to try current, which was found to be N.N.W. $\frac{1}{2}$ mile per hour. At 10 A.M. hove up dredge with some specimens, and put over trawl. At 1.30 P.M. hove up trawl which contained various

STATION 120. specimens of interest. At 2 P.M. made all plain sail. At 4 P.M. observed land to W.N.W. At 4.10 P.M. got up steam, and put over dredge, veering 800 fathoms. At 4.20 P.M. furled sails, and sounded in 500 fathoms, deposit Red Mud, containing 38·56 per cent. of carbonate of lime (Station 121). At 6.20 P.M. hove up dredge, which contained a few specimens, and proceeded under steam. At midnight sounded in 60 fathoms, no bottom.

Distance at noon from Cape San Antonio, Bahia, 360 miles. Made good 57 miles. Amount of current 24 miles, direction N. 19° W.

ANIMALS FROM DREDGE AND TRAWL.

The following species are recorded in the Zoological Reports from the dredge and trawl at these Stations, the only things from the dredging in 500 fathoms being two fishes :—

CORALS (Moseley, Zool. pt. 7).

Deltocyathus italicus, M.-Edwards and Haime. For distribution see Station 24.
Stephanotrochus diadema, n.g., n.sp. One large specimen; obtained also at Station 78.
,, *discoides*, n.g., n.sp. One specimen; obtained at no other locality.

ASTEROIDEA (Sladen, Zool. pt. 51).

Zoroaster fulgens, Wyville Thomson. For distribution see Station 46.

OSTRACODA (Brady, Zool. pt. 3).

Macrocypris similis, n.sp. Obtained also at Stations 305 and 344, 165 and 420 fathoms.
Bythocypris reniformis, n.g., n.sp. For distribution see Station 24.
Bairdia formosa, Brady, var. (?). For distribution see Station 76.
,, *victrix*, Brady. For distribution see Station 24.
Cythere pyriformis, n.sp. A few valves; obtained at no other locality.
,, *dictyon*, n.sp. Widely distributed (see Station 24).
,, *ericea*, n.sp. Obtained at no other locality.
Krithe producta, n.sp. Widely distributed (see Station 70).
Cytherella lata, n.sp. A few detached valves; for distribution see Station 24.

AMPHIPODA (Stebbing, Zool. pt. 67).

Andania boecki, n.sp. One specimen; obtained at no other locality.
Lanceola aestiva, n.sp. One specimen; obtained also at Station 106.

ISOPODA (Beddard, Zool. pt. 33).

Serolis gracilis, n.sp. Five specimens; obtained at no other locality.

MACRURA (Spence Bate, Zool. pt. 52).

Gennadas parvus, n.g., n.sp. One specimen; for distribution see Station 45.
Glyphocrangon aculeata, M.-Edwards. One specimen; obtained at no other locality by the Challenger. Recorded from Martinique.
Notostomus brevirostris, n.sp. One specimen; obtained at no other locality.
Hymenodora mollis (Smith). One specimen; obtained at no other locality by the Challenger. Recorded from N.W. Atlantic.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Ervilia subcancellata, n.sp. Obtained also at Station 33 and Fernando Noronha.
Nucula pernambucensis, n.sp. A few valves; obtained at no other locality.
Leda solidula, n.sp. Single valve; obtained at no other locality.
Lima (Limatula) confusa, n.sp. Obtained also at Stations 23 and 78.
Amussium lucidum (Jeffreys). Obtained also at Stations 73 and 78.

SCAPHOPODA and GASTEROPODA (Watson, Zool. pt. 42).

Dentalium subterfissum, Jeffreys. For distribution see Station 78.
Trochus (Margarita) clavatus, n.sp. (?). Obtained also at Station 24.
„ , two other species undetermined.
Basilissa alta, n.g., n.sp., var. *oxytoma*, nov. The species obtained also at Station 24. Recorded subsequently from Gulf of Mexico ("Blake").
Seguenzia monocingulata, Seguenza (?), var. *lineata*, nov. Obtained also at Station 122 (?), 350 fathoms. For distribution of the species see Station 24.
„ *carinata*, Jeffreys. For distribution see Station 73.
„ *trispinosa*, n.sp. Obtained at no other locality.
Cyclostrema sulcatum, n.sp. Obtained at no other locality.
„ *conicum*, n.sp. Obtained also at Station 122, 350 fathoms.
Ianthina exigua, Lamarck. For distribution see Station 70.
Scalaria sp. (?).
Pleurotoma (Surcula) hemimeres, n.sp. One fragmentary specimen; obtained at no other locality.
„ („) *bulbodes*, n.sp. One specimen; obtained at no other locality.
„ , two other species undetermined.
Clionella lophoëssa, n.sp. Obtained also at Station 122, 350 fathoms (var. *platia*).
Cassis sp. (?), fry, same as at Station 56.
Natica sp. (?). Obtained also at Stations 24, 85, and 122.
Bittium enode, n.sp. Obtained at no other locality.

STATION 120.

Bittium mamillanum, n.sp. One specimen (afterwards broken); obtained at no other locality.

Cithna tenella, Jeffreys. For distribution see Station 75.

FISHES (Günther, Zool. pt. 57).

Melamphaës crassiceps, n.sp. One specimen; obtained also at Stations 107, 146, and 220.

Gonostoma microdon, n.sp. Twenty-five specimens; for distribution see Station 23.

Bathytroctes rostratus, n.g., n.sp. One specimen; obtained at no other locality.

Bathypterois quadrifilis, n.g., n.sp. One specimen (500 fathoms); obtained also at Station 126, 770 fathoms.

Nemichthys infans, n.sp. One specimen (500 fathoms); obtained also at Station 101.

In addition to the foregoing, the following are recorded in the Station-book:—Sertularian, *Archaster*, Ophiurids, many specimens of *Salenia*, worm (?), many Schizopods.

Excluding Protozoa, about 150 specimens of invertebrates and fishes were obtained on this date, belonging to about 58 species, of which 34 are new to science, including representatives of 6 new genera; 15 of the new species were not obtained elsewhere.

Willemoes-Suhm writes: "Besides several Echinoderms, which have hitherto been found only in the north, the dredge brought up a Crustacean (*Serolis*), three species of which are known to occur on the coast of Patagonia in shallow water. There is besides a very curious red worm, in which no bristles could be found, and which somewhat approaches *Balanoglossus* in shape. The head and collar are, however, not very distinct, and its internal organisation must differ widely from that of *Balanoglossus*, for on being put into spirit it sent out a long penis. The presence of such an organ in worms indicates a much more elaborate and distinct arrangement of the genital organs than is found either in Nemerteans, Annelids, or *Balanoglossus*. Shrimps came up in considerable quantities, most of them not of great interest, with the exception of a little Schizopod with loose carapace; this species has been got before, and to-day many males and females were procured. Among the Peneids there was a very large animal with elevated carapace, marked out into different regions by longitudinal and transverse ridges. There was also an Amphipod, formerly got on the coast of Nova Scotia, and another somewhat approaching the Hyperinæ, but apparently blind. Both these forms seem to me to differ widely from known types."

The following species of Pteropoda, Heteropoda, and Foraminifera were observed in the deposit from Station 120, 675 fathoms (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.) :— Station 120. Organisms from the Deposit.

Pteropoda (Pelseneer, Zool. pt. 65).

Limacina inflata (d'Orbigny).
" *lesueuri* (d'Orbigny).
" *trochiformis* (d'Orbigny).
" *bulimoides* (d'Orbigny).
Agadina n.sp. [larval Gasteropod].
Clio (*Creseis*) *virgula* (Rang).
" (") *acicula* (Rang).
" (*Hyalocylix*) *striata* (Rang).
" (*Styliola*) *subula* (Quoy and Gaimard).
Clio polita (Craven, MS.).
" *pyramidata*, Linné.
Cuvierina columnella (Rang).
Cavolinia trispinosa (Lesueur).
" *quadridentata* (Lesueur).
" *longirostris* (Lesueur).
" *tridentata* (Forskål).
" *uncinata* (Rang).
" *inflexa* (Lesueur).

Heteropoda (Smith, Zool. pt. 72).

Atlanta peronii, Lesueur.
" *souleyeti*, Smith.
Atlanta fusca, Eydoux and Souleyet.
" *inclinata*, Eydoux and Souleyet.

Foraminifera (Brady, Zool. pt. 22).—The pelagic species, which make up about 64 per cent. of the carbonate of lime present in the deposit, are marked thus ×.

Biloculina depressa, d'Orbigny.
" *elongata*, d'Orbigny.
" *irregularis*, d'Orbigny.
" *ringens* (Lamarck).
" *sphæra*, d'Orbigny.
" sp. (?).
Spiroloculina acutimargo, Brady.
" *tenuis* (Czjzek).
" sp. (?).
Miliolina circularis (Bornemann).
" *insignis*, Brady.
" *oblonga* (Montagu).
" *seminulum* (Linné).
" *tricarinata* (d'Orbigny).
" sp. (?).
Ophthalmidium inconstans, Brady.
Planispirina celata (Costa).
" *sigmoidea*, Brady.
Cornuspira involvens, Reuss.
Orbiculina adunca (Fichtel and Moll).
Pelosina cylindrica, Brady.
Psammosphæra fusca, Schulze.
Saccammina sphærica, Sars.
Hyperammina elongata, Brady.
" *friabilis*, Brady.
Hyperammina ramosa, Brady.
" *vagans*, Brady.
Rhabdammina linearis, Brady.
Aschemonella catenata, Norman.
Reophax adunca, Brady.
" *difflugiformis*, Brady.
" *nodulosa*, Brady.
" *pilulifera*, Brady.
" *scorpiurus*, Montfort.
" sp. (?).
Haplophragmium agglutinans, d'Orbigny.
" *calcareum*, Brady.
" *globigeriniforme* (Parker and Jones).
" *latidorsatum* (Bornemann).
" *nanum*, Brady.
Thurammina papillata, Brady.
" sp. (?).
Ammodiscus charoides (Jones and Parker).
" *gordialis* (Jones and Parker).
" *incertus* (d'Orbigny).
" *tenuis*, Brady.
Trochammina conglobata, Brady.
" *coronata*, Brady.
" *lituiformis*, Brady.

STATION 120

Trochammina pauciloculata, Brady.
,, *proteus*, Karrer.
,, *trullissata*, Brady.
Webbina clavata, Jones and Parker.
Cyclammina cancellata, Brady.
Textularia aspera, Brady.
,, *gramen*, d'Orbigny.
,, *luculenta*, Brady.
,, *quadrilatera*, Schwager.
Verneuilina propinqua, Brady.
,, *pygmæa* (Egger).
Bigenerina capreolus (d'Orbigny).
,, *pennatula* (Batsch) (?).
Gaudryina filiformis, Berthelin.
,, *pupoides*, d'Orbigny.
,, ,, var. *chilostoma*, Reuss.
,, *rugosa*, d'Orbigny.
,, *siphonella*, Reuss.
Bulimina aculeata, d'Orbigny.
,, *buchiana*, d'Orbigny.
,, *elegans*, d'Orbigny.
,, *elegantissima*, d'Orbigny.
,, ,, var. *seminula*, Terquem.
,, *inflata*, Seguenza.
,, *subcylindrica*, Brady.
,, *subteres*, Brady.
Bolivina karreriana, Brady.
,, *punctata*, d'Orbigny.
,, *robusta*, Brady.
Cassidulina crassa, d'Orbigny.
,, *subglobosa*, Brady.
,, sp. (?).
Lagena acuta (Reuss).
,, *apiculata*, Reuss.
,, *aspera*, Reuss.
,, *distomapolita*, Parker and Jones.
,, *formosa*, Schwager.
,, *hispida*, Reuss.
,, *lævis* (Montagu).
,, *lagenoides* (Williamson).
,, *marginata* (Walker and Boys).
,, *orbignyana* (Seguenza).
,, *stelligera*, Brady (?).
,, *striatopunctata*, Parker and Jones.
,, sp. (?).
Polymorphina communis, d'Orbigny.
,, *[illegible]* ([illegible]).
,, *[illegible]*, d'Orbigny, var. *sublineata*, Brady.
,, *[illegible]* ([illegible]).
,, *[illegible]*, [illegible].

Lingulina carinata, d'Orbigny.
,, ,, var. *seminula*, Hantken.
Rhabdogonium tricarinatum (d'Orbigny).
Marginulina costata (Batsch).
Vaginulina spinigera, Brady.
Cristellaria convergens, Bornemann.
,, *crepidula* (Fichtel and Moll).
,, *cultrata* (Montfort).
,, *orbicularis* (d'Orbigny).
,, *rotulata* (Lamarck).
,, *variabilis*, Reuss.
Uvigerina asperula, Czjzek.
,, ,, var. *ampullacea*, Brady.
,, *pygmæa*, d'Orbigny.
Sagrina virgula, Brady.
Ramulina globulifera, Brady.
× *Globigerina æquilateralis*, Brady.
× ,, *bulloides*, d'Orbigny.
× ,, *conglobata*, Brady.
× ,, *digitata*, Brady.
× ,, *dubia*, Egger.
× ,, *helicina*, d'Orbigny.
× ,, *inflata*, d'Orbigny.
× ,, *rubra*, d'Orbigny.
× ,, *sacculifera*, Brady.
× *Orbulina universa*, d'Orbigny.
× *Hastigerina pelagica* (d'Orbigny).
× *Pullenia obliquiloculata*, Parker and Jones.
,, *quinqueloba*, Reuss.
,, *sphæroides* (d'Orbigny).
Sphæroidina bulloides, d'Orbigny.
× ,, *dehiscens*, Parker and Jones.
× *Candeina nitida*, d'Orbigny.
Spirillina decorata, Brady.
,, *limbata*, Brady.
Discorbina rosacea (d'Orbigny).
,, *rugosa* (d'Orbigny).
,, *vilardeboana* (d'Orbigny).
Truncatulina akneriana (d'Orbigny).
,, *culter* (Parker and Jones).
,, *lobatula* (Walker and Jacob).
,, *robertsoniana*, Brady.
,, *tenera*, Brady.
,, *wuellerstorfi* (Schwager).
Anomalina grosserugosa (Gümbel).
× *Pulvinulina canariensis* (d'Orbigny).
× ,, *crassa* (d'Orbigny).
,, *elegans* (d'Orbigny).
× ,, *menardii* (d'Orbigny).
× ,, ,, var. *fimbriata*, Brady.

× *Pulvinulina michelinianа* (d'Orbigny).	*Pulvinulina umbonata*, Reuss.	STATION 120.
„ *pauperata*, Parker and Jones.	*Rotalia orbicularis*, d'Orbigny.	
× „ *tumida*, Brady.	*Amphistegina lessonii*, d'Orbigny.	

Stations 122 to 122c (Soundings 201 to 204), between Pernambuco and Bahia (see Chart 15). STATIONS 122 TO 122c.

September 10, 1873; lat. 9° 5′ S., long. 34° 50′ W.
Temperature of air at noon, 79°·0; mean for the day, 76°·5.
Temperature of water at surface, 77°·5.

At 4.15 A.M. stopped and sounded in 350 fathoms, deposit Red Mud, containing 42·15 per cent. of carbonate of lime (Station 122). At daylight, observed land to N.W. At 6 A.M. stopped, and at 6.15 A.M. lowered trawl, which came up at 8 A.M. with numerous specimens. The dredge had been sent down at the same time as the trawl, and it also brought up several specimens. Put over trawl, after emptying it of its contents. At 9.30 A.M. sounded in 120 fathoms, deposit Red Mud, containing 49·10 per cent. of carbonate of lime (Station 122A). Hove up trawl containing several specimens. At 10 A.M. sounded in 32 fathoms, deposit Red Sandy Mud with shells (Station 122B). At 11.45 A.M. stopped and sounded in 400 fathoms, deposit Red Mud (Station 122c). Put over trawl, which came up at 1.40 P.M. with several specimens. At 2 P.M. made all plain sail.

Distance at noon from Cape San Antonio, Bahia, 318 miles. Made good 42 miles. Amount of current 17 miles, direction N. 36° W.

From the above it will be seen that on September 10, 1873, off the coast of Brazil, the trawl was sent down three times and the dredge once, while soundings of 350, 120, 32, and 400 fathoms were recorded (Stations 122, 122A, 122B, 122c). It is almost impossible to state exactly the depth from which the specimens were obtained, so in the following list of species recorded in the Zoological Reports the various stations are combined, the depth given being indicated :—

KERATOSA (Poléjaeff, Zool. pt. 31). ANIMALS FROM DREDGE AND TRAWL.

Cacospongia levis, n.sp. One specimen (400 fathoms); obtained at no other locality.

Stelospongos longispinus (Fonbressin and Michelotti). One specimen (400 fathoms); obtained at no other locality by the Challenger.

Verongia tenuissima, Hyatt (?). One specimen (400 fathoms); obtained at no other locality by the Challenger.

MONAXONIDA (Ridley and Dendy, Zool. pt. 59).

Phakellia ventilabrum (Johnston), var. *connexiva*, nov. Numerous specimens (400 fathoms); obtained also at Station 317, 1035 fathoms. The species recorded from Arctic and Atlantic.

TETRACTINELLIDA (Sollas, Zool. pt. 63).

Characella aspera, n.g., n.sp. Two fragments (350 fathoms); obtained at no other locality. Only species of the genus.

Synops neptuni, n.sp. One specimen (32 fathoms); obtained at no other locality.

„ *rosmaeri*, n.sp. One specimen (350 fathoms); obtained at no other locality.

Corallistes typus, Schmidt. One specimen (350 fathoms); obtained at no other locality by the Challenger. Recorded from Florida.

ALCYONARIA (Wright and Studer, Zool. pt. 64).

Dasygorgia spiculosa, Verrill. One colony (350 fathoms); obtained at no other locality by the Challenger. Recorded from West Indies and Gulf of Mexico.

Primnoella distans, Studer. Four specimens (120 to 400 fathoms); obtained also at Station 23.

CORALS (Moseley, Zool. pt. 7).

Stylaster duchassaingi, Pourtalès. (400 fathoms); obtained at no other locality by the Challenger. Recorded from Tortugas.

Caryophyllia maculata (Pourtalès). Five specimens (400 fathoms); obtained also at Station 170, 630 fathoms.

REEF CORALS (Quelch, Zool. pt. 46).

Orbicella cavernosa (Esper). (30 fathoms); obtained at no other locality by the Challenger. A common West Indian form.

HYDROIDA (Allman, Zool. pt. 20).

Halicornaria plumosa, n.sp. (32 fathoms); obtained at no other locality.

CRINOIDEA (Carpenter, Zool. pts. 32 and 60).

Rhizocrinus lofotensis, Sars. Two specimens (400 fathoms); obtained also at Stations 24 and 323.

Pentacrinus maclearanus, Wyville Thomson, n.sp. One specimen (350 fathoms); obtained at no other locality.

Atelecrinus balanoides, n.sp. One specimen (350 fathoms); obtained at no other locality by the Challenger. Recorded subsequently from Caribbean Sea. STATIONS 122 TO 122C.

ASTEROIDEA (Sladen, Zool. pt. 51).

Astropecten cingulatus, n.sp. One specimen (depth doubtful); obtained at no other locality.

Calyptraster coa, n.g., n.sp. Several specimens (depth doubtful, but probably 350 fathoms); obtained at no other locality. Only species of the genus.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophioglypha acervata, Lyman. (350 fathoms); obtained at no other locality by the Challenger.

,, *ljungmani*, n.sp. (350 fathoms); obtained at no other locality.

Ophiomusium pulchellum, Wyville Thomson, n.sp. (350 fathoms); obtained also at Stations 87 and 142.

Ophiactis mülleri, Lütken. (350 fathoms); obtained also at Bahia, 7 to 20 fathoms (var. *quinqueradia*).

Ophiocnida scabra, n.sp. [Reported from Station 128, evidently in error; probably from one of these Stations]; obtained at no other locality.

Ophiacantha cosmica, n.sp. (350 fathoms); obtained also at Stations 135, 146, 147, 153, 156, 157, 158, 191, 218, 298, and 299, 350 to 2225 fathoms.

Ophiosciasma attenuatum, n.g., n.sp. (350 fathoms); obtained at no other locality. Only species of the genus.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Salenia varispina, Agassiz. Many specimens (350 fathoms); for distribution see Station 23.

Aspidodiadema microtuberculatum, n.g., n.sp. (350 fathoms); obtained also at Stations 124, 134, 298, and 299, 1600 to 2225 fathoms. Recorded subsequently from North Atlantic ("Blake").

Echinocyamus pusillus (Müller). (Depth doubtful); obtained at no other locality by the Challenger.

Homolampas fragilis, Agassiz. A fragment (depth doubtful); obtained at no other locality by the Challenger.

Brissus damesi, n.sp. (350 fathoms); obtained also at Station 75.

Annelida (M'Intosh, Zool. pt. 34).

Syllis brasiliensis, n.sp. One specimen (350 fathoms); obtained at no other locality.

Nereis (*Ceratonereis*) *brasiliensis*, n.sp. One specimen (32 fathoms); obtained at no other locality.

Nematonereis schmardæ, n.sp. One fragmentary specimen (350 fathoms); obtained at no other locality.

Eunice equibranchiata, n.sp. One fragmentary specimen (32 fathoms); obtained at no other locality.

Ostracoda (Brady, Zool. pt. 3).

Macrocypris tenuicauda, n.sp. Many specimens (350 fathoms); obtained also at Station 24.

,, *decora*, Brady. (350 fathoms); for distribution see Station 24.

Bythocypris reniformis, n.g., n.sp. (350 fathoms); for distribution see Station 24.

Bairdia formosa, Brady. (350 fathoms); for distribution see Station 76.

,, *victrix*, Brady. (350 fathoms); for distribution see Station 24.

Cythere dictyon, n.sp. (350 fathoms); widely distributed (see Station 24).

,, *dasyderma*, n.sp. (350 fathoms); widely distributed (see Station 5).

Krithe producta, n.sp. (350 fathoms); widely distributed (see Station 70).

Isopoda (Beddard, Zool. pt. 33).

Serolis antarctica, n.sp. (400 fathoms); obtained also at Stations 146 and 147, 1375 and 1600 fathoms.

Macrura (Spence Bate, Zool. pt. 52).

Amphiplectus depressus, n.g., n.sp. One specimen (350 fathoms); obtained at no other locality. Only species of the genus.

Plesionika uniproducta, n.g., n.sp. Two specimens (350 fathoms); obtained at no other locality.

Nothocaris geniculatus (M.-Edwards). Seventeen specimens (350 fathoms); obtained at no other locality by the Challenger. Recorded from Bay of Biscay.

Campylonotus capensis, n.g., n.sp. Two specimens (350 fathoms); obtained also at Station 145, 140 fathoms.

Anomura (Henderson, Zool. pt. 69).

Eupagurus occlusus, n.sp. One specimen in shell of *Pleurotoma* (350 fathoms); obtained at no other locality.

Paguristes visor, n.sp. Two specimens in shells of *Cassidaria* (350 fathoms); obtained at no other locality.

Parapagurus gracilis, n.sp. Two specimens in shells of *Pleurotoma* (350 fathoms); obtained at no other locality. STATIONS 122 TO 122c.

Munida stimpsoni, M.-Edwards. One specimen (350 fathoms); obtained at no other locality by the Challenger. Recorded from West Indies ("Blake").

,, *miles*, M.-Edwards. Seven specimens (350 fathoms); obtained at no other locality by the Challenger. Recorded from West Indies ("Blake") and New England.

Munidopsis erinacea (M.-Edwards). Two specimens (350 fathoms); obtained at no other locality by the Challenger. Recorded from West Indies ("Blake").

BRACHYURA (Miers, Zool. pt. 49).

Leptopodia sagittaria (Fabricius). One specimen (30 to 350 fathoms); obtained also at Madeira, Cape Verdes, and Bahia.

Metoporaphis forficulatus, M.-Edwards. One injured specimen (30 to 350 fathoms); obtained also at Bahia. Recorded from Guiana.

Podochela riisei (Stimpson). One injured specimen (30 to 350 fathoms); obtained also at Bermuda.

Herbstia (*Herbstiella*) *depressa* (Stimpson) (?). Three specimens (30 to 350 fathoms); obtained at no other locality by the Challenger. Recorded from St. Thomas.

Mithrax hispidus (Herbst), var. *pleuracanthus*, Stimpson. Two specimens (30 to 350 fathoms); obtained at no other locality by the Challenger. Recorded from West Indies.

,, sp. (?). One specimen (30 to 350 fathoms).

Pilumnus floridanus, Stimpson. One specimen (30 to 350 fathoms); obtained also at Bahia (?). Recorded from Tortugas.

Neptunus (*Hellenus*) *spinicarpus* (Stimpson). Four specimens (30 to 350 fathoms); obtained at no other locality by the Challenger.

Bathyplax typhlus, M.-Edwards, var. *oculiferus*, nov. One specimen (30 to 400 fathoms); obtained at no other locality. The species recorded from Frederickstadt and Santa Lucia.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Semele obliqua (Wood), juv. One specimen (350 fathoms); obtained at no other locality by the Challenger.

,, (*Abra*) *braziliensis*, n.sp. (350 fathoms); obtained at no other locality.

Verticordia deshayesiana, Fischer. Single valve (350 fathoms); obtained also at Station 185, 155 fathoms.

,, *woodii*, n.sp. (350 fathoms); obtained also at Station 24.

Leda semen, n.sp. (350 fathoms); obtained at no other locality.

Mytilus exustus (Lamarck), Reeve. (350 fathoms); obtained also at Fernando Noronha.

Anomia ephippium, Linné, var. (?). A few valves (350 fathoms); obtained also at Station 135, 100 to 150 fathoms. Recorded from Europe.

Scaphopoda and Gasteropoda (Watson, Zool..pt. 42).

Dentalium circumcinctum, n.sp. (350 fathoms); obtained also at Stations II., 23, and 56.

Fissurella (*Lucapina*) *cayenensis*, Lamarck. (350 fathoms); obtained also at Station 33.

Trochus (*Omphalius*) *hotesserianus*, d'Orbigny. (350 fathoms); obtained at no other locality by the Challenger. Recorded from West Indies.

,, (*Margarita*) *dnopherus*, n.sp. (350 fathoms); obtained at no other locality.

,, sp. (?). 350 fathoms).

Seguenzia monocingulata, Seguenza (?), var. *lineata*, nov. (350 fathoms); obtained also at Station 120. For distribution of the species see Station 24.

Scissurella aëdonia, n.sp. (350 fathoms); obtained also at Station 135, 100 to 150 fathoms.

Cyclostrema conicum, n.sp. (350 fathoms); obtained also at Station 120.

Phasianella sp. (?). (350 fathoms).

Turbo (?) sp. (350 fathoms).

Solarium sp. (?). (350 fathoms).

Bifrontia (?) *pernambucensis*, n.sp. Three specimens (350 fathoms); obtained at no other locality.

Trachysma delicatum (Philippi). (350 fathoms); for distribution see Station 75.

Scalaria funiculata, n.sp. (350 fathoms); obtained at no other locality.

,, *vermetiformis*, n.sp. (350 fathoms); obtained at no other locality.

Murex (*Chicoreus*) *calcar*, Kiener. (350 fathoms); obtained at no other locality by the Challenger. Recorded from Senegambia.

Trophon aculeatus, n.sp. (350 fathoms); obtained at no other locality.

Fusus sarissophorus, n.sp. (350 fathoms); obtained at no other locality.

,, sp. (?). (350 fathoms).

Phos smithi, n.sp. (350 fathoms); obtained at no other locality.

Oliva (*Olivella*) *amblia*, n.sp. (350 fathoms); obtained at no other locality. Stations 122 to 122c.
,, (,,) *ephamilla*, n.sp. (350 fathoms); obtained at no other locality.
Columbella (*Pyrene*) *strix*, n.sp. (350 fathoms); obtained also at Stations 23 and 24 (var. *subacta*).
,, sp. (?). (350 fathoms).
Marginella sp. (?). (350 fathoms).
Cancellaria sp. (?). (350 fathoms).
Pleurotoma spicea, n.sp. (350 fathoms); obtained at no other locality.
,, (*Surcula*) *plebeia*, n.sp. (350 fathoms); obtained at no other locality.
,, (*Drillia*) *horrenda*, n.sp. (350 fathoms); obtained at no other locality.
,, (*Rhaphitoma*) *rhysa*, n.sp. (350 fathoms); obtained at no other locality.
,, (*Bela*) *phæacra*, n.sp. One specimen (350 fathoms); obtained at no other locality.
,, (*Spirotropis*) *stirophora*, n.sp. (350 fathoms); obtained at no other locality.
,, (,,) *tmeta*, n.sp. Fragment (350 fathoms); obtained at no other locality.
,, (*Perrona*) *marmarina*, n.sp. (350 fathoms); obtained at no other locality.
,, (*Mangelia*) *subtilis*, n.sp. (350 fathoms); obtained at no other locality.
,, (,,) *hypsela*, n.sp. One injured specimen (350 fathoms); obtained at no other locality.
,, sp. (?). (350 fathoms).
Clathurella crispata (Jan). (350 fathoms); obtained also at Station 75.
,, *hormophora*, n.sp. (350 fathoms); obtained also at Stations 23 and 24.
,, *chariessa*, n.sp. (350 fathoms); obtained also at Stations 24, 73, 78, and 85.
,, (?) *perparva*, n.sp. (350 fathoms); obtained at no other locality.
,, *porcellana*, n.sp. (350 fathoms); obtained at no other locality.
,, , two other species undetermined. (350 fathoms).
Borsonia silicea, n.sp. (350 fathoms); obtained at no other locality.
Clionella tholoïdes, n.sp. (350 fathoms); obtained at no other locality.
,, *lophoëssa*, n.sp., var. *platia*, nov. (350 fathoms); the species obtained also at Station 120.
Conus sp. (?). (350 fathoms).
Cassidaria (*Sconsia*) *striata*, Lamarck. (350 fathoms); obtained at no other locality by the Challenger. Original locality unknown.
Strombus pugilis, Linné. (350 to 400 fathoms); obtained at no other locality by the Challenger. Recorded from West Atlantic.

Stations 122 to 122c.

Cypræa cinera, Gmelin. (350 to 400 fathoms); obtained at no other locality by the Challenger. Recorded from West Indies.

,, *spurca*, Linné. (350 fathoms); obtained also at Station VIIp. and Fernando Noronha.

Velutina sp. (?). (350 fathoms).

Natica sp. (?). Same as at Stations 24, 85, and 120.

Mitrularia uncinata (Reeve). (350 fathoms); obtained also at Fernando Noronha and North Atlantic, deep water.

Xenophora caribæa, Petit. (350 fathoms); obtained at no other locality by the Challenger. Recorded from West Indies.

Siliquaria (*Tenagodus*) sp. (?). (350 fathoms).

Turritella exoleta (Linné). (350 fathoms); obtained at no other locality by the Challenger. Recorded from West Indies.

Odostomia turrita, Hanley (?). One specimen (350 fathoms); obtained also at Station VIIp.

,, *unidentata* (Montague). One injured specimen (350 fathoms); obtained at no other locality by the Challenger. Recorded from Arctic, North Atlantic, and Mediterranean. Fossil—Middle Pliocene of Calabria, English Crag, glacial beds of Norway and Scotland.

,, (*Turbonilla*) sp. (?). (350 fathoms).

Eulimella rudis, n.sp. (350 fathoms); obtained at no other locality.

Aclis hyalina, n.sp. (350 fathoms); obtained at no other locality.

,, *sarissa*, n.sp. (350 fathoms); obtained at no other locality.

Eulima ephamilla, n.sp. (350 fathoms); obtained at no other locality.

,, *sarissa*, n.sp. (350 fathoms); obtained at no other locality.

,, *hebes*, n.sp. (350 fathoms); obtained at no other locality.

,, sp. (?). (350 fathoms).

Bittium sp. (?). (350 fathoms).

Triforis perversa (Linné). (350 fathoms); obtained also at Stations VIIp. and 75.

Cithna tenella (Jeffreys). (350 fathoms); for distribution see Station 75.

Fossarus ambiguus (Linné). (350 fathoms); obtained also at Fernando Noronha.

Rissoa (*Alvania*) *deliciosa*, Jeffreys. (350 fathoms); obtained also at Station 85.

,, *xanthias*, n.sp. (350 fathoms); obtained also at Station 24.

,, *pernambucensis*, n.sp. (350 fathoms); obtained at no other locality.

,, (*Ceratia*) *pachia*, n.sp. (350 fathoms); obtained at no other locality.

,, (*Cingula*) *rustica*, n.sp. (350 fathoms); obtained at no other locality.

Rissoina dubiosa (Adams) (?). (350 fathoms); obtained at no other locality by the Challenger. Recorded from West Indies.

Ringicula peracuta, n.sp. (350 fathoms); obtained also at Stations 24 and 56.

Amphisphyra seguenzæ, n.sp. (350 fathoms); obtained at no other locality by the Challenger. Recorded from North Atlantic ("Porcupine"). Fossil—Middle Pliocene.

Cylichna alba (Brown). (350 fathoms); obtained also at Station 75.

,, *ovata*, Jeffreys. (350 fathoms); for distribution see Station 24.

Cæcum regulare, Carpenter. One specimen (350 fathoms); obtained at no other locality by the Challenger.

Adeorbis (?), two species undetermined. (350 fathoms).

CEPHALOPODA (Hoyle, Zool. pt. 44).

Octopus tuberculatus, Blainville. One young specimen (32 fathoms); obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean.

,, *januarii*, Steenstrup, MS. One specimen (350 fathoms); obtained also at Station 237, 1875 fathoms. Recorded from Rio Janeiro.

POLYZOA (Busk, Zool. pt. 30; Waters, pt. 79).

Pasythea eburnea (Smitt). (32 to 400 fathoms); obtained also at Stations 23 and 24.

Catenicella sacculata, n.sp. (32 to 400 fathoms); obtained at no other locality.

,, *elegans*, Busk. (32 to 400 fathoms); obtained also at Stations 135, 163A, and 188, 28 to 1100 fathoms. Recorded from Australia, Madeira, and Mediterranean or Red Sea.

Bicellaria navicularis, n.sp. (32 to 400 fathoms); obtained also at Station 332, 2200 fathoms.

Bugula versicolor, n.sp. (350 fathoms); obtained also at Station 23.

Kinetoskias pocillum, n.sp. (32 to 400 fathoms); obtained also at Station 299, 2160 fathoms.

Farciminaria brasiliensis, n.sp. (32 to 400 fathoms); obtained at no other locality.

,, *gracilis*, n.sp. (32 to 400 fathoms); obtained also at Station 70.

,, *biseriata*, Waters, n.sp. (350 fathoms); obtained at no other locality.

Bifaxaria submucronata, n.g., n.sp. (350 fathoms); obtained at no other locality.

,, *corrugata*, n.g., n.sp. (350 fathoms); obtained at no other locality.

Salicornaria magnifica, n.sp. (350 fathoms); obtained also at Stations 13, 157, and 323.

Mucronella castanea, n.sp. (32 to 400 fathoms); obtained also at Bahia, 10 to 20 fathoms. [Waters calls it *Lepralia castanea* (Busk)].

Adeonella distoma, Busk, var. *imperforata*, nov. (Depth not given); the species obtained also at Station 75.

Cellepora aspera, n.sp. (350 fathoms); obtained at no other locality.

Brachiopoda (Davidson, Zool. pt. 1).

Terebratulina cailleti, Crosse. One small specimen (350 fathoms); obtained at no other locality by the Challenger. Recorded from West Indies and South America.

Tunicata (Herdman, Zool. pts. 38 and 76).

Cystodytes draschii, n.sp. One specimen (400 fathoms); obtained at no other locality.

Pyrosoma giganteum, Lesueur (?). Two small colonies (surface ?).

Fishes (Günther, Zool. pts. 6 and 57).

Centropristis annularis, n.sp. One specimen (30 or 350 fathoms); obtained at no other locality.

Bathyanthias roseus, n.g., n.sp. One specimen (30 or 350 fathoms); obtained at no other locality. Only species of the genus.

Malthe vespertilio, Linné. (30 or 350 fathoms); obtained at no other locality by the Challenger.

Peristethus truncatum, n.sp. One specimen (30 or 350 fathoms); obtained at no other locality.

Heliastes flavicauda, n.sp. One specimen (30 fathoms); obtained at no other locality.

Rhomboidichthys cornutus, n.sp. Several specimens (30 or 350 fathoms); obtained at no other locality.

Hippocampus guttulatus, Cuv. (30 or 350 fathoms); obtained at no other locality by the Challenger.

Monacanthus occidentalis, Günther. (30 or 350 fathoms); obtained at no other locality by the Challenger.

Ostracion quadricornis, Linné. (30 or 350 fathoms); obtained at no other locality by the Challenger.

Neobythites ocellatus, n.sp. One specimen (350 fathoms); obtained at no other locality.

Diplacanthopoma brachysoma, n.g., n.sp. One specimen (350 fathoms); obtained at no other locality. Only species of the genus. Recorded subsequently from Indian Ocean ("Investigator").

Macrurus leptolepis, n.sp. One specimen (350 fathoms); obtained at no other locality. STATIONS 122 TO 122c.

,, *lævis*, Lowe. One specimen (350 fathoms); obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean.

In addition to the foregoing, the following are recorded in the Station-book:—Actinian, Polyps, Holothurians, Pycnogonid (*Zetes* sp. ?), several specimens of *Chalaraspis ungnifer* [=*Eucopia australis*, Dana], *Stylifer* on the Rhizocrini, and *Lithodomus* in the Coral.

Excluding Protozoa, over 300 specimens of invertebrates and fishes were obtained on this date, belonging to about 194 species, of which 100 are new to science, including representatives of 11 new genera; 70 of the new species and 6 new genera were not obtained elsewhere.

Willemoes-Suhm writes, with reference to the dredgings on this date: "Except *Salenia* and *Rhizocrinus*, most of the animals taken in 350 to 400 fathoms were shallow-water forms, for it is very doubtful whether the *Pentacrinus* is characteristic of the deep-sea fauna. Among the Polyzoa were some very fine small forms. The Crustaceans were all shallow-water forms, except perhaps *Serolis*, which is probably an inhabitant of deeper water, at least in the tropics. The shells, including some fine specimens of *Phorus*, all belonged to shallow water, with the exception of *Dentalium*, which may descend to great depths, as does also apparently the fish-genus *Macrurus*, a specimen of which was taken to-day along with such fishes as one might expect in the warmer regions of the Atlantic or Mediterranean at moderate depths. One of the Rhizocrini from 400 fathoms had on it *Stylifer*, with egg-capsules showing a rather thick pellucid envelope, in which the living young larvæ, with their well-known nautiloid shell, were making rotations with their cilia. Some oval bodies, from 350 fathoms, which were completely covered with fragments of Pteropods, Foraminifera, &c., were found to be Holothurians. The dredging in 30 fathoms brought up great masses of Sponges, Corals, and such animals as are usually attached to these colonies."

Moseley writes: "From 30 fathoms came up two huge specimens of *Astræa* [=*Orbicella*] *cavernosa* showing that these rest on the bottom unattached to the rock. Inside were some examples of *Lithodomus dactylus*, dead, closed in, and apparently killed, by the rapid growth of the Coral. A number of sea-weeds came up with them, including the *Sargassum* found at the surface, but here attached; what we have seen on the surface is therefore evidently only detached from the bottom by currents or waves, as was to be expected from its bearing fructification. A huge cup-like Sponge [*Synops*

STATIONS 122 TO 123. *neptuni*] came up covered with sea-weeds, Alcyonarians, Polyzoa, and Hydroids, while several beautiful specimens of *Stenorhynchus* were on it."

ORGANISMS FROM THE DEPOSIT. The following species of Pteropoda and Heteropoda were observed in the deposit from 350 fathoms (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.):—

PTEROPODA (Pelseneer, Zool. pt. 65).

Limacina inflata (d'Orbigny).
,, *lesueuri* (d'Orbigny).
,, *bulimoides* (d'Orbigny).
Peraclis reticulata (d'Orbigny).
,, *bispinosa*, n.sp.
Clio (*Creseis*) *acicula* (Rang).
,, (*Styliola*) *subula* (Quoy and Gaimard).
Clio pyramidata, Linné.
Cuvierina columnella (Rang).
Cavolinia trispinosa (Lesueur).
,, *quadridentata* (Lesueur).
,, *longirostris* (Lesueur).
,, *uncinata* (Rang).
,, *inflexa* (Lesueur).

HETEROPODA (Smith, Zool. pt. 72).

Atlanta peronii, Lesueur.
,, *souleyeti*, Smith.
Atlanta fusca, Eydoux and Souleyet.
,, *inclinata*, Eydoux and Souleyet.

STATION 123. **Station 123** (Sounding 205), between Pernambuco and Bahia (see Charts 12 and 15).

September 11, 1873; lat. 10° 9′ S., long. 35° 11′ W.
Temperature of air at noon, 80°·8; mean for the day, 77°·2.
Temperature of water at surface, 77°·5; bottom, 37°·0.
Density at 60° F. at surface, 1·02681.
Depth, 1715 fathoms; deposit, Globigerina Ooze, containing 54·52 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 2 A.M. sounded in 50 fathoms, no bottom, and at 4 A.M. in 60 fathoms, no bottom. At 6 A.M. shortened and furled sails, and got up steam to sound. At 7 A.M. sounded in 1715 fathoms. At 7.55 A.M. proceeded under steam. At 9.15 A.M. sounded in 1000 fathoms, no bottom.

STATION 124. **Station 124.**

At 10.40 A.M. stopped, put trawl over, and sounded in 1600 fathoms, deposit Globigerina Ooze, containing 40·63 per cent. of carbonate of lime. At 3 P.M. commenced heaving in trawl, which came up at 4.10 P.M. with a few specimens. At 4.15 P.M. made all plain sail.

Distance at noon from Cape San Antonio, Bahia, 251 miles. Made good 69 miles. Amount of current 10 miles, direction N. 73° W. STATION 124.

The following species are recorded in the Zoological Reports from the trawl at this Station :— ANIMALS FROM TRAWL.

TETRACTINELLIDA (Sollas, Zool. pt. 63).

Thenea fenestrata (Schmidt). One specimen and fragment; obtained also at Station 106.

HEXACTINELLIDA (Schulze, Zool. pt. 53).

Euplectella suberea, Wyville Thomson, n.sp. One specimen; obtained also at Stations IV. and V.

Pheronema carpenteri (Wyville Thomson). Several fragments; obtained at no other locality by the Challenger. Recorded from North Atlantic ("Lightning," "Porcupine," and "Triton").

ECHINOIDEA (Agassiz, Zool. pt. 9).

Salenia hastigera, n.sp. For distribution see Station 106.

Aspidodiadema microtuberculatum, n.g., n.sp. Obtained also at Stations 122, 134, 298, and 299.

,, *tonsum*, n.g., n.sp. Obtained also at Stations 170, 171, and 209, 100 to 630 fathoms. Recorded subsequently from North Atlantic ("Blake").

ANNELIDA (M'Intosh, Zool. pt. 34).

Polynoë (*Robertianella*) *synophthalma*, n.sp. One specimen; obtained also at Station 3.

FISHES (Günther, Zool. pt. 57).

Ipnops murrayi, n.g., n.sp. One specimen; obtained also at Stations 133 and 198, 1900 and 2150 fathoms. Only species of the genus.

In addition to the foregoing, the Station-book records also :—Small *Tisiphonia*, *Umbellula*, and *Dentalium*.

Excluding Protozoa, about 20 specimens of invertebrates and fishes were obtained at this Station, belonging to about 11 species, of which 6 are new to science, including representatives of 2 new genera.

Moseley writes: "The animals taken in the trawl are also to be obtained off the coast of Portugal, and the identical species have been thus obtained there in one

STATION 124.

haul by Professor Thomson. The similarity of the fauna here is most striking. The actual deep-sea fauna seems to be universally distributed; only the fauna of from 200 to 500 or 600 fathoms about the coast-lines is peculiar. *Serolis*, which we have taken lately, is a South American animal living in shallow water on the coast of Patagonia. We have here then a case of the shallow-water fauna of high latitudes inhabiting the deep-sea of the tropics,—a corresponding fact to many similar ones observed in the northern hemisphere."

STATIONS 125 TO 126A.

Stations 125 to 126A (Soundings 207 to 209), between Pernambuco and Bahia (see Charts 12 and 15).

September 12, 1873; lat. 10° 46′ S., long. 36° 2′ W.
Temperature of air at noon, 78°·3; mean for the day, 76°·5.
Temperature of water at surface, 77°·0.
Density at 60° F. at surface, 1·02746; bottom, 1·02730.
Depth, 1200 fathoms; deposit, Red Mud, containing 20·79 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 1, 2, 3, 4, and 5 A.M. sounded in 40 fathoms, no bottom. At 6 A.M. shortened and furled sails, and got up steam to sound. Sounded in 1200 fathoms (Station 125). At 7.30 A.M. proceeded under steam and sail. At 8.40 A.M. shortened sail, and at 9 A.M. stopped and sounded in 770 fathoms, deposit Red Mud, containing 5·75 per cent. of carbonate of lime (Station 126). At 10 A.M. put over trawl, which came up at 12.10 P.M. containing various specimens. At 12.45 P.M. stopped, put trawl over, and sounded in 700 fathoms, deposit Red Mud (Station 126A). At 3.10 P.M. hove up trawl with several specimens, and at 3.15 P.M. made all plain sail. At 4 P.M. the land was visible on the starboard beam, but not from the deck. At 10.50 and 11.50 P.M. sounded in 45 fathoms, no bottom.

Distance at noon from Cape San Antonio, Bahia, 197 miles. Made good 59 miles. Amount of current 6 miles, direction N.

From the above it will be seen that the trawl was put over twice on this date, while soundings of 770 and 700 fathoms were taken. The following species are recorded in the Zoological Reports:—

[*Polymastia corticata*, *Nymphaster basilicus*, *Aricia norvegica*, var., and *Synaphobranchus pinnatus*, are recorded from Station 125, 1200 fathoms, but a sounding only was taken at that depth at 6 A.M., the trawl being put over at 10 A.M. after the ship had steamed nearer the land at Stations 126 and 126A, 770 and 700 fathoms].

Stations 126 and 126a. Animals from Trawl.

Monaxonida (Ridley and Dendy, Zool. pt. 59).

Polymastia corticata, n.sp. One specimen; obtained at no other locality.

Hydroida (Allman, Zool. pt. 70).

Thuiaria hyalina, n.sp. One fragmentary specimen; obtained at no other locality.

Asteroidea (Sladen, Zool. pt. 51).

Nymphaster basilicus, n.g., n.sp. Obtained at no other locality. Recorded subsequently from Indian Ocean ("Investigator").

Echinoidea (Agassiz, Zool. pt. 9).

Hemiaster zonatus, n.sp. Obtained also at Station VIII.

Annelida (M'Intosh, Zool. pt. 34).

Aricia norvegica, Sars, var. (?). One fragmentary specimen; obtained also at Station 47.

Schizopoda (Sars, Zool. pt. 37).

Gnathophausia zoëa, Willemoes-Suhm, n.g., n.sp. One specimen; obtained also at Stations 73, 106, and 171.

Macrura (Spence Bate, Zool. pt. 52).

Acanthephyra edwardsii, n.sp. Two specimens; obtained at no other locality.

Cephalopoda (Hoyle, Zool. pt. 44).

Japetella prismatica, n.g., n.sp. One specimen; obtained at no other locality. Only species of the genus.

Fishes (Günther, Zool. pt. 57).

Bathypterois quadrifilis, n.g., n.sp. Two specimens; obtained also at Station 121.

Synaphobranchus pinnatus (Gronovius). One specimen; obtained also at Stations 210, 214, 232, and 235, 345 to 565 fathoms. Recorded from Madeira and coast of United States.

In addition to the foregoing, the following are recorded in the Station-book:—Fragments of *Chirodota*, *Synapta*, Nemertean, Caridid shrimp, and small fish.

Excluding Protozoa, about 20 specimens of invertebrates and fishes were obtained on this date, belonging to about 15 species, of which 8 are new to science, including representatives of 4 new genera; 5 of the new species and 1 new genus were not obtained elsewhere.

Stations 125 to 126a.

Willemoes-Suhm writes: "The trawl brought up a great many shrimps, including a Caridid with many spines, while the Peneids were represented by several forms got before. One of them, 3 inches in length, had a long rostrum and very long outer flagella; another had legs three times the length of its body and terminated by tufts of hairs. There was also a male specimen of *Gnathophausia zoëa*, and a fragment of another Schizopod. Among the worms a long Nemertean was found, showing the mouth and lateral organs, but no orifice of the proboscis."

Station 127.

Station 127 (Sounding 210), between Pernambuco and Bahia (see Charts 12 and 15).

September 13, 1873; lat. 11° 42′ S., long. 37° 3′ W.
Temperature of air at noon, 73°·8; mean for the day, 74°·7.
Temperature of water at surface, 77°·0; bottom, 38°·5.
Density at 60° F. at surface, 1·02748.
Depth, 1015 fathoms; deposit, Red Mud, containing 28·72 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 2.30 A.M. squall from S.E. accompanied by rain. At 4 A.M. got up steam. At 6.30 A.M. proceeded under steam; shortened and furled square sails. At 8.45 A.M. stopped and sounded in 1015 fathoms. At 9.20 A.M. proceeded. At 9.40 A.M. altered course S.W., and observed land on the starboard bow and beam. At 10 A.M. stopped engines, and made all plain sail. At 4.10 P.M. proceeded under steam within sight of land. Sounded hourly during the night and found no bottom at 50 fathoms.

Distance at noon from Cape San Antonio, 107 miles. Made good 91 miles. Amount of current 13 miles, direction N. 22° W.

Station 128.

Station 128 (Sounding 211), between Pernambuco and Bahia (see Charts 12 and 15).

September 14, 1873; lat. 13° 6′ S., long. 38° 7′ W.
Temperature of air at noon, 78°·3; mean for the day, 76°·0.
Temperature of water at surface, 76°·5.
Depth, 1275 fathoms; deposit, Globigerina Ooze, containing 50·65 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 5 A.M. observed land on the starboard bow. At 6 A.M. got up steam. At 6.30 A.M. sounded in 1275 fathoms. At 7 A.M. made all plain sail. At 8 A.M. shortened and furled sails. At 12.5 P.M. stopped engines, the coals being exhausted. While waiting for the sea breeze, the ship was surrounded by a flight of butterflies, myriads falling on the deck, principally *Heliconius narceus*. At 3.30 P.M. passed San Antonio Pt., and at 4.25 P.M. came to at Bahia in 7 fathoms.

Ophiocnida scabra, n.sp., is reported from this Station (Lyman, Zool. pt. 14), but it probably came from the dredgings on September 10 (Station 122). STATION 128.

The expedition remained at Bahia from September 14 till September 25, 1873. During the stay at Bahia the steam pinnace was engaged several days dredging in the bay. In some places the deposit was a white quartz sand, containing fragments of felspar, mica, magnetite, hornblende, and other minerals, and also fragments of Echinoderms, Polyzoa, *Serpulæ*, and other organisms. In other places it was a dark mud, containing, along with fine argillaceous matter, all the above-mentioned minerals and organisms. The dredgings were very successful, animals belonging to all the principal invertebrate groups being taken; Astrophytons and Ophiurids were especially abundant. AT BAHIA.

The following species are recorded in the Zoological Reports as having been obtained in shallow water at Bahia during the visit:— ANIMALS FROM BAHIA.

KERATOSA (Poléjaeff, Zool. pt. 31).

Spongelia pallescens, Schmidt. Several specimens (shallow water); obtained at no other locality by the Challenger.

Psammopemma porosum, n.sp. Numerous fragments (shallow water); obtained at no other locality.

Euspongia officinalis (Linné), var. *lobosa*, nov. One specimen (shallow water); obtained at no other locality by the Challenger.

Cacospongia amorpha, n.sp. Two specimens (shallow water); obtained at no other locality.

,, *compacta*, n.sp. One specimen (shallow water); obtained at no other locality.

MONAXONIDA (Ridley and Dendy, Zool. pt. 59).

Pachychalina fibrosa, n.sp. Several pieces (7 to 20 fathoms); obtained also at Station 208 and Bermuda (?).

Rhizochalina putridosa (Lamarck?) (?). Several fragments (7 to 20 fathoms); obtained also at Station 162 and Port Jackson, 30 to 38 fathoms. Recorded from Australian seas.

Oceanapia robusta (Bowerbank). Two specimens and fragments (doubtful whether from Bermuda or Bahia, shallow water); see Bermuda.

Toxochalina robusta, Ridley. One specimen (7 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from Port Jackson.

Esperella nuda, n.sp. One specimen (shallow water); obtained at no other locality.

,, *fusca*, n.sp. Four specimens (17 fathoms); obtained at no other locality.

BAHIA

Desmacidon reptans, n.sp. Five specimens and fragments (shallow water and 7 to 20 fathoms); obtained at no other locality.

Myxilla (?) *plumosa* (Montagu), var. *fusifera*, nov. One specimen and fragments (shallow water); obtained at no other locality. The species recorded from Britain.

Rhaphidophlus gracilis (Ridley). One specimen (7 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from Mascarene Island.

Axinella echidnæa, Ridley, var. nov. One specimen (shallow water); obtained at no other locality by the Challenger. Recorded from Torres Strait.

,, *reticulata*, n.sp. One specimen (7 to 20 fathoms); obtained at no other locality.

Raspailia tenuis, n.sp. Two specimens (shallow water and 7 to 20 fathoms); obtained at no other locality.

Thrinacophora funiformis, n.g., n.sp. Four specimens and six fragments (shallow water and 7 to 20 fathoms); obtained at no other locality.

Stylocordyla stipitata (Carter). One specimen (7 to 20 fathoms); obtained also at Stations 49 and 147.

TETRACTINELLIDA (Sollas, Zool. pt. 63).

Craniella carteri, n.sp. Two specimens; obtained at no other locality.

Samus anonymus, Gray. One specimen; obtained at no other locality by the Challenger. Recorded from West Indies, Australia, South Seas, and Seychelles.

Pilochrota crassispicula, n.g., n.sp. Two specimens (7 to 12 fathoms); obtained at no other locality.

,, *anancora*, n.g., n.sp. One specimen (7 to 20 fathoms); obtained at no other locality.

Tribrachium schmidtii, Weltner. Several specimens (7 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from off Morro Light.

Erylus formosus, n.sp. One specimen (7 to 20 fathoms); obtained at no other locality.

Caminus sphæroconica, n.sp. One specimen (shallow water); obtained at no other locality.

Cydonium gloriosus, n.sp. Two specimens (7 to 25 fathoms); obtained at no other locality.

Azorica pfeifferæ, Carter. Obtained also at Stations 33, 66, Cape Verdes, and Amboina. BAHIA.

Scolopes moseleyi, n.g., n.sp. One specimen; obtained at no other locality. Only species of the genus.

CALCAREA (Poléjaeff, Zool. pt. 24).

Amphoriscus flamma, n.sp. Colony of twenty individuals (shallow water); obtained at no other locality.

ALCYONARIA (Wright and Studer, Zool. pt. 64).

Muricea bicolor, n.sp. (10 to 20 fathoms); obtained at no other locality.

Leptogorgia purpurea (Pallas). Two specimens (10 to 20 fathoms); obtained also at Station 310, 400 fathoms. Recorded from Brazil.

Telesto (*Carijoa*) *rupicola*, Müller. One colony (10 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from Brazil.

HYDROIDA (Allman, Zool. pts. 20 and 70).

Aglaophenia calamus, n.sp. (10 to 20 fathoms); obtained at no other locality.

Lytocarpus racemiferus, n.sp. (10 to 20 fathoms); obtained at no other locality.

Campanularia ptychocyathus, n.sp. One specimen (10 to 20 fathoms); obtained at no other locality.

Thyroscyphus ramosus, Allman. One specimen (10 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from Sand Key.

Sertularia cylindritheca, n.sp. One specimen (10 to 20 fathoms); obtained at no other locality.

,, *integritheca*, n.sp. Several specimens (10 to 20 fathoms); obtained at no other locality.

Desmoscyphus pectinatus, n.sp. Obtained also at Station 162, 38 to 40 fathoms.

,, *obliquus*, n.sp. (10 to 20 fathoms); obtained also at Cape York, 8 to 12 fathoms.

,, *acanthocarpus*, n.sp. Several specimens (10 to 20 fathoms); obtained at no other locality.

Idia pristis, Lamouroux. Several specimens (10 to 20 fathoms); obtained also at Station 203, 20 fathoms. Recorded from Persian Gulf, Mergui Archipelago, and Australian seas.

BAHIA

CRINOIDEA (Carpenter, Zool. pt. 60).

Antedon dübeni, Böhlsche. One specimen (20 fathoms); obtained at no other locality by the Challenger. Recorded from Rio Janeiro and Abrolhos (?).

,, *carinata* (Lamarck). Several specimens (7 to 20 fathoms); obtained at no other locality by the Challenger. A widely-distributed species.

Actinometra meridionalis (Agassiz). Fourteen specimens (7 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from West Atlantic.

,, *lineata*, n.sp. Eight specimens (7 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from West Atlantic.

ASTEROIDEA (Sladen, Zool. pt. 51).

Astropecten brasiliensis, Müller and Troschel. Several specimens (7 to 20 fathoms); obtained also at Fernando Noronha.

Luidia alternata (Say), Lütken. (7 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from West Indies.

,, *clathrata* (Say), Lütken. (7 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from West Atlantic.

Narcissia trigonaria, n.sp. Obtained at no other locality.

Echinaster spinosus (Retzius), Müller and Troschel. (7 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from West Atlantic.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophiura brevispina, Say. Obtained at no other locality by the Challenger.

,, *appressa*, Say. Obtained at no other locality by the Challenger.

,, *cinerea* (Müller and Troschel). (7 to 20 fathoms); obtained also at St. Thomas.

Ophiocoma impressa (Lütken). (7 to 20 fathoms); obtained at no other locality by the Challenger.

Ophiactis mülleri, Lütken, var. *quinqueradia*, Lyman. (7 to 20 fathoms); obtained also at Station 122.

Ophionereis reticulata (Say). (7 to 20 fathoms); obtained also at Bermuda.

Ophiothrix angulata (Say), var. (7 to 20 fathoms); obtained also at Station 36 and Fernando Noronha.

Ophiomyxa flaccida (Say). (7 to 20 fathoms); obtained also at Station 36. BAHIA.

Astrophyton costosum, Seba. (7 to 20 fathoms); obtained at no other locality by the Challenger.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Cidaris tribuloides (Lamarck). (7 to 20 fathoms); obtained also at Cape Verdes and Fernando Noronha.

Clypeaster subdepressus (Gray). Obtained at no other locality by the Challenger.

Mellita sexforis, Agassiz. Obtained at no other locality by the Challenger.

Encope emarginata (Leske). (20 to 70 fathoms?); obtained at no other locality by the Challenger.

Metalia pectoralis, Agassiz. Obtained at no other locality by the Challenger.

HOLOTHURIOIDEA (Théel, Zool. pt. 39).

Colochirus pygmæus, n.sp. One specimen (7 to 20 fathoms); obtained at no other locality.

Thyone pervicax, n.sp. One specimen (7 to 20 fathoms); obtained at no other locality.

GEPHYREA (Selenka, Zool. pt. 36).

Thalassema baronii, Greeff. One specimen (7 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from Canaries.

MYZOSTOMIDA (Graff, Zool. pt. 27).

Myzostoma gigas, Lütken. (On *Antedon carinata*).

ISOPODA.

One specimen, genus and species undetermined.

MACRURA (Spence Bate, Zool. pt. 52).

Sicyonia carinata (Olivier). One specimen (20 fathoms); obtained also at St. Thomas.

Alpheus intrinsecus, n.sp. One specimen (7 to 20 fathoms); obtained at no other locality.

„ *minus*, Say. Three specimens; obtained also at St. Paul's Rocks and Fernando Noronha.

ANOMURA (Henderson, Zool. pt. 69).

Dromidia antillensis, Stimpson. Several specimens (7 to 20 fathoms); obtained at no other locality by the Challenger.

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Hypoconcha panamensis, Smith (?). One specimen (shallow water); obtained at no other locality by the Challenger.

Zanclifer caribensis (Freminville). One specimen (7 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from West Indies.

Petrolisthes serratus, n.sp. One specimen (7 to 20 fathoms); obtained at no other locality.

,, sp. (?). One specimen (shallow water).

BRACHYURA (Miers, Zool. pt. 49).

Leptopodia sagittaria (Fabricius). Several specimens (7 to 20 fathoms); obtained also at Station 122, Madeira, and Cape Verdes.

Metoporaphis forficulatus, M.-Edwards. One specimen (7 to 20 fathoms); obtained also at Station 122.

Notolopas brasiliensis, n.sp. Three specimens (7 to 20 fathoms); obtained at no other locality.

Picroceroides tubularis, n.g., n.sp. Two specimens; obtained also at Fernando Noronha.

Macrocœloma trispinosa (Latreille). Four specimens (shallow water); obtained also at Bermuda.

,, *septemspinosa* (Stimpson). One specimen (shallow water); obtained at no other locality by the Challenger. Recorded from Tortugas.

,, *concava*, n.sp. One specimen (shallow water); obtained also at Fernando Noronha.

Mithrax cornutus, Saussure. Four specimens (shallow water); obtained at no other locality by the Challenger. Recorded from West Indies.

,, *forceps* (M.-Edwards). One specimen (shallow water); obtained also at Bermuda.

Lambrus guérinii, Capello, var. (?). Two specimens (shallow water); obtained at no other locality by the Challenger. Recorded from West Atlantic and Mauritius.

,, *serratus*, M.-Edwards. Two specimens (shallow water); obtained at no other locality by the Challenger. Recorded from West Indies.

Heterocrypta granulata (Gibbes). One specimen (shallow water); obtained at no other locality by the Challenger. Recorded from North-West Atlantic.

Actæa rufopunctata (M.-Edwards), var. *nodosa*, Stimpson. One specimen (shallow water); obtained at no other locality by the Challenger. A widely-distributed species. BAHIA.

Micropanope spinipes, M.-Edwards (?). One specimen (shallow water); obtained at no other locality by the Challenger. Recorded from Brazil.

Pilumnus brasiliensis, n.sp. One specimen (7 to 20 fathoms); obtained at no other locality.

,, *floridanus*, Stimpson (?). Three specimens (shallow water); obtained also at Station 122.

,, *fragosus*, M.-Edwards, var. Two specimens (7 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from St. Thomas.

Cronius bispinosus, n.sp. Two specimens (shallow water); obtained at no other locality.

Ocypoda arenaria (Catesby). One specimen (shallow water); obtained also at Bermuda.

Sesarma mülleri, M.-Edwards. One specimen (shallow water); obtained at no other locality by the Challenger. A widely-distributed species.

Persephona punctata (Browne). One specimen (shallow water); obtained at no other locality by the Challenger. Recorded from America and South Africa.

Iliacantha intermedia, n.sp. One specimen (shallow water); obtained at no other locality.

Lithadia cariosa, Stimpson, var. (?). One specimen (shallow water); obtained at no other locality by the Challenger. Recorded from Eastern North America.

PYCNOGONIDA (Hoek, Zool. pt. 10).

Phoxichilidium fluminense, Krøyer. One specimen (7 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from Magellan Strait and Atlantic coast of South America.

,, *insigne*, n.sp. One specimen (7 to 20 fathoms); obtained at no other locality.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Cardium (*Papyridea*) *bullatum* ((Linne ?) Chemnitz). (7 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from West Indies and west coast of Central America.

BAHIA.

GASTEROPODA (Watson, Zool. pt. 42).

Fusus marmoratus, Philippi. (7 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from Brazil.

Marginella fulminata, Kiener. (7 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from Brazil.

Cypræa sp. (?). (7 to 20 fathoms).

POLYZOA (Busk, Zool. pts. 30 and 50; Waters, pt. 79).

Nellia oculata, Busk, (10 to 40 fathoms); obtained also at Stations 148, 151, 188, 190, and 208,-18 to 550 fathoms. Recorded from Torres Strait, Indian Ocean, and Gulf of Florida.

Bicellaria glabra (Hincks). (10 to 12 fathoms); obtained at no other locality by the Challenger. Recorded from Australia.

Smittia tenuis, n.sp. (?). (10 to 20 fathoms); obtained at no other locality.

Mucronella castanea, n.sp. (10 to 20 fathoms); obtained also at Station 122. [Waters calls it *Lepralia castanea* (Busk)].

Gemellipora glabra, Smitt. (10 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from Gulf of Florida and John Adams' Bank.

Cellepora imbellis, n.sp. (?). (10 to 20 fathoms); obtained at no other locality.

,, *mamillata*, var. *atlantica*, Busk. (10 to 20 fathoms); obtained also at Station 148, 210 fathoms. Recorded from Patagonia and Australia.

Cupularia monotrema, n.sp. (10 to 20 fathoms); obtained at no other locality.

,, *canariensis*, Busk. (10 to 80 fathoms); obtained at no other locality by the Challenger. A widely-distributed species. Fossil—Europe and Australia.

Amathia distans, n.sp. (10 to 20 fathoms); obtained at no other locality.

,, *brasiliensis*, n.sp. (10 to 20 fathoms); obtained at no other locality.

Farrella atlantica, n.sp. (10 to 20 fathoms—on *Amathia*); obtained at no other locality.

TUNICATA (Herdman, Zool. pts. 17 and 38).

Polycarpa pilella, n.sp. Twelve specimens (7 to 20 fathoms); obtained at no other locality.

Aplidium crassum, n.sp. One specimen (shallow water); obtained at no other locality.

Leptoclinum speciosum, n.sp. Several specimens (7 to 20 fathoms); obtained at no other locality.

Leptoclinum speciosum, var. *asperum*, nov. Several specimens (7 to 20 fathoms); obtained also at Station 142, 150 fathoms. BAHIA.

,, *annectens*, n.sp. One specimen (shallow water); obtained at no other locality.

Diplosoma macdonaldi, n.sp. One specimen (shallow water); obtained at no other locality.

FISHES (Günther, Zool. pt. 6).

Rhypticus arenatus, C.V. Obtained at no other locality by the Challenger.

Hippocampus villosus, n.sp. (7 to 20 fathoms); obtained at no other locality.

In the foregoing list 127 species are enumerated, of which 57 are new to science, including representatives of 4 new genera; 50 of the new species and 1 new genus were not obtained elsewhere.

Willemoes-Suhm writes, with regard to these dredgings by Thomson and Murray in shallow water off Bahia: "No forms of extraordinary size or development have been found in the bay, but simply those representatives of the marine classes as might be found anywhere in the Atlantic, while it seemed to me that there was not such a great variety as in the West Indies, where the large *Strombus*, Corals, and *Calappa* are so conspicuous. Several species of *Comatula* and Ophiurids seemed to be the commonest Echinoderms, and *Astrophyton* and *Mellita* were associated with them in sandy places. Small cherry-like siliceous Sponges, and other Sponges, were found covered by *Alcyonium* and Polyzoa. One Sipunculid and some large specimens of *Sabella* in soft tubes were taken, and among the Crustacea were several genera of Maiids and Cancerids, an animal allied to *Ranina*, the frog-crab, large Pagurids, *Porcellana*, *Alpheus*, &c. No Brachiopods were found, but many small Gasteropods, as *Turritella*, *Conus*, *Bulla*, and a large dead *Fusus*-like shell. Very fine specimens of a Plumularian, with *Caprella* on the branches, were taken."

The departure from Bahia was somewhat hastened owing to one of the crew, who had been sleeping on shore, having caught yellow fever, from which he afterwards died. After leaving Bahia the Challenger proceeded to the southward until September 30, without sounding or dredging, as it was desirable to get into cool weather at once to avoid any risk of yellow fever spreading amongst the ship's company. YELLOW FEVER.

Station 129 (Sounding 212), Bahia to Tristan da Cunha (see Chart 16 and Diagram 5). STATION 129.

September 30, 1873; lat. 20° 13′ S., long. 35° 19′ W.

Temperature of air at noon, 75°·5; mean for the day, 73°·9.

STATION 129.

Temperature of water :—

Surface,	74·0°	800 fathoms,	37·3°
75 fathoms,	65·9	900 ,,	37·1
100 ,,	63·2	1000 ,,	36·9
200 ,,	51·5	1100 ,,	36·7
300 ,,	43·5	1200 ,,	36·5
400 ,,	40·1	1300 ,,	36·3
500 ,,	38·8	1400 ,,	36·1
600 ,,	38·1	1500 ,,	36·0
700 ,,	37·7	Bottom,	34·2

Density at 60° F. :—

Surface,	1·02759	200 fathoms,	1·02735
50 fathoms,	1·02738	300 ,,	1·02560
100 ,,	1·02738	400 ,,	1·02733

Depth, 2150 fathoms ; deposit, Globigerina Ooze, containing 46·43 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.30 A.M. shortened and furled sails, and got up steam to sound and dredge. At 7.30 A.M. sounded in 2150 fathoms. At 8.30 A.M. put dredge over. At noon obtained serial temperatures at intervals of 100 fathoms down to 1500 fathoms. The carbonic acid was determined in water from 100 fathoms, and amounted to 36·0 milligrammes per litre ; owing to a fault in the new water-bottle this was probably surface water. At 3.30 P.M. commenced heaving in dredge, but at 4.10 P.M. the dredge-rope carried away, and dredge, weights, &c., were lost. At 4.20 P.M. made all plain sail.

Distance at noon from Tristan da Cunha, 1572 miles. Made good 70 miles. Amount of current 22 miles, direction S. 5° W.

ORGANISMS FROM SURFACE-NETS.

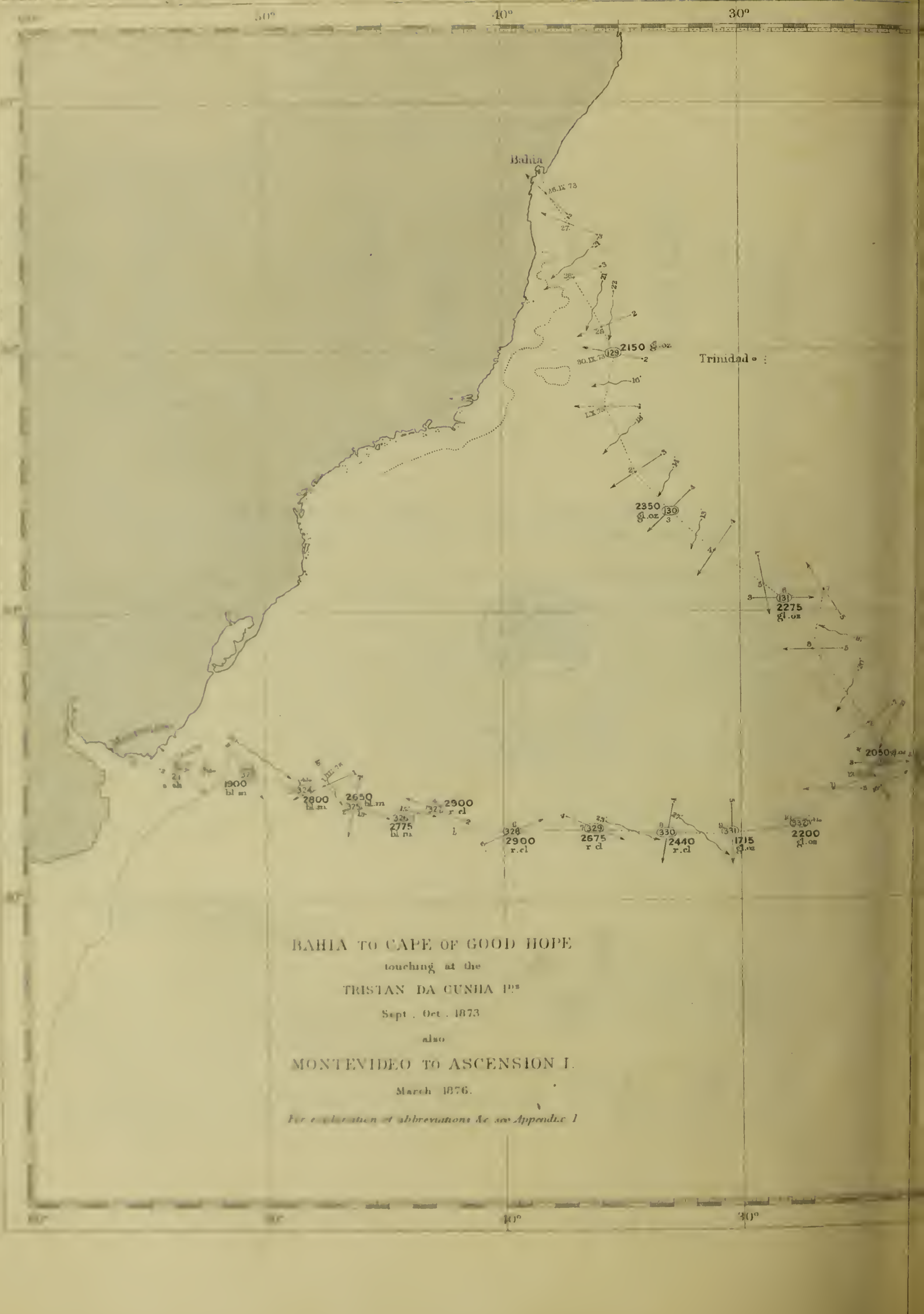
Surface Organisms.—The following species is recorded from the surface in this locality :—

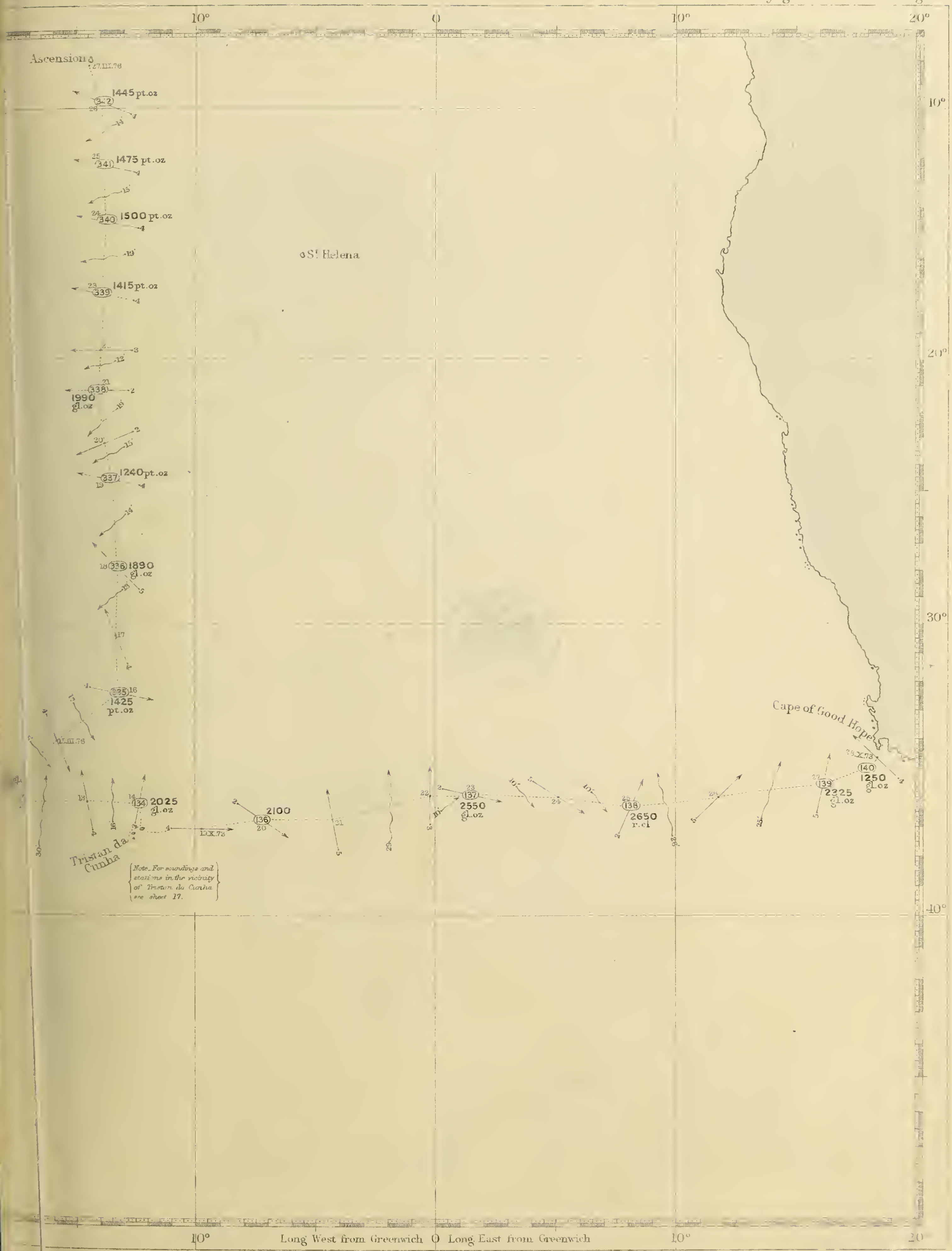
AMPHIPODA (Stebbing, Zool. pt. 67).

Scinà cornigera (M.-Edwards).

A little phosphorescence was observed during the night of September 29–30, and two hauls with the tow-net produced a few *Pyrocystis* and Foraminifera, *Physalia*, *Diphyes*, *Glebea*, *Alciopa*, *Phronima*, *Hyperia*, larvæ of *Squilla*, *Euphausia*, Zoëæ, many specimens of *Halobates*, *Phylliroë*, *Glaucus*, and flying-fish.

Willemoes-Suhm writes : "The tow-net procured several specimens of *Halobates*, the marine representative of *Hydrometra* so well known from the surface of our ponds ; there is another marine Hemipter, *Belostoma*, the representative of *Nepa*, which we have


BAHIA TO CAPE OF GOOD HOPE
touching at the
TRISTAN DA CUNHA Ids
Sept . Oct . 1873
also
MONTEVIDEO TO ASCENSION I.
March 1876.
For explanation of abbreviations &c see Appendix I
Bahia
Trinidad
50°
40°
30°
2150
2350
2275
2050
1900
2800
2650
2775
2900
2900
2675
2440
1715
2200


10°
0
10°
20°
Ascension
1445 pt.oz
1475 pt.oz
1500 pt.oz
S.t Helena
1415 pt.oz
1990 gl.oz
1240 pt.oz
1890 gl.oz
1425 pt.oz
2025 gl.oz
2100
2550 gl.oz
2650 r.cl
2325 gl.oz
1250 gl.oz
Cape of Good Hope
Tristan da Cunha
Note. For soundings and stations in the vicinity of Tristan da Cunha see sheet 17.
10°
20°
30°
40°
Long. West from Greenwich
Long. East from Greenwich

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not hitherto obtained, probably because it does not live on the surface but in the sea-weeds of shallow-water regions. *Phylliroë* was also present, but I am not sure whether it is identical with *Phylliroë bucephala*, which is well known from the North Atlantic and Mediterranean, and which is usually accompanied by a small jelly-fish (Discophore) attached to its ventral surface (described by Krohn under the name of *Mnestra parasitica*), or whether it belongs to the species upon which Adams founded his genus *Acura*. Our species was taken only to the south of the Cape Verdes, and, as it is quite transparent, is very useful for the study of the anatomy of the Nudibranchs. In the skin are many glands and silvery spots, which have proved to be chromatophores; the short intestine, terminated on the right side by an anus, is connected with four large lobes of liver, and there are also visible the generative organs (especially the two hermaphroditical glands, the seminal and ovarial gland with the penis, all running into a genital atrium), the heart with its atrium situated behind the ventricle, and the excretory organ (an elongated simple tube opening on the right side). There are no organs of locomotion, and branchiæ are entirely absent, so that the respiration must be cutaneous. In swimming on the surface the animal slightly moves the posterior and flattened part of its body when gliding along." Station 129.

Station 130 (Sounding 213), Bahia to Tristan da Cunha (see Chart 16 and Diagram 5). Station 130.

October 3, 1873; lat. 26° 15′ S., long. 32° 56′ W.

Temperature of air at noon, 73°·5; mean for the day, 70°·8.

Temperature of water:—

	°		°
Surface,	69·0	900 fathoms,	37·1
100 fathoms,	60·5	1000 „	37·0
200 „	54·3	1100 „	36·9
300 „	48·3	1200 „	36·8
400 „	42·8	1300 „	36·7
500 „	39·0	1400 „	36·6
600 „	38·0	1500 „	36·5
700 „	37·5	Bottom,	34·7
800 „	37·3		

Density at 60° F.:—

Surface,	1·02710	200 fathoms,	1·02614
4 fathoms,	1·02711	300 „	1·02578
50 „	1·02690	400 „	1·02562
100 „	1·02658	Bottom,	1·02714

Station 130.

Depth, 2350 fathoms; deposit, Globigerina Ooze, containing 35·93 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.20 A.M. shortened and furled sails, and got up steam. At 7.30 A.M. put trawl over, and veered 3500 fathoms. At 8.20 A.M. brought ship to wind, and proceeded under steam to sound. Sounded in 2350 fathoms. At 9 A.M. obtained serial temperatures at intervals of 100 fathoms down to 1500 fathoms. The carbonic acid was determined in bottom water, and amounted to 49·1 milligrammes per litre. At 2 P.M. commenced heaving in trawl. At 6.30 P.M. the trawl came to the surface, apparently heavily laden judging from the full extension of the accumulators, but at the moment when the beam of the trawl appeared at the surface, the swivel between the rope and the chain carried away, and the trawl with its unknown burden sank, to the intense disappointment of the naturalists and naval officers gathered on the bridge. At 6.50 P.M. made all plain sail.

Distance at noon from Tristan da Cunha, 1235 miles. Made good 118 miles. Amount of current 14 miles, direction S. 27° W.

Organisms from Surface Nets.

Surface Organisms.—The following are recorded in the note-books from the tow-nets hauled in twice from a depth of 100 fathoms:—*Pyrocystis*, Foraminifera, Radiolaria, *Cuboides*, *Alciopa*, *Hyalophyllum* [=*Saphirinella*] and other Copepods, *Phronima*, *Hyperia*, *Lucifer*, Decapod larvæ, and *Cranchia*.

Willemoes-Suhm writes: "Remarkable among the surface animals is the male of *Phronima*, which is rather rare and only recently described by Claus, also a very big species of *Lucifer* not got before. There is apparently not much difference between the faunæ of the South and North Atlantic; the same animals occur again and again."

Station 131.

Station 131 (Sounding 214), Bahia to Tristan da Cunha (see Chart 16 and Diagram 5).

October 6, 1873, lat. 29° 35′ S., long. 28° 9′ W.

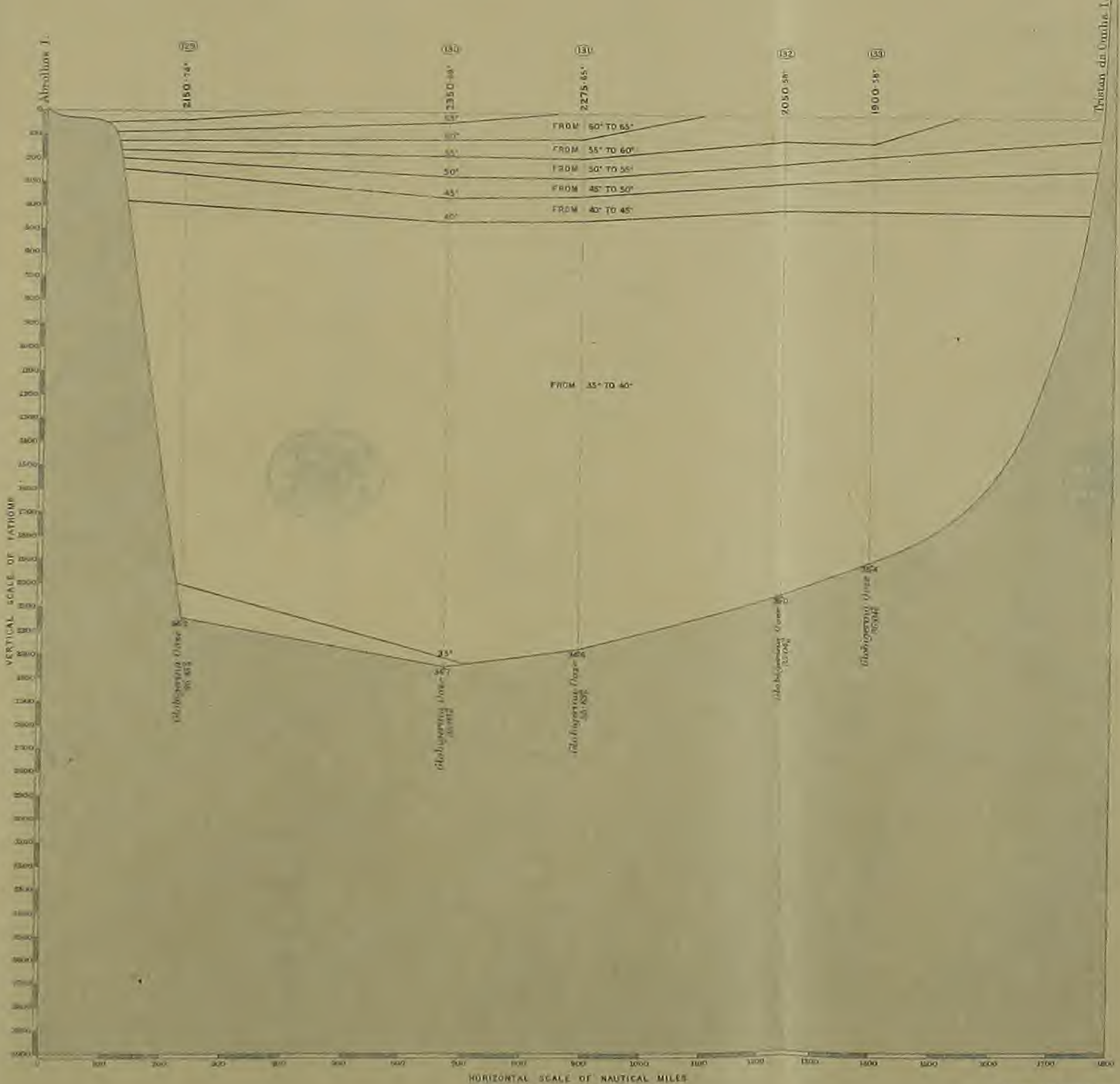
Temperature of air at noon, 70°·3; mean for the day, 66°·3.

Temperature of water:—

	°		°
Surface,	65·0	600 fathoms,	37·9
100 fathoms,	61·0	700 „	37·5
200 „	54·7	800 „	37·3
300 „	48·5	900 „	37·1
400 „	42·2	1000 „	37·0
500 „	39·2	Bottom,	34·6

ATLANTIC OCEAN. Diagonal Temperature Section: Abrolhos I^d to Tristan da Cunha I^ds

For explanation of Symbols see Appendix I.



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Station 130.

Station 131.

Density at 60° F. :— Station 131.

Surface,	1·02663	300 fathoms,	1·02572
100 fathoms,	1·02637	400 „	1·02548
200 „	1·02609	500 „	1·02580

Depth, 2275 fathoms; deposit, Globigerina Ooze, containing 55·63 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 7 A.M. shortened and furled sails, and got up steam to sound and trawl. Put trawl over. At 8 A.M. brought ship to wind, and sounded in 2275 fathoms. At 9.30 A.M. obtained serial temperatures at intervals of 100 fathoms down to 1000 fathoms. Obtained specimens of water from different depths. The carbonic acid was determined in water from 1000 fathoms, and amounted to 55·6 milligrammes per litre. At 3 P.M. commenced heaving in trawl, which came up at 4.30 P.M. nearly empty, containing only a polyp and a sandy Foraminiferous tube attached to the ear-bone of a *Ziphius*, a small piece of Cetacean bone, and two pieces of pumice, about the size of hens' eggs, one with egg-capsule of Mollusc (?) attached. At 5.40 P.M. made sail. About 8.45 P.M. the wind shifted very suddenly from W.N.W. to S.W. and then to S.E. by S. accompanied by rain. The first albatross was seen on October 4.

Distance at noon from Tristan da Cunha, 912 miles. Made good 55 miles. Amount of current 4 miles, direction S. 50° W.

Organisms from Surface-Nets.

Surface Organisms.—The following species are recorded from the surface near this Station (October 5, 1873) :—

Copepoda (Brady, Zool. pt. 23).
Pontella strenua (Dana).

Amphipoda (Stebbing, Zool. pt. 67).
Scinà cornigera (M.-Edwards).
Vibilia milnei, n.sp.
Eupronoë inscripta, n.sp.
Sympronoë propinqua, n.g., n.sp.

Schizopoda (Sars, Zool. pt. 37).
Euphausia pellucida, Dana.

Macrura (Spence Bate, Zool. pt. 52).
Sergestes longicollus, n.sp.

Between 7 and 9 P.M. the tow-net procured many specimens of *Collosphæra* and *Physalia*, while between 9 and 11 P.M. *Phylliroë* and Crustacea, which were nearly or quite absent in the first haul, were taken. A lead was attached to the net, but, though the ship was going only 3 knots, it did not sink far below the surface. In addition to the organisms already mentioned, the following are recorded in the note-books :— Small Medusæ, *Diphyes*, *Alciopa*, *Tomopteris*, many Copepods, *Phronima*, *Cystisoma*, *Oxycephalus*, *Hyperia*, Isopod, *Lucifer* (two large, and a few small ones), *Atlanta*, *Styliola*, and *Cuvierina*.

Station 132

Station 132 (Sounding 215), Bahia to Tristan da Cunha (see Chart 16, and Diagrams 5 and 6).

October 10, 1873; lat. 35° 25′ S., long. 23° 40′ W.

Temperature of air at noon, 59°·8; mean for the day, 51°·1.

Temperature of water :—

Surface,	58·0	400 fathoms,	40·0
100 fathoms,	55·2	500 „	38·8
200 „	50·0	600 „	35·0
300 „	43·8		

Density at 60° F. :—

Surface,	1·02619	300 fathoms,	1·02552
100 fathoms,	1·02623	400 „	1·02551
200 „	1·02581	Bottom,	1·02590

Depth, 2050 fathoms; deposit, Globigerina Ooze, containing 85·04 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 8 A.M. got up steam. At 9.30 A.M. shortened sail, proceeded under steam, and sounded in 2050 fathoms. At 1.30 P.M. completed serial temperatures at intervals of 100 fathoms down to 600 fathoms. At 1.45 P.M. made all plain sail, and continued under sail for the rest of the day. Flights of birds, chiefly Cape pigeons and albatrosses, began to accompany the ship; several specimens were shot.

Distance at noon from Tristan da Cunha, 561 miles. Made good 98 miles. Amount of current for the last two days 41 miles, direction S. 27° W.

Observations from Surface Nets.

Surface Organisms.—The following species are recorded from the surface at this Station :—

COPEPODA (Brady, Zool. pt. 23).
Saphirina reticulata, n.sp.
Saphirinella stylifera (Lubbock).

TUNICATA (Herdman, Zool. pt. 76).
Appendicularia sp. (?).

In addition the following are recorded in the note-books :—*Peridinium*, Foraminifera, compound Radiolaria, *Cydippe*, very large specimens of *Tomopteris*, *Calanus*, and *Spirialis rostralis* [= *Limacina inflata*]. From 100 fathoms :—Foraminifera, Radiolaria, *Hyalophyllum pellucidum* [= *Saphirinella stylifera*] and other Copepods, *Phromina*, *Hyperia*, *Dexamine*, and many Decapod larvæ in the megalopa stage.

Willemoes-Suhm writes : "There were many larvæ of Decapoda. Where do they come from? They are probably not all larvæ of surface animals, though that may be so. Perhaps they come up from deep water and sink when full grown. It will be necessary to make out with certainty that they are not the larvæ of *Lucifer*, *Sergestes*, nor the surface Mysidæ or Euphausidæ, which will be difficult. Of *Phronima*, the vagant male, with its clypeiform anterior antennæ, was present again, along with another Amphipod, which I have not seen before. Except the larvæ of Crustacea, one seldom observes a larva of any kind, which shows clearly that the larvæ of most animals living at the bottom do not ascend to the surface, for we are here probably on rich ground, the depth being 2000 fathoms, and the mud brought up by the sounding apparatus shows plenty of organic material." Station 132.

Station 133 (Sounding 216), Bahia to Tristan da Cunha (see Chart 16, and Diagrams 5 and 6). Station 133

October 11, 1873; lat. 35° 41′ S., long. 20° 55′ W.

Temperature of air at noon, 56°·8; mean for the day, 56°·0.

Temperature of water:—

Surface,	58·0°	75 fathoms,	56·2°
25 fathoms,	57·5	100 „	55·5
50 „	56·9	Bottom,	35·4

Density at 60° F. at surface, 1·02626; bottom, 1·02587.

Depth, 1900 fathoms; deposit, Globigerina Ooze, containing 86·04 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.30 A.M. got up steam. At 7.20 A.M. shortened and furled sails. At 8.20 A.M. put trawl over, veering 2500 fathoms, and sounded in 1900 fathoms. At 1.20 P.M. commenced heaving in trawl, which came up at 3.20 P.M. with numerous specimens. At 3.30 P.M. made all plain sail, and shaped course towards Tristan da Cunha. A specimen of *Procellaria gigantea* was caught on the upper deck.

Distance at noon from Inaccessible Island, 410 miles. Made good 133 miles. Amount of current 16 miles, direction N. 64° E.

The following species are recorded in the Zoological Reports from the trawl at this Station:— Animals from Trawl.

Pennatulida (Kölliker, Zool. pt. 2).

Anthoptilum simplex, n.g., n.sp. One injured specimen [stated in error to be from 1500 fathoms]; obtained at no other locality.

Corals (Moseley, Zool. pt. 7).

Bathyactis symmetrica (Pourtalès). For distribution see Station 24.

ASTEROIDEA (Sladen, Zool. pt. 51).

Dytaster exilis, n.g., n.sp., var. *gracilis*, nov. One specimen; the species obtained also at Stations 44 and 300.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophioglypha bullata, Wyville Thomson, n.sp. Obtained also at Stations 45, 54, and 61.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Cystechinus clypeatus, n.g., n.sp. Numerous fragments; obtained also at Stations 205 and 334, 1050 and 1915 fathoms.

HOLOTHURIOIDEA (Théel, Zool. pt. 13).

Psychropotes semperiana, n.g., n.sp. One specimen; obtained also at Station 101.

ANNELIDA (M'Intosh, Zool. pt. 34).

Laetmonice producta, Grube, var. *willemoesi*, nov. Obtained also at Stations 70, 146, 169, and 184.

AMPHIPODA (Stebbing, Zool. pt. 67).

Stenopleura atlantica, n.g., n.sp. One specimen (probably from the surface); obtained also at Station 106. Only species of the genus.

MACRURA (Spence Bate, Zool. pt. 52).

Willemoesia leptodactyla, Willemoes-Suhm, n.sp. One specimen; obtained also at Stations 13, 298, and 300.

Hemipenaeus spinidorsalis, n.g., n.sp. Two injured specimens; obtained also at Station 213, 2050 fathoms.

Aristeus armatus, n.sp. One specimen; obtained also at Stations 184, 213, 237, 246, 276, and 323, 1400 to 2350 fathoms. Recorded subsequently from Indian Ocean ("Investigator").

Benthesicymus iridescens, n.g., n.sp. Two specimens; obtained at no other locality.

,, *altus*, n.g., n.sp. Three specimens; obtained also at Stations 170, 171, 174, 184, 205, 214, 232, and 235, 345 to 1400 fathoms.

,, *mollis*, n.g., n.sp. One specimen; obtained at no other locality.

Pontophilus gracilis, n.sp. One specimen; obtained also at Stations 168, 184, and 198, 1100 to 2150 fathoms.

Notostomus murrayi, n.sp. One specimen; obtained at no other locality.

Hymenodora mollicutis, n.sp. Two specimens; obtained also at Stations 87, 104, 156, 157, and 318

ANOMURA (Henderson, Zool. pt. 69).

Parapagurus abyssorum, M.-Edwards. Three specimens in shells of *Ianthina* and *Pleurotoma*; obtained also at Stations 56, 106, 195, 205, 218, 237, 300, 304, and 335.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Lyonsiella grandis, n.sp. One specimen; obtained at no other locality.

Cryptodon moseleyi, n.sp. Obtained at no other locality.

GASTEROPODA (Watson, Zool. pt. 42).

Ianthina rotundata, Leach. For distribution see Station 64.

Pleurotoma (*Spirotropis*) *aganactica*, n.sp. One injured specimen; obtained at no other locality.

TUNICATA (Herdman, Zool. pt. 76).

Pyrosoma spinosum, n.sp. Fragment of large specimen (may have come from near the surface); obtained also at Station 69.

FISHES (Günther, Zool. pt. 57).

Ipnops murrayi, n.g., n.sp. Two specimens; obtained also at Stations 124 and 198. Only species of the genus.

In addition to the foregoing, the following are recorded in the Station-book:—*Palythoa* on *Ianthina* shells, *Chalaraspis ungnifer* [= *Eucopia australis*, Dana], *Petalophthalmus armiger*, large *Euphausia*, five specimens of *Macrurus* belonging to three species (in the larger specimens the scales were entirely rubbed off, the exposed flesh being of a white colour, except in the largest example, where the flesh was of a rose colour; the gill-membranes were black).

Excluding Protozoa, about 50 specimens of invertebrates and fishes were obtained at this Station, belonging to about 31 species, of which 21 are new to science, including representatives of 8 new genera; 7 of the new species were not obtained elsewhere.

Willemoes-Suhm writes: "The trawling to-day shows that in the South Atlantic the deep-sea fauna is not very different from that in the North Atlantic. A small male of *Deidamia* [= *Willemœsia*] *leptodactyla*, first discovered in the north, was taken, and many Peneid shrimps, some of which were taken near Sombrero and off the coast of Brazil. Schizopods were represented by *Petalophthalmus*, a *Chalaraspis*, and a new very large *Euphausia* differing from all hitherto-known species of that genus by the absence of lateral eyes."

Station 133

Moseley remarks: "We have found nearly all the forms also in the North Atlantic; the universal distribution of deep-sea forms becomes more and more apparent."

Organisms from Surface Nets.

Surface Organisms.—The tow-net sent down to a depth of about 100 fathoms brought up:—Foraminifera, Radiolaria, *Sagitta*, *Tomopteris*, a great many Copepods, *Hyperia*, *Oxycephalus*, *Vibilia*, *Cleodora* [= *Clio*], developmental stages of *Pyrosoma*, and *Appendicularia*, while the tow-net attached to the dredge-line brought up many surface animals, including Medusæ, some Amphipods, and a naked Pteropod, the Amphipods being more abundant than at the surface. Many of the *Globigerinæ* and *Pulvinulinæ* were surrounded with a mass of yellow sarcode in which were entangled many Coccospheres, Rhabdospheres, Infusoria (*Tintinnus*), and Diatoms. These minute organisms were also observed in the stomachs of the Tunicates. The Foraminifera were different from those found near the equator on the trip from Cape Verdes to Bahia, the shells being less massive and *Sphæroidina* and *Pullenia* did not appear to be present in the surface gatherings.

Station 134

Station 134 (Sounding 217), off Tristan da Cunha (see Chart 16 and Diagram 7).

October 14, 1873; lat. 36° 12′ S., long. 12° 16′ W.

Temperature of air at noon, 47°·8; mean for the day, 47°·3.

Temperature of water:—

	°		°
Surface,	53·5	1100 fathoms,	36·8
200 fathoms,	46·0	1300 ,,	36·6
700 ,,	37·2	Bottom,	36·0
900 ,,	37·0		

Density at 60° F. at surface, 1·02616; bottom, 1·02583.

Depth, 2025 fathoms; deposit, Globigerina Ooze, containing 59·18 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 3 A.M. got up steam. At 4.30 A.M. shortened and furled sails. At 5.30 A.M. observed Tristan da Cunha with its snow-covered summit to the S.S.W. At 7 A.M. stopped and sounded in 2025 fathoms. At 9 A.M. put dredge over. Obtained a series of temperatures. At 1.15 P.M. commenced heaving in dredge, which came up at 3 P.M. with a few specimens. Proceeded under steam. At 4 P.M. altered course as requisite to swing ship. At 6 P.M. completed swinging ship. At sunset Tristan da Cunha ahead. Director of Scientific Staff arranging exploring parties for examining the island on the morrow. At 10.15 P.M. stopped and lay to for the night, the island of Tristan da Cunha to the S.W. The weather became sensibly colder, necessitating change of clothing.

Distance at noon from Tristan da Cunha, 50 miles. Made good 105 miles. Amount of current 16 miles, direction N. STATION 134.

The following species is recorded from the dredge at this Station :— ANIMALS FROM DREDGE.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Aspidodiadema microtuberculatum, n.g., n.sp. Two specimens; obtained also at Stations 122, 124, 298, and 299.

Surface Organisms.—The following species is recorded from the surface :— ORGANISMS FROM SURFACE-NETS.

NUDIBRANCHIATA (Bergh, Zool. pt. 26).

Acura pelagica, Adams.

Two hauls of the tow-net from a depth of about 100 fathoms produced :—*Cydippe*, *Sagitta*, many *Saphirinæ* and *Hyalophyllum* [= *Saphirinella*], some Amphipods, *Euphausia*, a few Zoëæ, *Appendicularia*, and *Salpæ* with Rhabdospheres and Coccospheres in their stomachs.

Stations 135 to 135G (Soundings 218 to 225), off Tristan da Cunha (see Chart 17).

STATIONS 135 TO 135G. (TRISTAN DA CUNHA).

October 15 to 18, 1873.

At 3 A.M. on October 15, proceeded under steam S.W. At 6 A.M. stopped off Tristan da Cunha settlement, named Edinburgh after H.R.H. the Duke of Edinburgh, who visited it in H.M.S. "Galatea" in 1867. Communicated with the shore. At 8 A.M. came to in 19 fathoms. Landed exploring parties and surveying officers to obtain observations. Visited the settlement and Mr. Green, the present head of the colony, consisting of 15 families, 86 individuals. The colonists live in houses built of large basaltic blocks shaped with the axe, and made to fit each other closely, as there exists no lime on the island to make mortar with. They possess a large stock of cattle, and a good supply of meat and vegetables was obtained for the ship. Several of the inhabitants are engaged in the whale fishery. As usual, the photographer was on shore, and obtained several views. Exploring parties returned at 3 P.M., having obtained natural history and other specimens. Heard of two German settlers on Inaccessible Island, who had not been communicated with for many months, and were supposed to be dead. It was decided to go and look for them. At 5 P.M. weighed anchor and proceeded. At 6 P.M. stopped and sounded in 360 fathoms, deposit Volcanic Sand, containing 6·93 per cent. of carbonate of lime (Station 135). At 6.20 P.M. proceeded. At 10 P.M. stopped engines, set fore and aft sails, and lay to on port tack for the night to the north of Inaccessible Island.

Tristan da Cunha.

Temperature of the air at noon, 52°·8; mean for the day, 50°·7. Temperature of surface water, 53°·5.

At 3.10 A.M. on October 16, proceeded under steam S. by E. At 5 A.M. steamed towards the east point of Inaccessible Island. At 6 A.M. stopped off the east side of Inaccessible Island, and lowered boat to communicate with the shore. Sounded in 65 fathoms. At 7.20 A.M. boats returned; proceeded. At 8 A.M. stopped and came to in 15 fathoms. Landed exploring and surveying parties. At 11.15 A.M. got up steam, weighed anchor, and proceeded under steam for a cruise round the island, sounding, &c. At 5 P.M. stopped off the north side of the island, and put dredge over in 60 fathoms. At 5.30 P.M. hove up dredge containing numerous specimens, and proceeded. At 6 P.M. stopped and put dredge over in 75 fathoms, Hard Ground, shells, and gravel (Station 135A). At 6.15 P.M. hove up dredge, which again brought up numerous specimens, chiefly by means of the tangles. Proceeded for anchorage. At 6.40 P.M. stopped and came to in 17 fathoms. Exploring parties returned with many prizes in the shape of birds, insects, geological specimens, &c. Observed a remarkable colony of penguins close to the landing place. Took on board for passage to Cape of Good Hope the two German settlers, Frederic and Gustavus Stoltenkoff, natives of Aix-la-Chapelle, who had come here for seal fishing, and had led for two years a sort of Robinson Crusoe life, having had but rare opportunities of communicating with passing ships or with the inhabitants of Tristan da Cunha. Temperature of air at noon, 50°·8; mean for the day, 50°·0. Temperature of surface water, 54°·0.

At 4.30 A.M. on October 17, got up steam. At 5.15 A.M. weighed anchor and proceeded under steam. Shaped course S.S.E. towards Nightingale Island. At 7 A.M. stopped and sounded in 465 fathoms, Hard Ground, shells, and gravel (Station 135B). At 8.45 A.M. stopped off Nightingale Island. Landed exploring and surveying parties. At 9 A.M. proceeded on a sounding and dredging cruise round Nightingale Island. Between 4 and 6 P.M. two hauls of the dredge were taken in depths of 150 to 100 fathoms, Coarse Shelly Bottom, containing 96·00 per cent. of carbonate of lime (Station 135C). A large number of specimens of all groups were obtained. A sounding was also taken in 72 fathoms, Coarse Shelly Bottom (Station 135D). At 6.15 P.M. surveying and exploring parties returned on board with numerous specimens. Temperature of the air at noon, 51°·2; mean for the day, 51°·2. Temperature of surface water, 54°·0.

At 6.45 A.M. on October 18, got up steam to sound and dredge. At 7 A.M. shortened and furled sails, and proceeded under steam to sound. At 8 A.M. sounded in 1000 fathoms, Hard Ground, shells, and gravel (Station 135E). At 9 A.M. put over dredge, and veered 1500 fathoms. Obtained serial temperatures at intervals of 100 fathoms down to 600 fathoms. At 11.30 A.M. dredge came up with several specimens. Proceeded towards Tristan da Cunha. At noon stopped and put dredge over a second time. At 12.10 P.M. sounded in 1100 fathoms, Hard Ground (Station 135F). Lowered second gig. At 2.10 P.M. hove up dredge containing some pumice-stones, and stood in to within $1\frac{1}{2}$ miles of the west side of Tristan da Cunha. At 3.50 P.M. sounded in 550 fathoms, Hard Ground (Station 135G). Put dredge over a third time, and veered 700 fathoms. At 5.45 P.M. the dredge was hauled on board containing several specimens. At this time the ship was close to the island, and for a moment the clouds, which had veiled the summit for the last few days, opened and revealed the whole island of Tristan da Cunha from its base to its snow-clad peak; a sketch of the same was obtained. At 6.15 P.M. made all plain sail and proceeded towards the Cape, with a favourable breeze from the N.W. Temperature of air at noon, 51°·8; mean for the day, 51°·6. Temperature of water:— TRISTAN DA CUNHA.

	°		°
Surface,	53·5	400 fathoms,	40·0
100 fathoms,	48·5	500 ,,	38·3
200 ,,	45·1	600 ,,	37·2
300 ,,	42·3		

The following species are recorded in the Zoological Reports from the vicinity of the Tristan da Cunha Islands; as it is almost impossible to give a separate list for each dredging, the various Stations are here combined, the depth given in the Reports being indicated:— ANIMALS FROM TRISTAN DA CUNHA.

KERATOSA (Poléjaeff, Zool. pt. 31).

Coscinoderma altum, n.sp. One specimen (75 fathoms); obtained at no other locality.

MONAXONIDA (Ridley and Dendy, Zool. pt. 59).

Rhizochalina singaporensis (Carter) (?). Fragment (360 fathoms); obtained at no other locality by the Challenger. Recorded from Singapore and Torres Strait.

Gelliodes licheniformis (Lamarck). One specimen (60 fathoms ?); obtained at no other locality by the Challenger.

Iophon pattersoni (Bowerbank). Numerous fragments (off Nightingale Island, depth not given); obtained also at Stations 308 and 311, 175 and 245 fathoms. Recorded from British Islands and Magellan Strait.

Agelas mauritianus (Carter). One specimen (60 fathoms ?); obtained at no other locality by the Challenger. Recorded from Mauritius.

Axinella erecta (Carter). Eight specimens (90 to 150 fathoms); obtained also at Stations 145, 147, and 148, 310 to 1600 fathoms. Recorded from North Atlantic.

(?) *paradoxa*, n.sp. One specimen (90 fathoms); obtained at no other locality.

Tristan da Cunha.

Tentorium semisuberites (Schmidt). Four specimens of dwarf variety (60 to 90 fathoms); obtained also at Stations 49 and 50.

Latrunculia (?) *acerata*, n.sp. One injured specimen (60 fathoms); obtained at no other locality.

TETRACTINELLIDA (Sollas, Zool. pt. 63).

Pachastrella abyssi, Schmidt. Two specimens (110 fathoms); obtained at no other locality by the Challenger. Recorded from North Atlantic ("Porcupine") and Gulf of Mexico.

CALCAREA (Poléjaeff, Zool. pt. 24).

Sycon raphanus, Schmidt, var. *tergestinum*, Haeckel. One specimen (60 to 90 fathoms); obtained also at Station 209, 95 fathoms. Recorded from Adriatic.

Pericharax carteri, n.g., n.sp. One specimen and fragment (60 fathoms); obtained at no other locality. Only species of the genus.

ALCYONARIA (Wright and Studer, Zool. pts. 64 and 81).

Clavularia cylindrica, n.sp. One specimen (100 to 150 fathoms); obtained at no other locality.

Sympodium glomeratum, n.sp. One specimen (100 to 150 fathoms); obtained at no other locality.

Sarakka crassa, Danielssen. One specimen (100 to 550 fathoms); obtained at no other locality by the Challenger. Recorded from North Atlantic.

Sarcophytum atlanticum, n.sp. One specimen (60 fathoms); obtained at no other locality.

Thouarella affinis, n.sp. One specimen (55 to 70 fathoms); obtained at no other locality.

Amphilaphis regularis, n.g., n.sp. Two specimens (75 to 150 fathoms); obtained at no other locality. Only species of the genus.

Clematissa verrilli, n.g., n.sp. (360 fathoms); obtained at no other locality.

ACTINIARIA (Hertwig, Zool. pts. 15 and 73).

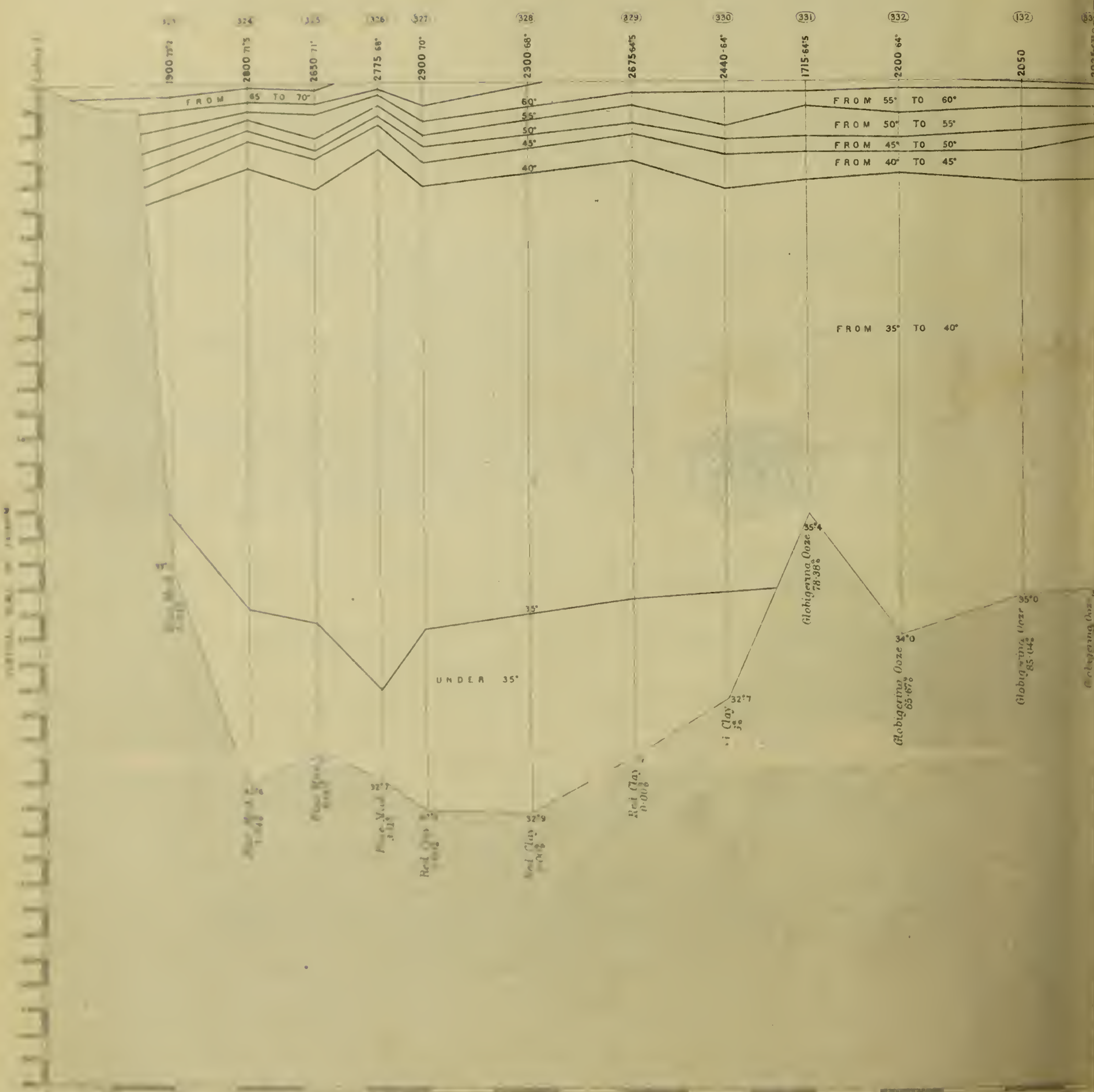
Tealia bunodiformis, n.sp. Three specimens (shore); obtained at no other locality.

Polythoa anguicoma, Norman. (60 to 90 fathoms); obtained at no other locality by the Challenger.

[illegible] sp. (?). (60 to 150 fathoms).

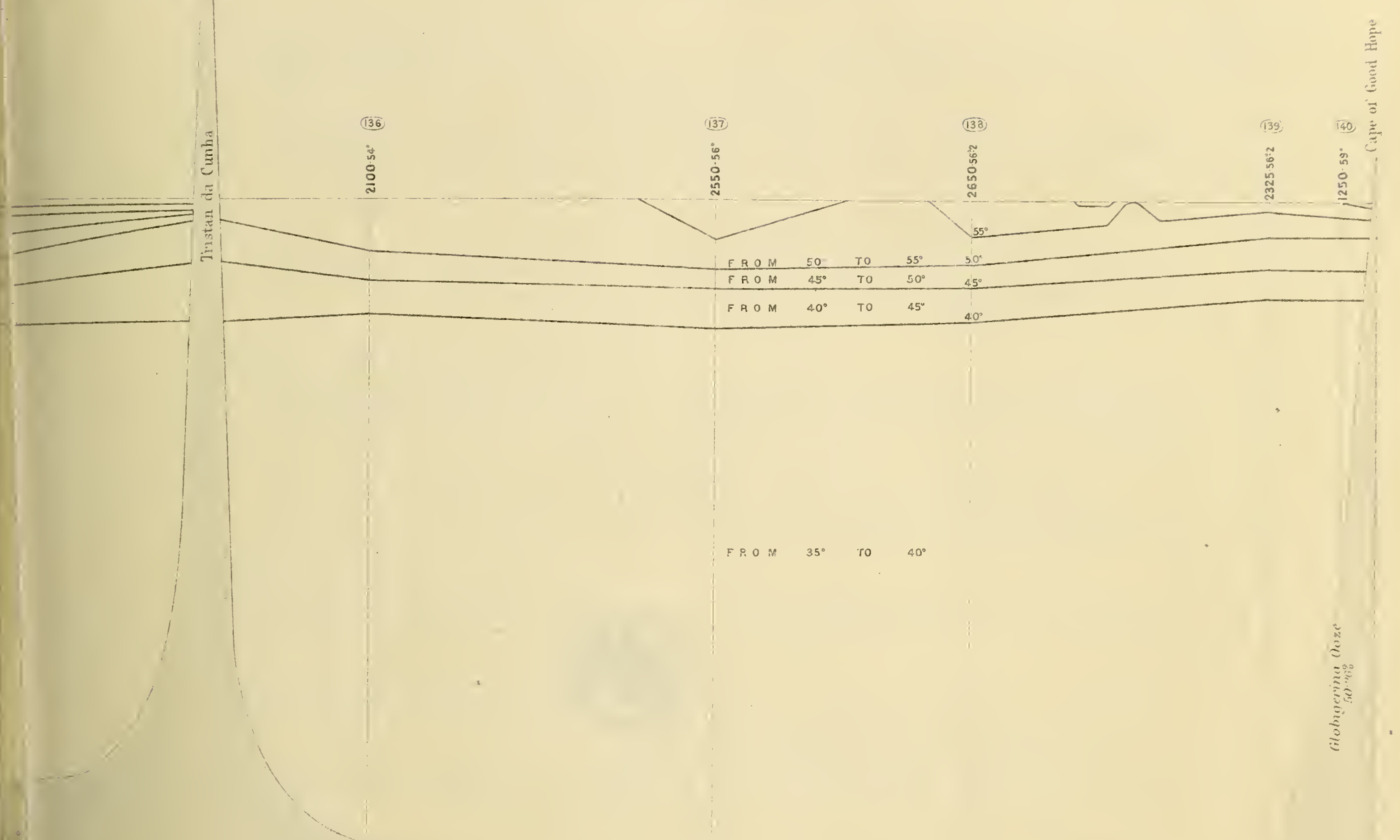
ATLANTIC OCEAN. Longitudinal Temperature S

For expl



Rio de la Plata to Tristan da Cunha I. and Cape of Good Hope

...bols see Appendix I



CORALS (Moseley, Zool. pt. 7).

Errina labiata, n.sp. Several specimens (90 to 150 fathoms); obtained also at Station 320, 600 fathoms.

Caryophyllia profunda, n.sp. Numerous specimens (100 to 150 fathoms); obtained also at Cape Verdes.

Lophohelia prolifera, M.-Edwards and Haime. Numerous specimens (90 to 150 fathoms); for distribution see Station 23.

Solenosmilia variabilis, Duncan. Numerous specimens (1000 fathoms); obtained also at Stations 145 and 344, 310 and 420 fathoms.

HYDROIDA (Allman, Zool. pts. 20 and 70).

Plumularia stylifera, n.sp. (100 to 150 fathoms); obtained at no other locality.

Antennularia fascicularis, n.sp. One specimen (100 to 150 fathoms); obtained at no other locality.

Halecium fastigiatum, n.sp. (110 fathoms); obtained at no other locality.

Sertularia leiocarpa, n.sp. (100 to 150 fathoms); obtained at no other locality.

CRINOIDEA (Carpenter, Zool. pt. 60).

Antedon multispina, n.sp. (550 fathoms); obtained also at Station 344, 420 fathoms.

ASTEROIDEA (Sladen, Zool. pt. 51).

Astropecten mesactus, n.sp. (90 fathoms); obtained at no other locality. Recorded subsequently from Buenos Ayres ("Gazelle").

Crossaster penicillatus, n.sp. (110 fathoms); obtained also at Station 145 (?), 140 fathoms.

Cribrella simplex, n.sp. (90 to 150 fathoms); obtained also at Stations 145 and 148, 50 to 310 fathoms.

Asterias (Stolasterias) eustyla, n.sp. One specimen (100 to 150 fathoms); obtained at no other locality.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophioglypha jejuna, n.sp. (500 and 1000 fathoms); obtained also at Station 164B, 410 fathoms.

,, *inermis*, n.sp. (500 fathoms); obtained at no other locality.

Ophiomusium lymani, Wyville Thomson. (1100 fathoms); for distribution see Station 45.

Ophiactis poa, n.sp. (500 and 1000 fathoms); obtained at no other locality.

Ophiacantha cosmica, n.sp. (1000 fathoms); for distribution see Station 122.

Ophiomyces grandis, n.sp. (1000 fathoms); obtained at no other locality.

TRISTAN DA CUNHA.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Arbacia dufresnii (Bl.). (100 to 150 fathoms); obtained also at Stations 304 and 308, 45 and 175 fathoms.

Echinus elegans (Düben and Koren). (1100 fathoms); obtained also at Stations 46 and 219.

OSTRACODA (Brady, Zool. pt. 3).

Bairdia villosa, n.sp. (100 to 150 fathoms); obtained also at Stations 145, 149, and 162, 38 to 150 fathoms.

Cythere impluta, n.sp. (100 to 150 fathoms); obtained also at Station 316, 6 fathoms.

Cytherella punctata, Brady. (100 to 150 fathoms); obtained also at Stations 167, 191, 305, and Port Jackson, 2 to 580 fathoms. Recorded from the Levant (?).

CIRRIPEDIA (Hoek, Zool. pt. 25).

Scalpellum carinatum, n.sp. Two specimens (1000 fathoms); obtained at no other locality.

,, *africanum*, n.sp. Four specimens (100 fathoms); obtained at no other locality.

,, *elongatum*, n.sp. (Depth not given); obtained also at Stations 164B and 169, 410 and 700 fathoms.

,, *eximium*, n.sp. One specimen attached to pumice-stone (1000 fathoms); obtained at no other locality.

AMPHIPODA (Stebbing, Zool. pt. 67).

Metopa crenatipalmata, n.sp. One specimen (100 to 150 fathoms); obtained also at Station 313, 55 fathoms.

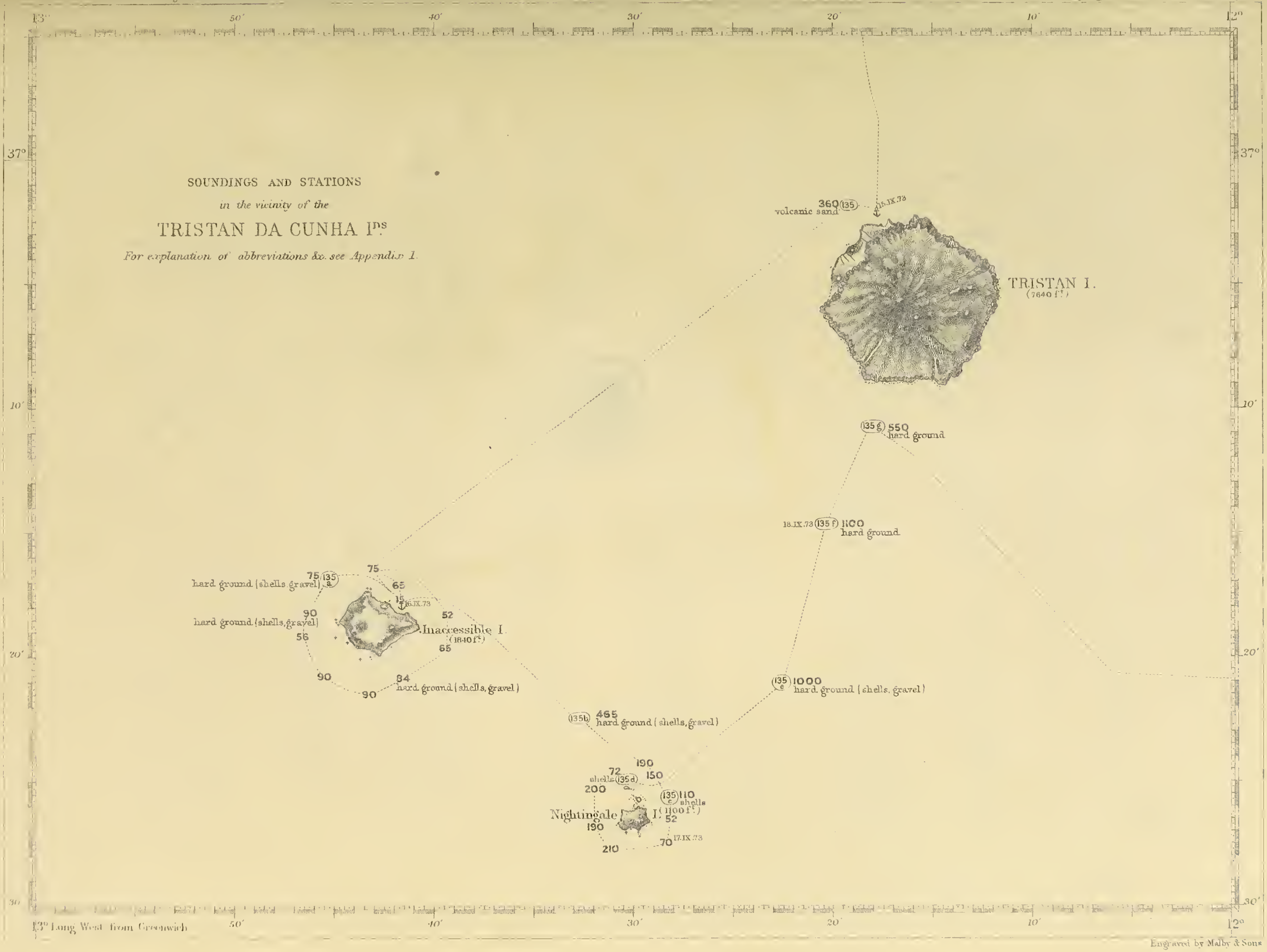
Podocerus tristanensis, n.sp. Two specimens (110 fathoms); obtained at no other locality.

Caprellinoides tristanensis, n.g., n.sp. One specimen (110 fathoms); obtained at no other locality. Only species of the genus.

Aeginella tristanensis, n.sp. One specimen (110 fathoms); obtained at no other locality.

ISOPODA (Beddard, Zool. pt. 48).

Janira tristani, n.sp. Two specimens (100 to 150 fathoms); obtained at no other locality.


SOUNDINGS AND STATIONS
in the vicinity of the
TRISTAN DA CUNHA I^ds
For explanation of abbreviations &c. see Appendix 1.
TRISTAN I.
(7640 f^t)
360 (135)
volcanic sand
15.IX.73
(135 g) 550
hard ground
18.IX.73 (135 f) 1100
hard ground
(135 e) 1000
hard ground (shells, gravel)
(135 b) 465
hard ground (shells, gravel)
Inaccessible I.
(1840 f^t)
75 (135 a)
hard ground (shells gravel)
90
hard ground (shells, gravel)
56
75
65
15
16.IX.73
52
65
84
hard ground (shells, gravel)
90
90
Nightingale I.
(1100 f^t)
190
72
shells (135 d)
150
200
(135 c) 110
shells
52
190
210
70
17.IX.73
13°
50'
40'
30'
20'
10'
12°
37°
10'
20'
30'
13° Long. West from Greenwich
Engraved by Malby & Sons

Pleurogonium minutum, n.sp. One specimen (100 to 150 fathoms); obtained at no other locality. TRISTAN DA CUNHA.

One specimen, genus and species undetermined (Nightingale Island).

SCHIZOPODA (Sars, Zool. pt. 37).

Bentheuphausia amblyops, n.g., n.sp. One specimen (1000 fathoms); obtained also at Stations 107 and 158.

MACRURA (Spence Bate, Zool. pt. 52).

Palinosytus (*Palinostus*) *lalandii* (Lamarck). One specimen (100 to 150 fathoms); two young specimens obtained also from screw day after leaving the Cape.

ANOMURA (Henderson, Zool. pt. 69).

Eupagurus tristanensis, n.sp. One specimen in shell of *Murex* (110 fathoms); obtained at no other locality.

Parapagurus dimorphus (Studer). Several specimens in shells of *Murex* (110 fathoms); obtained also at Stations 142, 145, and 311, 140 to 310 fathoms. Recorded from the Cape ("Gazelle").

BRACHYURA (Miers, Zool. pt. 49).

Pilumnoplax heterochir (Studer). Numerous specimens (100 fathoms); obtained also at Station 142, 150 fathoms.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Saxicava arctica, Linné. (100 to 150 fathoms); for distribution see Station 75.

Venus philomela, n.sp. (100 to 150 fathoms); obtained at no other locality.

,, (*Chamelæa*) *mesodesma*, Quoy and Gaimard. Two specimens (1000 fathoms); obtained also at D'Urville Island, New Zealand.

Diplodonta sp. (?). Single valve (100 to 150 fathoms).

Carditella exulata, n.sp. (100 to 150 fathoms); obtained at no other locality.

Lima (*Mantellum*) *loscombii*, Sowerby. (100 to 150 fathoms); obtained also at Station 75.

,, (*Limatula*) sp. (?). Single valve (100 to 150 fathoms).

Pecten limatula, Reeve, var. (?). (100 to 150 fathoms); obtained also at Station 141, 98 fathoms.

Anomia ephippium, Linné, var. (?). (100 to 150 fathoms); obtained also at Station 122.

TRISTAN DA CUNHA.

GASTEROPODA (Watson, Zool. pt. 42).

Emarginula sp. (?).

Scissurella aëdonia, n.sp. (100 to 150 fathoms); obtained also at Station 122.

,, , two other species undetermined.

Scalaria philtata, n.sp. (100 to 150 fathoms); obtained at no other locality.

Murex (*Pseudomurex*) *aëdonius*, n.sp. (100 to 150 fathoms); obtained at no other locality.

Buccinum (?) sp. (100 to 150 fathoms).

Pleurotoma (*Thesbia*) *eritima*, n.sp. (100 to 150 fathoms); obtained at no other locality.

Triton (*Simpulum*) *philomelæ*, n.sp. (100 to 150 fathoms); obtained at no other locality.

Ranella (*Argobuccinum*) *argus* (Gmelin). (Shore and 100 to 150 fathoms); obtained at no other locality by the Challenger. A widely-distributed species.

Crepidula onyx, Sowerby. One specimen (shore); obtained at no other locality by the Challenger. Recorded from Panama and Mazatlan.

Odostomia (*Turbonilla*) *philomelæ*, n.sp. (100 to 150 fathoms); obtained at no other locality.

Bittium pigrum, n.sp. (100 to 150 fathoms); obtained at no other locality.

,, *lusciniæ*, n.sp. (100 to 150 fathoms); obtained at no other locality.

,, *philomelæ*, n.sp. (100 to 150 fathoms); obtained at no other locality.

,, *delicatum*, n.sp. (100 to 150 fathoms); obtained at no other locality.

,, *aëdonium*, n.sp. (100 to 150 fathoms); obtained at no other locality.

,, sp. (?). (100 to 150 fathoms).

Triforis hebes, n.sp. Three specimens (100 to 150 fathoms); obtained at no other locality.

Rissoa (*Alvania*) *lusciniæ*, n.sp. (100 to 150 fathoms); obtained at no other locality.

,, (*Onoba*) *arenaria* (Mighels). One specimen (100 to 150 fathoms); obtained at no other locality by the Challenger. Recorded from Arctic and North Atlantic.

,, (,,) *aëdonis*, n.sp. (100 to 150 fathoms); obtained at no other locality.

,, (*Ceratia*) *glaphyra*, n.sp. (100 to 150 fathoms); obtained at no other locality.

,, (,,) *mucra*, n.sp. (100 to 150 fathoms); obtained at no other locality.

,, (*Setia*) *philomelæ*, n.sp. (100 to 150 fathoms); obtained at no other locality.

Cylichna cylindracea (Pennant). One specimen (110 fathoms); obtained also at Station 344, 420 fathoms. Recorded from North Atlantic and Mediterranean. Fossil — European Pliocenes. TRISTAN DA CUNHA.

Siphonaria (*Liriola*) *tristensis*, Leach. (Shores of Tristan and Inaccessible Islands); obtained at no other locality by the Challenger. Recorded from Tristan, South America, and Kerguelen.

Lachesis sp. (?). (100 to 150 fathoms).

POLYPLACOPHORA (Haddon, Zool. pt. 43).

Plaxiphora simplex (Carpenter, MS.). Four specimens (shore and 100 to 150 fathoms); obtained at no other locality by the Challenger. Recorded from Tristan.

„ *carpenteri*, n.sp. One specimen (depth not given); obtained at no other locality.

CEPHALOPODA (Hoyle, Zool. pt. 44).

Octopus verrucosus, n.sp. Two specimens (shore of Inaccessible Island); obtained at no other locality.

POLYZOA (Busk, Zool. pts. 30 and 50; Waters, pt. 79).

Ætea anguina (Linné). (75 and 110 fathoms); obtained also at Stations 36, 161, 162, and 304.

Hippothoa divaricata, Lamouroux. (60 to 1000 fathoms); obtained also at Station 75.

Catenicella elegans, Busk. (60 to 1100 fathoms); obtained also at Stations 122, 163, and 188.

Scrupocellaria pilosa (Audouin). (75 and 110 fathoms); obtained at no other locality by the Challenger. Recorded from Mediterranean (?).

Caberea darwinii, Busk. (110 and 150 fathoms); obtained also at Stations 142, 145, 148, and 149, 45 to 500 fathoms. Recorded from Cumberland Island, New Zealand, and Magellan Strait.

Membranipora crassimarginata (Hincks), var. *incrustans*, nov. (75 to 150 fathoms); obtained also at Stations 151 and 162, 38 to 85 fathoms (var. *erecta*). Recorded from Madeira and Gulf of Florida. [Waters calls it *Membranipora dumerilii*, Audouin].

Micropora uncifera, n.sp. (75 to 150 fathoms); obtained at no other locality.

„ *coriacea* (Esper). (75 to 90 fathoms); obtained also at Station 75.

Cribrilina radiata (Moll). (75 to 90 fathoms); obtained also at Station 75.

Microporella malusii (Audouin). (110 to 150 fathoms); obtained also at Station 315, 5 to 12 fathoms. A widely-distributed species.

,, *ciliata* (Pallas). (110 to 150 fathoms); obtained at no other locality by the Challenger. A widely-distributed species.

Lepralia incisa, n.sp. (?). (60 to 90 fathoms); obtained at no other locality. [Waters calls it *Schizoporella vitrea* (MacGillivray)].

Chorizopora hyalina, var. *bougainvillei*, d'Orbigny. (75 to 90 fathoms); obtained also at Stations 149 and 315, 28 and 12 fathoms. Recorded from Kerguelen.

Aspidostoma giganteum (Busk). (110 to 150 fathoms); obtained at no other locality by the Challenger. Recorded from Patagonia and Falkland Islands. Fossil—Australia.

Schizoporella auriculata, Hassall (?), var. *alba*, nov. (75 to 150 fathoms); obtained at no other locality.

,, *circinata* (MacGillivray). (75 to 90 fathoms); obtained at no other locality by the Challenger.

Haswellia auriculata, n.g., n.sp. (75 to 150 fathoms); obtained also at Station 142, 150 fathoms. Recorded from New Zealand. Fossil—New Zealand.

Adeonella atlantica, n.g., n.sp. (75 and 110 fathoms); obtained at no other locality by the Challenger. Recorded from Tierra del Fuego, South Africa (?), and Gulf of Florida (?).

Cellepora tubulosa (Hincks) (?). (75 and 110 fathoms); obtained at no other locality by the Challenger.

Crisia biciliata, MacGillivray. (60 to 1100 fathoms); obtained at no other locality by the Challenger. Recorded from Australia.

,, *denticulata* (Lamarck). (60 to 90 fathoms); obtained also at Stations 109 and 186.

,, *cylindrica*, n.sp. (100 to 150 fathoms); obtained at no other locality.

Idmonea atlantica, Forbes. (100 to 150 fathoms); obtained also at Stations 49, 149, and Simon's Bay, Cape.

Alecto granulata, M.-Edwards. (60 to 90 fathoms); obtained at no other locality by the Challenger. Recorded from North Atlantic.

Diastopora patina (Lamarck). (100 to 150 fathoms); obtained at no other locality by the Challenger. Recorded from Arctic, North Atlantic. and Mediterranean.

Lichenopora fimbriata, Busk. (100 to 150 fathoms); obtained at no other locality by the Challenger. Recorded from South America and Tasmania. TRISTAN DA CUNHA.

,, *hispida* (Fleming). (100 to 1100 fathoms); obtained at no other locality by the Challenger. Recorded from Arctic and North Atlantic. Fossil—Coral Crag, and Post-Pliocene of Canada.

Fasciculipora ramosa, d'Orbigny. (60 to 150 fathoms); obtained at no other locality by the Challenger. Recorded from Patagonia. [Waters calls it *Frondipora verrucosa* (Lamouroux)].

Ascopodaria discreta, n.g., n.sp. (100 to 150 fathoms); obtained at no other locality.

Rhabdopleura normani, Allman. Several specimens attached to a colony of *Lophohelia* (see G. H. Fowler, *Proc. Roy. Soc.*, vol. lii. pp. 132–134; and Festschr. z. Costen Geburtst. R. Leuckarts, pp. 293–297, Leipzig, 1892).

In addition to the foregoing, the following are recorded in the Station-book:—small Pennatulid, *Rhizocrinus*, and *Galathea*.

In the foregoing list 135 species are enumerated, of which 70 are new to science, including representatives of 8 new genera; 55 of the new species and 3 new genera were not obtained elsewhere.

With reference to these dredgings off the Tristan da Cunha group, Professor Thomson writes:—

"From 150 to 100 fathoms the dredge brought up a large quantity of specimens of all groups, the most prominent a fine species of *Primnoa*, many Gorgoniæ, and other Alcyonarians; abundance of *Oculina* [= *Lophohelia*] *prolifera* or some very closely allied Coral, and of a *Caryophyllia* near *C. borealis* [= *Caryophyllia profunda*]; many Hydroids and Sponges; a few Starfishes, one a *Solaster* near *S. papposus* and a *Cribrella* close to *C. sanguinolenta* [= *Cribrella simplex*]; one or two specimens of one of the Mollusca allied to *Nassa*, but few species of Molluscs. Altogether a large mass of material much like what is found off the coast of England.

"From 60 fathoms there were large quantities of things, especially Corals (*Lophohelia* and *Caryophyllia*), Alcyonarians (*Primnoa, Gorgonia*, &c.); Polyzoa were very abundant, and there were some Starfishes of the genera *Cribrella, Solaster*, and *Astropecten*, but few Mollusca.

"From 75 fathoms nearly the same things were got as in 60 fathoms, notably a profusion of Alcyonarians. These shallow-water dredgings round Tristan da Cunha gave a great amount of material, the fauna being very much of the same character as that of

Tristan da Cunha.

somewhat shallower water in the north. The species seem in many cases to be identical, but this will require critical examination to determine."

Organisms from the Deposit.

Foraminifera (Brady, Zool. pt. 22).—The following species of Foraminifera were observed in the deposit from Station 135c, 100 to 150 fathoms (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.). The pelagic species, which make up less than 5 per cent. of the carbonate of lime present in the deposit, are marked thus × :—

Miliolina circularis (Bornemann).
,, *oblonga* (Montagu).
,, sp. (?).
Hyperammina ramosa, Brady.
Haplophragmium anceps, Brady.
Trochammina nitida, Brady.
Textularia agglutinans, d'Orbigny.
,, sp. (?).
Cassidulina crassa, d'Orbigny.
Nodosaria perversa, Schwager.
,, sp. (?).
Cristellaria articulata, Reuss.
,, sp. (?).
Polymorphina lactea (Walker and Jacob).
,, *regina*, Brady, Parker, and Jones.
Uvigerina angulosa, Williamson.
,, ,, var. *spinipes*, Brady.
× *Globigerina bulloides*, d'Orbigny.
× ,, *inflata*, d'Orbigny.
× *Orbulina universa*, d'Orbigny.
Spirillina limbata, Brady (?).
Discorbina globularis (d'Orbigny).
Truncatulina variabilis, d'Orbigny.
Anomalina polymorpha, Costa (?).
,, sp. (?).
× *Pulvinulina canariensis* (d'Orbigny).
,, *concentrica*, Parker and Jones.
,, *elegans* (d'Orbigny).
× ,, *micheliniana* (d'Orbigny).
Gypsina inhærens (Schultze).

Station 136.

Station 136 (Sounding 226), Tristan da Cunha to Cape of Good Hope (see Chart 16 and Diagram 6).

October 20, 1873; lat. 36° 43′ S., long. 7° 13′ W.
Temperature of air at noon, 55°·0; mean for the day, 53°·3.
Temperature of water:—

Surface, ...	54°·0	400 fathoms, . . .	39°·5
100 fathoms, . . .	52·2	500 ,, . . .	38·0
200 ,, . . .	49·2	600 ,, . . .	37·2
300 ,, . . .	43·2	Bottom, . . .	35·2

Density at 60° F.:—

Surface, ...	1·02616	300 fathoms, . . .	1·02554
100 fathoms, . . .	1·02598	400 ,, . . .	1·02547
200 ,, . . .	1·02580	Bottom, . . .	1·02592

Depth, 2100 fathoms.

At 7.30 A.M. got up steam, and shortened sail. At 8.30 A.M. proceeded under steam to sound. At 9.10 A.M. sounded in 2100 fathoms, but the tube came up empty. At

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10 A.M. put dredge over, and veered 2700 fathoms. Obtained a series of temperatures at intervals of 100 fathoms down to 600 fathoms. At 4 P.M. dredge became entangled at the bottom, but was cleared, and came up empty at 5.30 P.M. At 6 P.M. made all plain sail. Weather cloudy with rain. STATION 136.

Distance at noon from Cape of Good Hope, 1293 miles. Made good 119 miles. Amount of current 7 miles, direction N. 65° E.

Station 137 (Sounding 227), Tristan da Cunha to Cape of Good Hope (see Chart 16 and Diagram 6). STATION 137.

October 23, 1873; lat. 35° 59′ S., long. 1° 34′ E.

Temperature of air at noon, 54°·3 ; mean for the day, 52°·9.

Temperature of water :—

	°		°
Surface,	56·1	450 fathoms,	39·4
50 fathoms,	56·0	500 „	38·7
100 „	55·6	700 „	37·0
150 „	54·3	900 „	36·8
200 „	51·8	1100 „	36·6
250 „	47·9	1300 „	36·5
300 „	44·6	1500 „	36·4
350 „	42·3	Bottom,	34·5
400 „	40·4		

Density at 60° F. :—

Surface,	1·02637	300 fathoms,	1·02569
100 fathoms,	1·02605	400 „	1·02556
200 „	1·02595	Bottom,	1·02585

Depth, 2550 fathoms; deposit, Globigerina Ooze, containing 35·22 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.30 A.M. shortened and furled sails, and got up steam to sound and dredge. Put dredge over, and veered 3000 fathoms. At 9 A.M. sounded in 2550 fathoms. At 11 A.M. obtained serial temperatures down to 1500 fathoms. At 1.30 P.M. commenced heaving in dredge, which came up at 3.30 P.M. with a few specimens. At 3.45 P.M. made sail.

Distance at noon from Cape of Good Hope, 850 miles. Made good 82 miles. Amount of current 10 miles, direction N. 51° E.

Station 137. Animals from Dredge.

The following species are recorded in the Zoological Reports from the dredge at this Station :—

ASTEROIDEA (Sladen, Zool. pt. 51).

Porcellanaster eremicus, n.g., n.sp. One specimen ; obtained at no other locality.

MACRURA (Spence Bate, Zool. pt. 52).

Sergestes profundus, n.sp. One specimen ; obtained also at Station 300, 1375 fathoms.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Malletia pallida, n.sp. Obtained at no other locality.

FISHES (Günther, Zool. pt. 57).

Gonostoma microdon, n.sp. One specimen ; for distribution see Station 23.

The Station-book records also :—Fragment of Schizopod (last segments of pleon and tail of *Gnathophausia zoëa*).

Excluding Protozoa, 5 specimens were obtained at this Station, belonging to 5 species, of which 4 are new to science, including representative of 1 new genus ; 2 of the new species were not obtained elsewhere.

Organisms from Surface Net.

Surface Organisms.—The following species is recorded from the surface at this Station :—

MACRURA (Spence Bate, Zool. pt. 52).

Gennadas intermedius, n.g., n.sp.

The tow-net was sent down to a depth of 100 fathoms, and brought up *Diphyes*, *Gleba*, *Cydippe*, great quantities of *Sagitta*, and Copepods.

Station 138.

Station 138 (Sounding 228), Tristan da Cunha to Cape of Good Hope (see Chart 16 and Diagram 6).

October 25, 1873 ; lat. 36° 22′ S., long. 8° 12′ E.
Temperature of air at noon, 53°·8 ; mean for the day, 53°·5.
Temperature of water :—

Surface,	56°·2	300 fathoms,	44°·0
50 fathoms,	56·1	350 ,,	41·5
100 ,,	56·0	400 ,,	39·9
150 ,,	53·5	450 ,,	38·9
200 ,,	50·5	500 ,,	38·3
250 ,,	47·0	Bottom,	35·4

Density at 60° F. at surface, 1·02631 ; bottom, 1·02580. STATION 138.

Depth, 2650 fathoms; deposit, Red Clay, containing 26·22 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 7.30 A.M. shortened and furled sails, and got up steam to sound. At 8 A.M. proceeded under steam, and at 9 A.M. sounded in 2650 fathoms. Obtained serial temperatures at intervals of 50 fathoms down to 500 fathoms. At 11.30 A.M. completed temperature observations, and at 11.45 A.M. made all plain sail.

Distance at noon from Cape of Good Hope, 519 miles. Made good 135 miles. Amount of current 10 miles, direction S. 38° E.

ORGANISMS FROM THE DEPOSIT.

DIATOMACEÆ.—The following species of Diatoms were observed by Mr. Comber in the deposit from this Station (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.):—

Nitzschia marina, Grunow.
Coscinodiscus lineatus, Ehrenberg.
,, *lentiginosus*, Janisch.
,, *atlanticus*, Castracane.
,, *curvatulus*, Grunow.
Coscinodiscus centralis, Ehrenberg, var.
,, *elegans*, Greville.
Hemidiscus cuneiformis, Wallich.
Actinoptychus splendens, Ralfs.

The siliceous organisms in this deposit do not make up more than one or two per cent. of this Red Clay, and more than half the Diatoms belong to *Coscinodiscus lentiginosus*, a species common in the Antarctic Diatom Ooze.

ORGANISMS FROM THE SURFACE.

Surface Organisms.—The following species is recorded from the surface (attached to a floating spar) on October 24 :—

CIRRIPEDIA (Hoek, Zool. pt. 25).

Lepas anatifera, Linné.

The specimens of *Lepas anatifera* were extremely large, and among them the common Atlantic *Idothea* was found.

Station 139 (Sounding 229), Tristan da Cunha to Cape of Good Hope (see Chart 16 and Diagram 6). STATION 139.

October 27, 1873 ; lat. 35° 35′ S., long. 16° 9′ E.

Temperature of air at noon, 54°·3 ; mean for the day, 53°·6.

Station 139.

Temperature of water :—

Surface,	56°·2	250 fathoms,	44°·0
10 fathoms,	56·1	300 ,,	41·0
20 ,,	56·0	350 ,,	39·0
30 ,,	55·0	400 ,,	38·0
40 ,,	52·9	450 ,,	37·6
50 ,,	52·3	500 ,,	37·5
60 ,,	52·1	700 ,,	37·2
70 ,,	52·0	900 ,,	37·0
80 ,,	51·8	1100 ,,	36·8
90 ,,	51·6	1300 ,,	36·6
100 ,,	51·5	1500 ,,	36·4
150 ,,	47·3	Bottom,	34·1
200 ,,	45·8		

Density at 60° F. at surface, 1·02614 ; bottom, 1·02582.

Depth, 2325 fathoms ; deposit, Globigerina Ooze, containing 47·15 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

A strong breeze from S.W. and a heavy sea during the night. At 8.20 A.M. brought ship to wind on starboard tack, and got up steam. At 11 A.M. shortened and furled sails, and proceeded under steam to sound. At noon sounded in 2325 fathoms. At 1 P.M. obtained serial temperatures down to 1500 fathoms. At 3.45 P.M. completed temperatures, and made all plain sail. At 9 P.M. got up steam, and at 9.40 P.M. proceeded under steam, the wind having sunk to nearly a calm.

Distance at noon from Cape of Good Hope, 138 miles. Made good 218 miles. Amount of current 25 miles, direction N. 18° E.

Station 140.

Station 140 (Sounding 230), Tristan da Cunha to Cape of Good Hope (see Chart 16 and Diagram 6).

October 28, 1873 ; lat. 35° 0′ S., long. 17° 57′ E.

Temperature of air at noon, 58°·8 ; mean for the day, 57°·6.

Temperature of water :—

Surface,	59°·0	60 fathoms,	53°·3
10 fathoms,	58·7	70 ,,	53·0
20 ,,	58·4	80 ,,	53·0
30 ,,	58·1	90 ,,	53·0
40 ,,	56·9	100 ,,	53·0
50 ,,	54·6		

Density at 60° F. at surface, 1·02620; 20 fathoms, 1·02625; 50 fathoms, 1·02616. STATION 140.

Depth, 1250 fathoms; deposit, Globigerina Ooze, containing 50·26 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 3.15 A.M. stopped engines. At daylight observed land to E.N.E. At 6 A.M. shortened and furled sails, and got up steam to sound. At 7 A.M. stopped and sounded in 1250 fathoms. At 8 A.M. completed sounding, and proceeded under steam and sail, Table Mountain and the mountains surrounding Simon's Bay in sight. At 11.30 A.M. obtained serial temperatures at intervals of 10 fathoms down to 100 fathoms. At 12.30 P.M. completed temperatures, and proceeded under sail and steam. Got into the warm current (62°·2 F. = 16°·8 C.) about 20 nautical miles S.W. of Cape of Good Hope. Altered course as requisite, rounding the Anvil and Bellows Rocks. At 2 P.M. rounded Cape of Good Hope, shortened and furled sail. At 3.35 P.M. stopped and came to in 9 fathoms; moored ship. Refused pratique on account of case of yellow fever which was reported to have occurred on board the ship at Bahia.

ORGANISMS FROM THE DEPOSIT.

DIATOMACEÆ.—The following species of Diatoms were observed by Mr. Comber in the deposit from this Station (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.):—

Nitzschia marina, Grunow.
Grammatophora serpentina, Ehrenberg.
Coscinodiscus excentricus, Ehrenberg.
,, *concavus*, Gregory.
,, *curvatulus*, Grunow.
,, *nodulifer*, Janisch.
,, *radiatus*, Ehrenberg.
Coscinodiscus centralis, Ehrenberg.
,, *elegans*, Greville.
Triceratium grande, Porter.
,, *junctum* A. Schmidt.
Hemidiscus cuneiformis, Wallich.
Arachnoidiscus ornatus, Ehrenberg.
Hyalodiscus lævis, Ehrenberg.

AT CAPE OF GOOD HOPE.

The Expedition remained at the Cape of Good Hope from October 28 till December 17, 1873. During the stay Mr. Murray packed up and catalogued all the deep-sea collections made during the first year of the cruise. The sixty-four boxes containing these collections were addressed to the Hydrographer of the Admiralty, and were landed at the dockyard to be forwarded to England. The following species are recorded in the Zoological Reports as having been obtained during the stay, principally from Simon's Bay and on shore at Sea Point, near Cape Town:—

ANIMALS FROM CAPE OF GOOD HOPE.

MONAXONIDA (Ridley and Dendy, Zool. pt. 59).

Esperella simonis, n.sp. Three specimens (Simon's Bay, 10 to 20 fathoms); obtained at no other locality.

Cape of Good Hope.

Desmacidon conulosa, n.sp. Two specimens (Simon's Bay, 10 to 20 fathoms); obtained at no other locality.

,, (*Homœodictya*) *grandis*, n.sp. One specimen (Simon's Bay, 10 to 20 fathoms); obtained at no other locality.

Rhaphidophlus lobatus (Vosmaer), var. *horrida*, nov. One specimen (Simon's Bay, 10 to 20 fathoms); obtained at no other locality. The species recorded from the Cape.

Raspailia flagelliformis, n.sp. One specimen (Simon's Bay, 10 to 20 fathoms); obtained at no other locality.

Dendropsis bidentifera, n.g., n.sp. Two specimens (Simon's Bay, 10 to 20 fathoms); obtained at no other locality. Only species of the genus.

Proteleia sollasi, n.g., n.sp. One specimen (Simon's Bay, 10 to 20 fathoms); obtained at no other locality. Only species of the genus.

ALCYONARIA (Wright and Studer, Zool. pt. 64).

Eunicella papillosa (Esper), Verrill. One branch (Simon's Bay); obtained at no other locality by the Challenger.

Lophogorgia flammea (Ellis and Solander). Fragment (doubtful whether from Simon's Bay or Prince Edward Island); obtained at no other locality by the Challenger. Recorded from the Cape.

ACTINIARIA (Hertwig, Zool. pts. 15 and 73).

Comactis flagellifera (Drayton). One specimen (Simon's Bay, 25 fathoms); obtained at no other locality by the Challenger.

Aulactinia sp. (?). One specimen (Simon's Bay, 10 to 20 fathoms).

Zoanthus confertus, Verrill. (Simon's Bay, 10 to 20 fathoms); obtained at no other locality by the Challenger.

Corticifera tuberculosa (Klunzinger). Colony of about forty individuals (Simon's Bay, 10 to 20 fathoms); obtained at no other locality by the Challenger.

CORALS (Moseley, Zool. pt. 7).

Cladocora arbuscula, M.-Edwards and Haime. One specimen (Simon's Bay, 10 to 20 fathoms); obtained also at Station 33.

REEF CORALS (Quelch, Zool. pt. 46).

Manicina areolata (Linné). One specimen (Simon's Bay, 10 to 20 fathoms); obtained also at St. Thomas.

Cape of Good Hope.

Hydroida (Allman, Zool. pts. 20 and 70).

Aglaophenia attenuata, n.sp. (Simon's Bay, 10 to 20 fathoms); obtained at no other locality.

Halecium dichotomum, n.sp. (Simon's Bay, shallow water); obtained at no other locality.

Thuiaria pectinata, n.sp. (Simon's Bay); obtained at no other locality.

Thecocladium flabellum, n.g., n.sp. (Simon's Bay, 10 to 20 fathoms); obtained at no other locality. Only species of the genus.

Crinoidea (Carpenter, Zool. pt. 60).

Actinometra parvicirra (Müller). One specimen (Simon's Bay); obtained also at Stations 174, 186, Banda, Ternate, Admiralty Islands, and Philippines, 8 to 610 fathoms. A widely-distributed species.

Asteroidea (Sladen, Zool. pt. 51).

Pseudarchaster tessellatus, n.g., n.sp. Two specimens (Simon's Bay); obtained at no other locality.

Astropecten pontoporæus, n.sp. (Simon's Bay, 5 to 20 fathoms); obtained at no other locality.

Psilaster acuminatus, n.g., n.sp. Two specimens (Simon's Bay); obtained also at Stations 164 and 167, 410 (?) and 150 fathoms.

Luidia africana, n.sp. (Simon's Bay); obtained at no other locality by the Challenger. Recorded from North Atlantic ("Porcupine").

Calliaster baccatus, n.sp. (Simon's Bay, 5 to 18 fathoms); obtained at no other locality.

Patiria bellula, n.sp. Two specimens (Simon's Bay, shallow water); obtained at no other locality.

Asterina e[illegible]amarck), Perrier. (Sea Point and Simon's Bay, shallow water); obtained also at Port Jackson and Philippines, 6 and 10 fathoms. A widely-distributed species.

Stichaster felipes, n.sp. Several specimens (Simon's Bay); obtained also at Station 142, 150 fathoms.

Cribrella ornata, Perrier. (Simon's Bay, shallow water to 20 fathoms); obtained at no other locality by the Challenger. Recorded from the Cape, New Zealand, and Campbell Island.

Asterias (*Stolasterias*) *africana* (Müller and Troschel), Perrier. (Simon's Bay, shallow water to 20 fathoms); obtained at no other locality by the Challenger. Recorded from the Cape.

Cape of Good Hope.

Ophiuroidea (Lyman, Zool. pt. 14).

Ophiura tongana (Lütken) (?). (Simon's Bay, 10 to 20 fathoms); obtained at no other locality by the Challenger.

Ophiactis carnea, Ljungman. (Simon's Bay, 10 to 20 fathoms); obtained at no other locality by the Challenger.

Amphiura incana, n.sp. (Simon's Bay, 10 to 20 fathoms); obtained at no other locality.

Ophiocoma scolopendrina (Lamarck). (Simon's Bay, 10 to 20 fathoms); obtained also at Tongatabu, Fiji, and Philippines.

Ophiothrix triglochis, Müller and Troschel. (Simon's Bay, 5 to 18 fathoms); obtained at no other locality by the Challenger.

Gorgonocephalus verrucosus (Lamarck). (Simon's Bay, 10 to 20 fathoms); obtained at no other locality by the Challenger.

Echinoidea (Agassiz, Zool. pt. 9).

Echinus angulosus (Leske). (Simon's Bay, 10 to 20 fathoms); obtained at no other locality by the Challenger.

Lovenia elongata, Gray. (Simon's Bay); obtained also at Stations 188 and 212, 10 to 28 fathoms. Recorded from Gulf of California and Philippines.

Brissopsis lyrifera (Forbes). (Simon's Bay, 5 to 18 fathoms); obtained also at Stations 141 and 142, 98 and 150 fathoms. A widely-distributed species.

Holothurioidea (Théel, Zool. pt. 39).

Cucumaria discolor, n.sp. One specimen (Simon's Bay, 10 to 20 fathoms); obtained at no other locality.

,, *insolens*, n.sp. Numerous specimens (Simon's Bay, 10 to 20 fathoms); obtained at no other locality.

Holothuria africana, n.sp. One specimen (Simon's Bay, 10 to 20 fathoms); obtained at no other locality.

Gephyrea (Selenka, Zool. pt. 36).

Phascolosoma capense, Teuscher. Numerous specimens (Sea Point, shallow water); obtained at no other locality by the Challenger. Recorded from the Cape.

Annelida (M'Intosh, Zool. pt. 34).

Euphrosyne capensis, Kinberg. Many specimens (Sea Point, under stones between tide-marks); obtained at no other locality by the Challenger. Recorded from the Cape and St. Paul.

Cape of Good Hope.

Lepidonotus wahlbergi, Kinberg. Several specimens (Sea Point, between tide-marks); obtained at no other locality by the Challenger. Recorded from the Cape and Port Natal.

Eunoa capensis, n.sp. One specimen (Sea Point, between tide-marks); obtained at no other locality.

Polynoë attenuata, n.sp. One specimen (Sea Point, between tide-marks); obtained at no other locality.

Eulalia capensis, Schmarda. One specimen (Sea Point, between tide-marks); obtained at no other locality by the Challenger. Recorded from Table Bay.

Notocirrus capensis, n.sp. One specimen (Sea Point, between tide-marks); obtained at no other locality.

Nematonereis sp. (?). Fragment (Sea Point, beach).

Eunice murrayi, n.sp. One specimen (Simon's Bay, 18 fathoms); obtained at no other locality.

Trophonia capensis, n.sp. One specimen (Sea Point, between tide-marks); obtained at no other locality.

Cirratulus capensis, Schmarda. Several specimens (Sea Point, between tide-marks); obtained at no other locality by the Challenger. Recorded from the Cape.

Nicomache capensis, n.sp. One specimen (Sea Point, between tide-marks); obtained at no other locality.

Sabellaria (*Pallasia*) *capensis* (Schmarda). Several specimens (Sea Point, between tide-marks); obtained at no other locality by the Challenger. Recorded from the Cape.

Schmardanella pterochæta (Schmarda). Several specimens (Sea Point, between tide-marks); obtained at no other locality by the Challenger. Recorded from the Cape.

Dasychone violacea (Schmarda). Several specimens (Sea Point, between tide-marks); obtained at no other locality by the Challenger. Recorded from the Cape.

Ostracoda (Brady, Zool. pt. 3).

Pontocypris (?) *subreniformis*, n.sp. (Simon's Bay, 15 to 20 fathoms); obtained also at Port Jackson, 2 to 10 fathoms.

Macrocypris maculata, Brady. (Simon's Bay, 15 to 20 fathoms); obtained also at Stations 145, 149, 162, and Amboina, 15 to 150 fathoms. Recorded from Australia, West Indies, and Turk's Island.

CAPE OF GOOD HOPE.

Bairdia ovata, Bosquet (?). (Simon's Bay, 15 to 20 fathoms); obtained also at Station 167, 150 fathoms.

Cythere exilis, n.sp. (Simon's Bay, 15 to 20 fathoms); obtained at no other locality.

,, *flabellicostata*, n.sp. (Simon's Bay, 15 to 20 fathoms); obtained at no other locality.

,, *craticula*, n.sp. (Simon's Bay, 15 to 20 fathoms); obtained at no other locality.

,, *stolonifera*, n.sp. (Simon's Bay, 15 to 20 fathoms); obtained at no other locality.

,, *lepralioides*, n.sp. (Simon's Bay, 15 to 20 fathoms); obtained also at Station 142, 150 fathoms.

Loxoconcha subrhomboidea, n.sp. (Simon's Bay, 15 to 20 fathoms); obtained at no other locality.

Xestoleberis africana, n.sp. (Simon's Bay, 15 to 20 fathoms); obtained at no other locality.

Cytherura mucronata, n.sp. (Simon's Bay, 15 to 20 fathoms); obtained at no other locality.

,, *clausi*, n.sp. (Simon's Bay, 15 to 20 fathoms); obtained at no other locality.

Cytherella dromedaria, n.sp. (Simon's Bay, 15 to 20 fathoms); obtained at no other locality.

AMPHIPODA (Stebbing, Zool. pt. 67).

Lysianax variegatus (Stimpson). Several specimens (Simon's Bay, 18 fathoms); obtained at no other locality by the Challenger. Recorded from the Cape.

ISOPODA.

Fourteen specimens, belonging to five species undetermined (Simon's Bay and Cape Town).

ANOMURA (Henderson, Zool. pt. 69).

Dromidia spongiosa, Stimpson. One specimen (Simon's Bay, 10 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from the Cape and St. Paul.

Pseudodromia latens, Stimpson. One specimen (Simon's Bay, 10 to 12 fathoms); obtained at no other locality by the Challenger. Recorded from the Cape.

Diogenes brevirostris, Stimpson. One specimen (Simon's Bay, 10 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from the Cape.

CAPE OF GOOD HOPE.

Pagurus granulatus, Olivier. Two specimens (Simon's Bay, 10 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from West Atlantic.

Anapagurus pusillus, n.sp. (?). One specimen (Simon's Bay, 18 fathoms); obtained also at Stations VIIp. and 75.

Porcellana streptocheles, Stimpson. Two specimens (Simon's Bay, 5 to 18 fathoms); obtained at no other locality by the Challenger. Recorded from the Cape.

Galathea labidolepta, Stimpson (?). One specimen (Simon's Bay, 5 to 18 fathoms); obtained at no other locality by the Challenger. Recorded from the Cape.

,, sp. (?). Three specimens (Simon's Bay, 5 to 18 fathoms).

BRACHYURA (Miers, Zool. pt. 49).

Stenorhynchus falcifer, Stimpson. Three specimens (Simon's Bay, 5 to 18 fathoms); obtained at no other locality by the Challenger. Recorded from the Cape.

Achæopsis spinulosus, Stimpson. Four specimens (Simon's Bay, 5 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from the Cape.

Dehaanius dentatus (M.-Edwards). One specimen (Simon's Bay, 10 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from the Cape and Natal.

Pericera cornuta, M.-Edwards. One specimen (Simon's Bay, 10 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from the Cape and West Atlantic.

Thelphusa (*Potamonautes*) *perlata*, M.-Edwards. Many specimens (Cape Town and Wellington, from rivers); obtained at no other locality by the Challenger.

Plagusia chabrus (Linné). Two specimens (Simon's Bay, 10 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from New Zealand.

Hymenosoma orbiculare, Desmarest. Many specimens (Simon's Bay, 5 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from the Cape.

Calappa flammea (Herbst). One specimen (Simon's Bay, 10 to 20 fathoms); obtained also at Bermuda.

Mursia cristimana (M.-Edwards). Two specimens (Sea Point and Simon's Bay); obtained also at Station 142, 150 fathoms.

Cape of Good Hope.

Pycnogonida (Hoek, Zool. pt. 10).

Discoarachne brevipes, n.g., n.sp. One specimen (Sea Point); obtained at no other locality. Only species of the genus.

Hannonia typica, n.g., n.sp. One specimen (Sea Point); obtained at no other locality. Only species of the genus.

Lamellibranchiata (Smith, Zool. pt. 35).

Tellina (*Angulus*) *natalensis*, Krauss. (Simon's Bay, 15 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from South Africa.

Cardium (*Papyridea*) *semisulcatum*, Gray. (Simon's Bay, 15 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from West Indies and Ceylon (?).

Cardita (*Thecalia*) *concamerata* (Chemnitz). Several specimens (Sea Point); obtained at no other locality by the Challenger.

Carditella capensis, n.sp. (Simon's Bay, 15 to 20 fathoms); obtained at no other locality.

Nucudina ovalis (Wood). Three valves (Simon's Bay, 15 to 20 fathoms); obtained at no other locality by the Challenger. Known previously only as a Crag fossil.

Scaphopoda and Gasteropoda (Watson, Zool. pt. 42).

Dentalium dentalis, Linné. (Simon's Bay, 15 to 20 fathoms); obtained also at Station 75.

Patella granatina, Linné. (Sea Point); obtained at no other locality by the Challenger. Recorded from the Cape and Antilles.

Fissurella mutabilis, Sowerby. (Sea Point); obtained at no other locality by the Challenger. Recorded from the Cape.

,, (*Lucapina*) *fumata*, Reeve (?). (Sea Point); obtained at no other locality by the Challenger. Original locality unknown.

Trochus (*Monilea*) *benzi*, Krauss. (Simon's Bay, 15 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from the Cape.

,, (*Gibbula*) *zonatus*, Wood. (Sea Point); obtained at no other locality by the Challenger. Recorded from the Cape.

,, sp. (?). (Simon's Bay, 15 to 20 fathoms).

Phasianella sp. (?) (Simon's Bay, 15 to 20 fathoms).

Bullia lævigata (Chemnitz). (Simon's Bay, 15 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from the Cape.

CAPE OF GOOD HOPE.

Fusus verruculatus, Lamarck. (Simon's Bay, 15 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from East Indies (?).

Cominella porcata (Gmelin). (Simon's Bay, 10 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from the Cape.

Ancilla (*Anaulax*) *obtusa* (Swainson). (Simon's Bay, 15 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from the Cape and East Africa.

Columbella mercatoria (Linné). (Sea Point); obtained also at Fernando Noronha.

Mitra sp. (?). (Sea Point).

Marginella (*Glabella*) *chrysea*, n.sp. (Sea Point); obtained at no other locality.

Strombus lentiginosus, Linné. (Simon's Bay); obtained at no other locality by the Challenger. Recorded from East Africa throughout Indian Ocean to Australia.

Turritella knysnaënsis, Krauss. (Simon's Bay, 15 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from the Cape.

Odostomia sp. (?). (Simon's Bay, 15 to 20 fathoms).

Cerithium vulgatum, Bruguière. (Simon's Bay, 15 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from Black Sea, Mediterranean, and North Atlantic. Fossil—Middle Miocene of Italy onwards.

Rissoa (*Onoba*) *fenestrata*, Krauss. (Simon's Bay, 15 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from the Cape.

Aplysia depilans, Linné. (Simon's Bay, 15 to 20 fathoms); obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean.

Dolabrifera triangularis, n.sp. (Simon's Bay, 15 to 20 fathoms); obtained at no other locality.

Coralliophila wahlbergi (Krauss). (Sea Point, shallow water). [See Smith, *Proc. Zool. Soc. Lond.*, 1891, pp. 436, 437].

POLYPLACOPHORA (Haddon, Zool. pt. 43).

Ischnochiton viridulus (Couthouy). One specimen (Cape Town); obtained at no other locality by the Challenger. Recorded from the Cape.

Chiton nigrovirescens, Blainville. Six specimens (Sea Point, shore); obtained at no other locality by the Challenger. Recorded from the Cape.

Cape of Good Hope.

Acanthochiton garnoti (Blainville). Seven specimens (Sea Point, shore); obtained at no other locality by the Challenger.

CEPHALOPODA (Hoyle, Zool. pt. 44).

Argonauta argo, Linné. One specimen (Cape); obtained at no other locality by the Challenger. A widely-distributed species.

Octopus granulatus, Lamarck. One specimen (Simon's Bay, 10 to 20 fathoms); obtained also at Cape Verdes.

POLYZOA (Busk, Zool. pts. 30 and 50; Waters, pt. 79).

Menipea flabellum, Lamouroux. (Simon's Bay); obtained at no other locality by the Challenger. Recorded from Natal.

" *triseriata*, Busk. (Simon's Bay); obtained at no other locality by the Challenger.

" *cirrata*, Lamouroux. (Simon's Bay); obtained at no other locality by the Challenger.

Membranipora galeata, Busk, var. *multifida*, nov. (Simon's Bay); the species obtained also at Stations 75, 145, 149, 150, 163A, and 320.

Amphiblestrum imbricatum, n.sp. (Simon's Bay); obtained at no other locality.

" *capense*, n.sp. (Simon's Bay); obtained at no other locality. [Waters calls it *Monoporella* (?) *capensis* (Busk)].

Foveolaria tubigera, n.g., n.sp. (Simon's Bay); obtained at no other locality.

Onchoporella bombycina (Linné). (Simon's Bay); obtained at no other locality by the Challenger.

Retepora tessellata, Hincks. (Simon's Bay); obtained at no other locality by the Challenger.

" " var. *cæspitosa*, nov. (Simon's Bay); obtained at no other locality.

" " var. *pubens*, nov. (Simon's Bay); obtained at no other locality.

" *lata*, n.sp. (Simon's Bay); obtained at no other locality.

Cribrilina labiosa, Busk, var. *fragilis*, nov. (Simon's Bay); obtained at no other locality.

Chorizopora brongniartii (Audouin). (Simon's Bay, 18 fathoms); obtained at no other locality by the Challenger. Recorded from Mediterranean and North Atlantic. Fossil—Coralline Crag, Pliocene and Miocene of Europe.

Mucronella contorta, Busk. (Simon's Bay); obtained at no other locality by the Challenger. Recorded from Natal.

" *tricuspis*, Hincks. (Simon's Bay); obtained also at Stations 145 and 315, 12 to 150 fathoms. Recorded from South America and Bass Strait.

Schizoporella tenuis, n.sp. (Simon's Bay); obtained also at Sandwich Islands, 20 to 40 fathoms. CAPE OF GOOD HOPE.

Gemellipora cribritheca, n.sp. (Simon's Bay); obtained at no other locality.

Cellepora simonensis, n.sp. (?). (Simon's Bay); obtained at no other locality.

,, *conica*, n.sp. (?). (Simon's Bay); obtained at no other locality.

Idmonea atlantica, Forbes. (Simon's Bay, 18 fathoms); obtained also at Stations 135 and 149.

TUNICATA (Herdman, Zool. pts. 17 and 38).

Cynthia pallida, Heller. One specimen (Simon's Bay, 10 to 20 fathoms); obtained also at Fiji. Recorded from Tahiti.

Pachychlæna gigantea, n.g., n.sp. Two specimens (Simon's Bay, 10 to 20 fathoms); obtained at no other locality.

Clavelina enormis, n.sp. Colony of four adults and several buds (Simon's Bay, 10 to 20 fathoms); obtained at no other locality.

Atopogaster elongata, n.g., n.sp., var. *pallida*, nov. One specimen (Simon's Bay, 10 to 20 fathoms); the species obtained also at Station 313, 55 fathoms.

Leptoclinum albidum, Verrill (?). Several colonies (Simon's Bay, 10 to 20 fathoms); obtained also at Cape Verdes.

Goodsiria placenta, n.sp. Two specimens (Simon's Bay, 10 to 20 fathoms); obtained at no other locality.

,, ,, var. *fusca*, nov. Two specimens (Simon's Bay, 10 to 20 fathoms); obtained at no other locality.

FISHES (Günther, Zool. pt. 6).

Chorisochismus dentex, Pall. (Simon's Bay); obtained at no other locality by the Challenger.

Tetrodon honckeni, Bl. [Poison-fish of Simon's Bay]. (Cape); obtained at no other locality by the Challenger.

Bdellostoma cirrhatum, Forst. (Simon's Bay); obtained also at New Zealand.

Spirobranchus capensis, C.V. (Cape Town and Wellington, from rivers); obtained at no other locality by the Challenger.

Barbus afer, Peters. (Cape Town and Wellington, from rivers); obtained at no other locality by the Challenger.

,, sp. (?). (Cape Town, from river).

CETACEA (Turner, Zool. pt. 4).

Mesoplodon layardi, Gray. (Cape); obtained also at Falkland Islands. Recorded from Chatham Islands, New Zealand, and Australia.

Cape of Good Hope.

In the foregoing list 158 species are enumerated, of which 62 are new to science, including representatives of 10 new genera; 54 of the new species and 5 new genera were not obtained elsewhere.

Surface Organisms.—The following species are recorded from the surface :—

Cirripedia (Hoek, Zool. pt. 25).

Lepas anatifera, Linné (from log of wood).

Stomatopoda (Brooks, Zool. pt. 45).

Alima bidens, Claus [= larva of *Squilla*].

Schizopoda (Sars, Zool. pt. 37).

Stylocheiron longicorne, n.g., n.sp.

Tunicata (Herdman, Zool. pt. 76).

Salpa democratica-mucronata, Forskåhl.

The water in Simon's Bay was frequently very luminous, and was found to contain many specimens of *Noctiluca* in the flagellated stage.

Station 141.

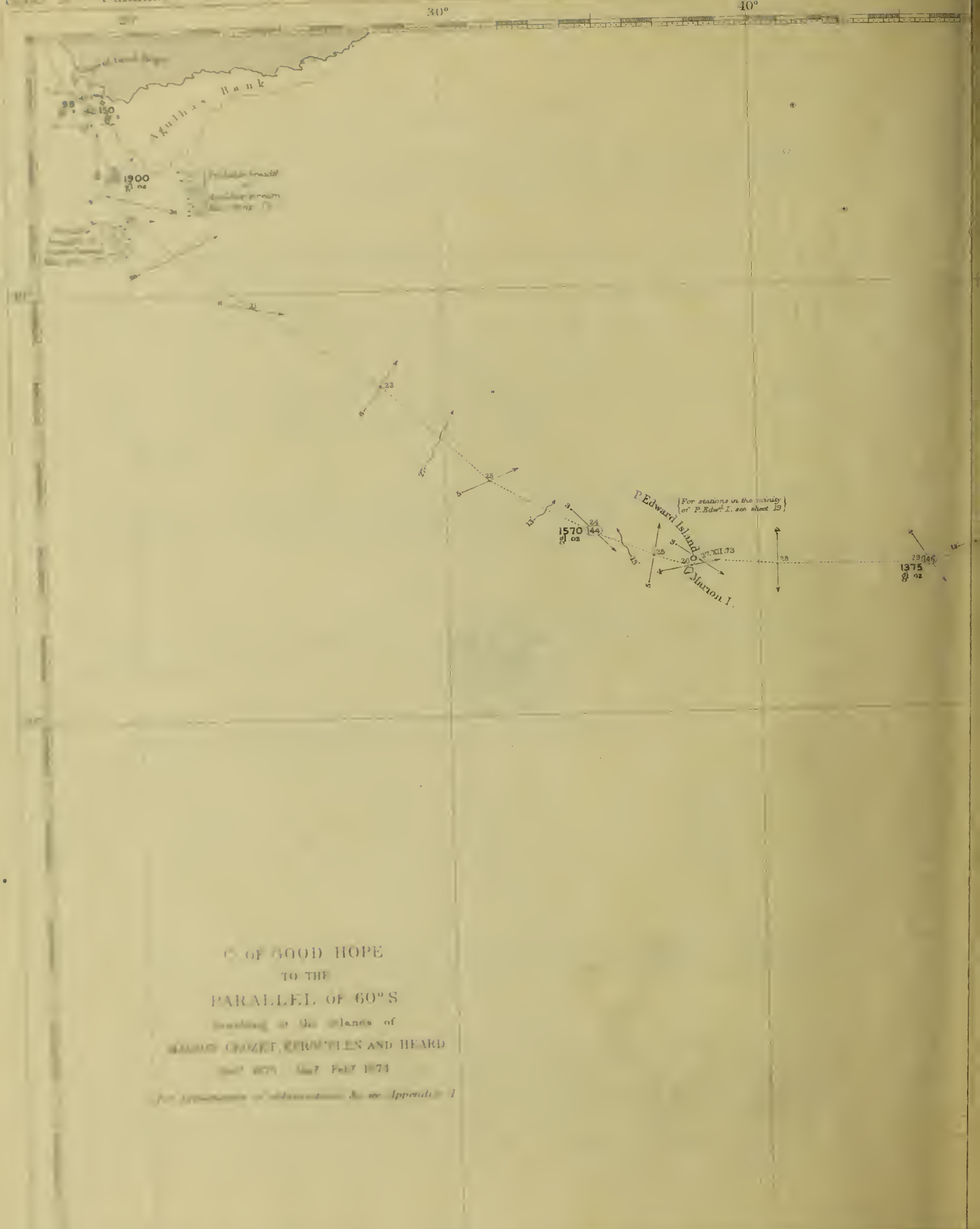
Station 141 (Sounding 231), Cape of Good Hope to Marion Island (see Chart 18 and Diagram 8).

December 17, 1873; lat. 34° 41′ S., long. 18° 36′ E.
Temperature of air at noon, 66°·8; mean for the day, 67°·5.
Temperature of water :—

	°		°
Surface,	66·5	60 fathoms,	52·8
10 fathoms,	66·2	70 ,,	51·4
20 ,,	65·3	80 ,,	50·3
30 ,,	63·9	90 ,,	49·6
40 ,,	59·8	Bottom,	49·5
50 ,,	54·9		

Depth, 98 fathoms; deposit, Green Sand, containing 49·46 per cent. of carbonate of lime, and phosphatic and glauconitic concretions (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6.30 A.M. weighed anchor and proceeded out of Simon's Bay on the voyage to the Antarctic ice and Australia. At 1.35 P.M. stopped and sounded in 98 fathoms on the edge of the Agulhas Bank. Put dredge over, and obtained serial temperatures at intervals of 10 fathoms down to the bottom. At 3.30 P.M. hove up dredge with numerous specimens, and sent it down again at 4 P.M. At 5 P.M. hove up dredge with many specimens,


30°
40°
Agulhas Bank
1900
1570
1375
P. Edward Island
Marion I.
For stations in the vicinity of P. Edwd. I. see sheet 19
OF GOOD HOPE
TO THE
PARALLEL OF 60° S
30°
40°


50°
60°
70°
80°
40°
50°
(For stations in the vicinity of Crozet Is see sheet 20.)
Crozet Is
Kerguelen I.
(For stations in the vicinity of Kerguelen I. see sheet 21.)
150
coarse gravel
Heard I.
60°
70°
Long. East from Greenwich

and sent it down again. Three hauls were taken with the dredge, and the swabs were crowded with specimens of *Brissopsis lyrifera*. At 5.45 P.M. made all plain sail. Weather fine, almost a calm; sea smooth. STATION 141.

The following species are recorded in the Zoological Reports from the dredge at this Station:— ANIMALS FROM DREDGE.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophioglypha costata, n.sp. Obtained also at Station 142, 150 fathoms.
Amphiura capensis, Ljungman. Obtained at no other locality by the Challenger.
,, *dilatata*, n.sp. Obtained at no other locality.
,, *squamata* (Delle Chiaje), Sars. Obtained also at Station 163, 120 fathoms. A widely-distributed species.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Spatangus raschi, Lovén. Obtained also at Station 142, 150 fathoms. Recorded from East Atlantic.
Brissopsis lyrifera (Forbes). Many specimens; obtained also at Simon's Bay, Cape, and Station 142.

HOLOTHURIOIDEA (Théel, Zool. pt. 39).

Cucumaria capensis, n.sp. One specimen; obtained also at Station 142, 150 fathoms.

ANNELIDA (M'Intosh, Zool. pt. 34).

Polynoë capensis, n.sp. Two specimens; obtained at no other locality.
Syllis capensis, n.sp. One small specimen; obtained at no other locality.
Lumbriconereis pettigrewi, n.sp. Several specimens; obtained at no other locality.
Scalibregma inflatum, Rathke, var. (?). Numerous specimens; obtained also at Station 169, 700 fathoms.
Ranzania (?) *capensis*, n.sp. One fragmentary specimen; obtained at no other locality.
Prionospio capensis, n.sp. One fragmentary specimen; obtained at no other locality.
Praxilla capensis, n.sp. Two fragmentary specimens; obtained at no other locality.

SCHIZOPODA (Sars, Zool. pt. 37).

Lophogaster typicus, Sars. One or two specimens; obtained also at Station 142, 150 fathoms. Recorded from North Atlantic.

STATION 141 LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Saxicava arctica, Linné. For distribution see Station 75.
Pecten limatula, Reeve, var. (?). Obtained also at Station 135.

GASTEROPODA (Watson, Zool. pt. 42).

Fusus (Sipho) pyrrhostoma, n.sp. One specimen; obtained at no other locality.
Ancilla (Anaulax) montrouzieri (Souverbie). One specimen; obtained at no other locality by the Challenger. Recorded from New Caledonia.
Voluta (Volutilithes) abyssicola, Adams and Reeve. One or two specimens; obtained also at Station 142, 150 fathoms. Recorded from the Cape.

TUNICATA (Herdman, Zool. pt. 38).

Psammaplidium exiguum, n.g., n.sp. One specimen; obtained at no other locality.

In addition to the foregoing, the following are recorded in the Station-book:—Hydroid, *Palythoa* (?), *Luidia fragilissima*, *Astrogonium* sp., *Archaster andromeda*, *Caprella*, *Pagurus*.

Excluding Protozoa, over 100 specimens of invertebrates were obtained at this Station, belonging to about 28 species, of which 11 are new to science, including representative of 1 new genus; 9 of the new species were not obtained elsewhere.

OBSERVATIONS FROM SURFACE NETS. Surface Organisms.—The following species are recorded from the surface at this Station:—

AMPHIPODA (Stebbing, Zool. pt. 67).
Hyperia promontorii, n.sp.
Hyperoche cryptodactylus, n.sp.

SCHIZOPODA (Sars, Zool. pt. 37).
Euphausia splendens, Dana.
Anchialus typicus, Krøyer.

In the evening the water was very luminous, apparently caused by myriads of Zoëæ, including a few larger Megalopæ; there were also *Peridinium*, Medusæ, *Velellæ*, *Sagittæ*, and larvæ of Decapods and *Squilla*.

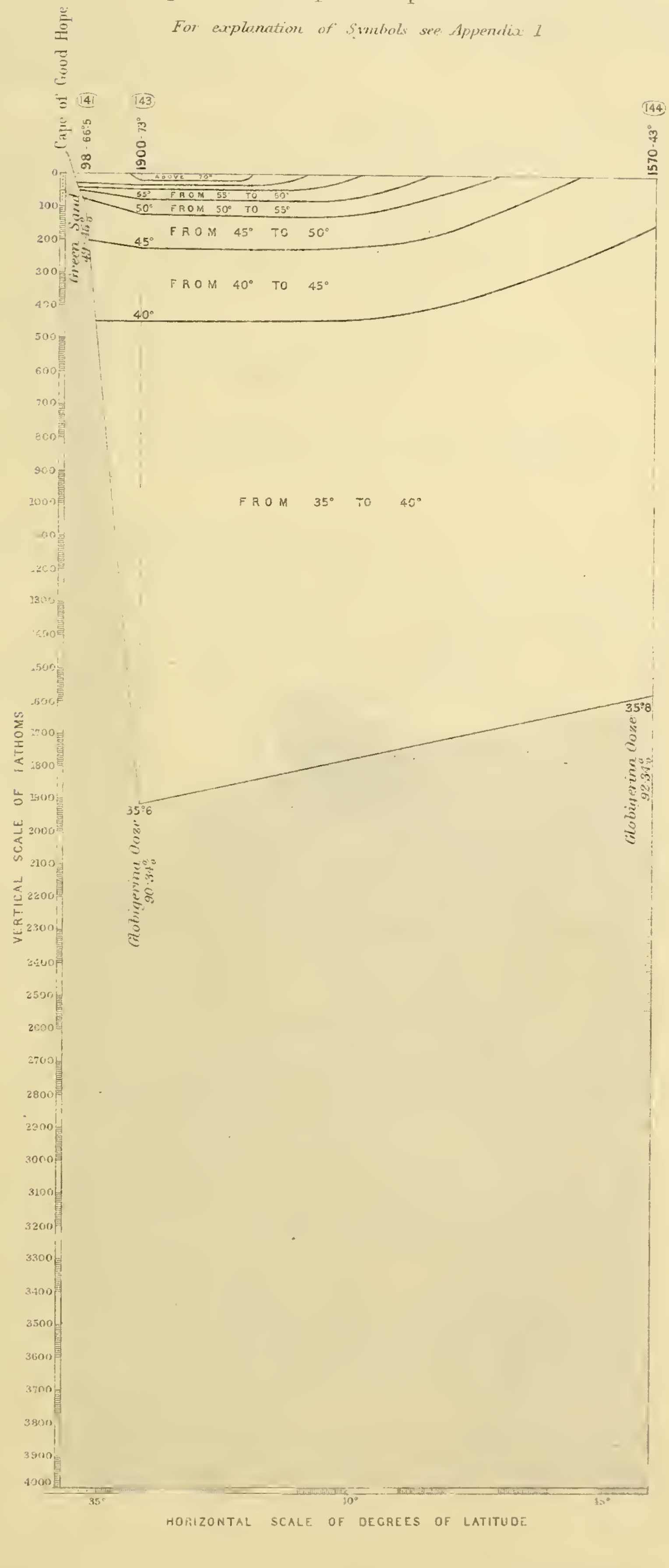
STATION 142. Station 142 (Sounding 232), Cape of Good Hope to Marion Island (see Chart 18).

December 18, 1873; lat. 35° 4′ S., long. 18° 37′ E.
Temperature of air at noon, 67°·0; mean for the day, 65°·7.
Temperature of water at surface, 65°·5; bottom, 47°·0
Density at 60° F. at surface, 1·02665; bottom, 1·02658.

INDIAN OCEAN

Meridional Temperature Section
Cape of Good Hope to the parallel of 46° S.

For explanation of Symbols see Appendix 1



Engraved by Malby & Sons

Depth, 150 fathoms; deposit, Green Sand, containing 67·75 per cent. of carbonate of lime, and phosphatic and glauconitic concretions (see Murray and Renard, Deep-Sea Deposits Chall. Exp.). STATION 142.

At 5 A.M. got up steam. At 6.10 A.M. shortened sail, and proceeded under steam to sound and dredge. Sounded in 150 fathoms. Put dredge over. At 8 A.M. hove up dredge containing numerous specimens, nearly all the invertebrate groups being represented. The swabs were filled with large colonies of Polyzoa and Sponges. At 8.30 A.M. made all plain sail. Shaped course S.S.W. Later in forenoon picked up a favourable westerly breeze.

Distance at noon from Prince Edward Island, 1083 miles. Made good 47 miles. Amount of current 11 miles, direction S. 21° W.

ANIMALS FROM DREDGE.

The following species are recorded in the Zoological Reports from the dredge at this Station :—

MONAXONIDA (Ridley and Dendy, Zool. pt. 59).

Petrosia similis, n.sp. Several specimens; obtained also at Station 150, 150 fathoms. Recorded subsequently from Kerguelen.

Gellius glacialis, n.sp. About twenty-five specimens; obtained at no other locality.

Vomerula esperoides, n.sp. Numerous specimens; obtained also at Station 320, 600 fathoms.

Desmacidon (?) *ramosa*, n.sp. Several specimens; obtained also at Station 145, 50 to 75 fathoms.

Iophon chelifer, n.sp. Young specimen encrusting a branched Polyzoon; obtained also at Stations 145 and 148, 310 and 550 fathoms.

Myxilla digitata, n.sp. One specimen; obtained at no other locality.

Raspailia (?) *rigida*, n.sp. One specimen; obtained at no other locality.

CORALS (Moseley, Zool. pt. 7).

Caryophyllia communis (Seguenza). One dead broken specimen; for distribution see Station 45.

Rhizotrochus fragilis, Pourtalès. One specimen; obtained also at Station 177 (?), 50 to 125 fathoms.

ASTEROIDEA (Sladen, Zool. pt. 51).

Stichaster felipes, n.sp. Obtained also at Simon's Bay, Cape.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophiopeza aster, n.sp. Obtained at no other locality.

Ophioglypha costata, n.sp. Obtained also at Station 141.

Station 142.

Ophiomusium pulchellum, Wyville Thomson, n.sp. Obtained also at Stations 87 and 122.

Ophiomastus sp. (?). Young.

Ophiactis flexuosa, n.sp. Ten specimens (young ?); obtained also at Station 171, 600 fathoms.

,, *plana*, Lyman (?). Young; obtained at no other locality by the Challenger. Recorded from Florida.

Ophiothamnus remotus, n.sp. Obtained at no other locality.

Ophiothrix aristulata, n.sp. Obtained also at Stations 161 and 163, 38 and 120 fathoms.

Ophioscolex dentatus, n.sp. Obtained at no other locality.

Ophiomyxa vivipara, Studer. Obtained also at Stations 308, 313, and 314, 55 to 175 fathoms. Recorded from the Cape, Kerguelen, and Magellan Strait.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Spatangus raschi, Lovén. Obtained also at Station 141.

Echinocardium flavescens (Müller). Obtained at no other locality by the Challenger. Recorded from East Atlantic.

Brissopsis lyrifera (Forbes). Obtained also at Simon's Bay, Cape, and Station 141.

Schizaster fragilis (Düben and Koren). Obtained also at Station 49.

HOLOTHURIOIDEA (Théel, Zool. pt. 39).

Cucumaria capensis, n.sp. Two specimens; obtained also at Station 141.

ANNELIDA (M'Intosh, Zool, pt. 34).

Dasychone capensis, n.sp. Obtained at no other locality.

Euphione elisabethæ, n.g., n.sp. Obtained at no other locality. Only species of the genus.

Protula capensis, n.sp. One specimen; obtained at no other locality.

OSTRACODA (Brady, Zool. pt. 3).

Cythere cytheropteroides, n.sp. A few specimens; obtained at no other locality.

,, *lepralioides*, n.sp. Obtained also at Simon's Bay, Cape.

Polycope orbicularis, Sars (?). Obtained also at Stations 149, 185, and Vigo Bay, 11 to 150 fathoms. Recorded from Arctic and North Atlantic. Fossil—Post-Tertiary of Scotland.

AMPHIPODA (Stebbing, Zool. pt. 67).

Ampelisca fusca, n.sp. Three specimens; obtained at no other locality.

Gammaropsis afra, n.sp. One specimen; obtained at no other locality.

Lætmatophilus purus, n.sp. One specimen; obtained at no other locality. STATION 142.
Leucothoë miersi, n.sp. One specimen; obtained at no other locality.
Mæra bruzelii, n.sp. One specimen; obtained at no other locality.
„ *rubromaculata*, Stimpson. One specimen; obtained also at Port Jackson, 30 to 120 fathoms. Recorded from Australia and Tasmania.
Stenothoë adhærens, n.sp. Two specimens; obtained at no other locality.

SCHIZOPODA (Sars, Zool. pt. 37).

Lophogaster typicus, Sars. Obtained also at Station 141.

MACRURA (Spence Bate, Zool. pt. 52).

Chlorotocus incertus, n.sp. One specimen; obtained at no other locality.
Merhippolyte agulhasensis, n.g., n.sp. Five specimens; obtained at no other locality.
Pandalus modestus, n.sp. Three specimens; obtained at no other locality.

ANOMURA (Henderson, Zool. pt. 69).

Dromidia bicornis, Studer. Four specimens; obtained at no other locality by the Challenger. Recorded from south of the Cape ("Gazelle").
Eudromia frontalis, n.g., n.sp. Two specimens; obtained at no other locality. Only species of the genus.
Parapagurus dimorphus (Studer). Numerous specimens; obtained also at Stations 135, 145, and 311.

BRACHYURA (Miers, Zool. pt. 49).

Lispognathus thomsoni (Norman). Five specimens; obtained also at Station 164B, 410 fathoms. Recorded from North Atlantic and Mediterranean.
Litocheira kingsleyi, n.sp. Many specimens; obtained at no other locality.
Mursia cristimana, de Haan. Three specimens; obtained also at the Cape.
Ebalia tuberculosa (Milne-Edwards). Three specimens; obtained also at Stations 162, 163, 167, and Port Jackson, 30 to 150 fathoms. Recorded from South Africa.
Pilumnoplax heterochir (Studer). Several specimens; obtained also at Station 135.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Neæra capensis, n.sp. Obtained at no other locality.
Saxicava arctica, Linné. For distribution see Station 75.

Station 142. GASTEROPODA (Watson, Zool. pt. 42).

Cancellaria imbricata, n.sp. One specimen ; obtained at no other locality.
Fasciolaria rutila, n.sp. Obtained at no other locality.
Fusus radialis, n.sp. One specimen ; obtained at no other locality.
Marginella (*Glabella*) *musica*, Hinds. One specimen ; obtained also at Station VIII.
Natica psila, n.sp. Obtained at no other locality.
Pleurotoma (*Surcula*) *anteridion*, n.sp. Obtained at no other locality.
Pleurotoma sp. (?).
Voluta (*Volutilithes*) *abyssicola*, Adams and Reeve. Obtained also at Station 141.
Lampusia (*Priene*) *murrayi*, Smith, n.sp. [See *Proc. Zool. Soc. Lond.*, 1891, p. 436].

POLYZOA (Busk, Zool. pts. 30 and 50 ; Waters, pt. 79).

Adeonella regularis, n.g., n.sp. Obtained at no other locality.
Caberea darwinii, Busk. Also obtained at Stations 135, 144A, 145, and 149.
Cellepora cylindriformis, n.sp. Obtained at no other locality. [Waters calls it *Cellepora megasoma*, MacGillivray].
Flustramorpha marginata (Krauss). Obtained also at Station 144A, 50 to 100 fathoms. Recorded from South Africa.
Gephyrophora polymorpha, n.g., n.sp. Obtained at no other locality. [Waters calls it *Schizoporella polymorpha* (Busk)].
Haswellia auriculata, n.g., n.sp. Obtained also at Station 135 and New Zealand.
Menipea marionensis, n.sp. Obtained also at Station 144A, 50 to 100 fathoms.
Retepora tessellata, Hincks, var. *pubens*, Busk. Obtained also at Simon's Bay, Cape.
Schizoporella elegans (d'Orbigny). Obtained also at Station 148, 210 to 550 fathoms.
,, *nivea*, n.sp. Obtained at no other locality.
Turritigera stellata, n.g., n.sp. Obtained also at Station 320, 600 fathoms.
Alcyonidium flustroides, n.sp. Obtained at no other locality.
Lichenopora holdsworthii, Busk. Obtained at no other locality by the Challenger.

BRACHIOPODA (Davidson, Zool. pt. 1).

Kraussina pisum (Val. *apud* Lamarck). A few specimens ; obtained at no other locality by the Challenger. Recorded from Natal.
Terebratula vitrea (Born), var. *minor*, Philippi. Two specimens ; obtained also at Stations 24 and 73.
Terebratulina caput-serpentis, Linné, var. *septentrionalis*, Couthouy. Many specimens ; for distribution see Station 48.

TUNICATA (Herdman, Zool. pts. 17 and 38). STATION 142.

Ascidia nigra (Savigny). Three specimens (probably from this Station); obtained also at Bermuda.

Amaroucium colelloides, n.sp. One specimen; obtained at no other locality.

Didemnum savignii, n.sp. One large colony (probably from this Station); obtained at no other locality.

Leptoclinum edwardsi, n.sp. Several small colonies; obtained at no other locality.

,, *speciosum*, n.sp., var. *asperum*, nov. Two small colonies; the species and variety obtained also at Bahia.

Psammaplidium subviride, n.g., n.sp. Nine colonies; obtained at no other locality.

In addition to the foregoing, the following are recorded in the Station-book :—Actiniæ, one free and one parasitic on *Pagurids*, and four Sphæromids.

Excluding Protozoa, about 300 specimens of invertebrates and fishes were obtained at this Station, belonging to about 87 species, of which 52 are new to science, including representatives of 8 new genera; 37 of the new species and 2 new genera were not obtained elsewhere.

Willemoes-Suhm writes: "Besides the remarkable Echinoderms, there were beautiful specimens of a large Sabellid, probably belonging to the genus *Vermilia*, and *Psygmobranchus*. A whitish Sphæromid was very much like a Trilobite. There was a *Calappa* much more resembling *Calappa mediterranea* than the tropical species, besides some Maiidæ, *Herbstiæ*, and some shells. The *Terebratula* is very like *Terebratula caput-serpentis*, and there were also some specimens of a *Megerlia*." All the naturalists remarked the resemblance between the forms taken here and at similar depths in the north.

The following species of Foraminifera and Diatoms were observed in the deposit from this Station (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.) :— ORGANISMS FROM THE DEPOSIT.

FORAMINIFERA (Brady, Zool. pt. 22).—The pelagic species, which make up about 44 per cent. of the carbonate of lime present in the deposit, are marked thus ×.

Biloculina bulloides, d'Orbigny.
,, *ringens* (Lamarck).
,, *sphæra*, d'Orbigny.
Miliolina agglutinans (d'Orbigny).
,, *circularis* (Bornemann).
,, *seminulum* (Linné).
,, *venusta* (Karrer).
Astrorhiza arenaria, Norman.
Psammosphæra fusca, Schulze.
Hyperammina friabilis, Brady.
Marsipella cylindrica, Brady.
Rhabdammina abyssorum, Sars.
Rhizammina algæformis, Brady.
,, *indivisa*, Brady.
Reophax dentaliniformis, Brady.
,, *fusiformis* (Williamson).
Haplophragmium agglutinans (d'Orbigny).
,, *canariense* (d'Orbigny).

STATION 142.

Haplophragmium emaciatum, Brady.
,, *turbinatum*, Brady.
Textularia agglutinans, d'Orbigny.
,, *aspera*, Brady.
,, *sagittula*, Defrance.
Gaudryina rugosa, d'Orbigny.
Bulimina aculeata, d'Orbigny.
,, *buchiana*, d'Orbigny.
,, *inflata*, Seguenza.
,, *marginata*, d'Orbigny.
,, *punctata*, d'Orbigny.
,, *pyrula*, d'Orbigny.
Bolivina robusta, Brady.
Cassidulina crassa, d'Orbigny.
,, *lævigata*, d'Orbigny.
Lagena alveolata, Brady, var. *substriata*, Brady.
,, *marginata* (Walker and Boys).
,, *sulcata* (Walker and Jacob).
,, ,, var. *interrupta*, Williamson.
Nodosaria (*Glandulina*) *æqualis*, Reuss.
,, *consobrina*, d'Orbigny.
,, ,, var. *emaciata*, Reuss.
,, *lævigata*, d'Orbigny.
,, *obliqua* (Linné).
,, *perversa*, Schwager.
,, *radicula* (Linné).
,, *scalaris* (Batsch).
Frondicularia inæqualis, Costa.
Marginulina costata, Batsch.
Vaginulina linearis (Montagu).
Cristellaria acutauricularis (Fichtel and Moll).
,, *obtusata*, Reuss.
,, ,, var. *subulata*, Brady.
,, *rotulata* (Lamarck).
Amphicoryne falx (Jones and Parker).
Polymorphina myristiformis, Williamson.
Uvigerina angulosa, Williamson.
,, *canariensis*, d'Orbigny.
Uvigerina pygmæa, d'Orbigny.
,, *schwageri*, Brady.
,, *tenuistriata*, Reuss.
Sagrina nodosa, Parker and Jones.
,, *striata*, Schwager.
× *Globigerina æquilateralis*, Brady.
× ,, *bulloides*, d'Orbigny.
× ,, ,, var. *triloba*, Reuss.
× ,, *conglobata*, Brady.
× ,, *dubia*, Egger.
× ,, *inflata*, d'Orbigny.
× ,, *rubra*, d'Orbigny.
× ,, *sacculifera*, Brady.
× *Orbulina universa*, d'Orbigny.
× *Pullenia obliquiloculata*, Parker and Jones.
× *Sphæroidina bulloides*, d'Orbigny.
,, *dehiscens*, Parker and Jones.
Truncatulina haidingerii (d'Orbigny).
,, *lobatula* (Walker and Jacob).
,, *refulgens* (Montfort).
,, *variabilis*, d'Orbigny.
,, *wuellerstorfi* (Schwager).
Anomalina ariminensis (d'Orbigny).
,, *coronata*, Parker and Jones.
Rupertia stabilis, Wallich.
× *Pulvinulina canariensis* (d'Orbigny).
,, *elegans* (d'Orbigny).
× ,, *menardii* (d'Orbigny).
× ,, *micheliniana* (d'Orbigny).
,, *oblonga* (Williamson).
,, *partschiana* (d'Orbigny).
,, *umbonata*, Reuss.
Rotalia orbicularis, d'Orbigny.
,, *soldanii*, d'Orbigny.
,, sp. (?).
Nonionina sp. (?).
Polystomella macella (Fichtel and Moll).
Operculina ammonoides (Gronovius).

DIATOMACEÆ.—The following species of Diatoms were observed by Mr. Comber, who received much assistance from Mr. E. Grove in determining the critical species in the Southern Ocean deposits :—

Navicula gregoriana, Greville.
,, *[illegible]ta*, A. Schmidt.
Pleurosigma directum, Grunow.
Campyloneis grevillei, Grunow.
Cocconeis scutellum, Ehrenberg.
,, *pseudomarginata*, Gregory.
,, *gr[illegible]tiana*, Greville.
Grammatophora marina, Kutzing.
Coscinodiscus excentricus, Ehrenberg.
,, *curvatulus*, Grunow.
,, *lentiginosus*, Janisch.
,, *nodulifer*, Janisch.
,, *radiatus*, Ehrenberg.
,, ,, var. *minor*, Rattray.

STATION 142.

Coscinodiscus decrescens, Grunow.
,, *apiculatus*, Ehrenberg.
,, *africanus*, Janisch.
,, *janischii*, A. Schmidt.
,, *concinnus*, W. Smith.
,, *elegans*, Greville.
Paralia sulcata, Cleve.
Hyalodiscus scoticus, Grunow.
Triceratium grande, Brightwell.
Hemidiscus cuneiformis, Wallich.
Actinocyclus subtilis, Ralfs.
,, *ralfsii*, Ralfs.
Actinoptychus vulgaris, Schumann.
Auliscus ovalis, Arnott.
Goniothecium sp. (?).

ORGANISMS FROM SURFACE-NETS.

Surface Organisms.—The following species are recorded from the surface at this Station :—

RADIOLARIA (Haeckel, Zool. pt. 40).
Rhaphidozoum capense, Haeckel.
Haliomma capense, Haeckel.

AMPHIPODA (Stebbing, Zool. pt. 67).
Paratyphis promontorii, n.sp.

SCHIZOPODA (Sars, Zool. pt. 37).
Euphausia splendens, Dana.

PTEROPODA (Pelseneer, Zool. pt. 65).
Limacina inflata (d'Orbigny).
Clio pyramidata, Linné.
Cavolinia inflexa (Lesueur).

TUNICATA (Herdman, Zool. pt. 76).
Salpa democratica-mucronata, Forskåhl.

FISHES (Günther, Zool. pt. 78).
Pimelepterus fuscus, Lacép.

Two hauls of the tow-net were taken between 8 and 12 P.M., and procured :—Saphirinid, *Hyperia*, Zoëæ (much larger than on the previous day), other Decapod larvæ, *Atlanta*, *Styliola*, *Cleodora* [= *Clio*], *Salpa* (*in catena*, very numerous). In the stomachs of the *Salpæ* were many Coccospheres and a few Rhabdospheres. There was little phosphorescence at the surface.

STATION 143.

Station 143 (Sounding 233), Cape of Good Hope to Marion Island (see Chart 18 and Diagram 8).

December 19, 1873 ; lat. 36° 48′ S., long. 19° 24′ E.
Temperature of air at noon, 71°·8 ; mean for the day, 69°·1.
Temperature of water :—

	°		°
Surface,	73·0	80 fathoms,	55·0
10 fathoms,	73·0	90 ,,	53·8
20 ,,	73·0	100 ,,	52·5
30 ,,	68·5	200 ,,	46·2
40 ,,	64·0	300 ,,	43·0
50 ,,	59·5	400 ,,	40·8
60 ,,	57·7	Bottom,	35·6
70 ,,	56·5		

Station 143.

Density at 60° F. :—

Surface, ...	1·02657	300 fathoms, . . .	1·02572
50 fathoms, . . .	1·02629	400 ,, . . .	1·02579
100 ,, . . .	1·02616	Bottom, . . .	1·02607
200 ,, . . .	1·02593		

Depth, 1900 fathoms; deposit, Globigerina Ooze, containing 90·34 per cent. of carbonate of lime, and phosphatic concretions (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 6 A.M. shortened and furled sails, and got up steam. At 7 A.M. sounded in 1900 fathoms. At 9 A.M. obtained serial temperatures down to 400 fathoms, and samples of water for analysis. At 9 A.M. put dredge over. At 2 P.M. commenced heaving in dredge, which came up at 3.30 P.M. with a few specimens. At 3.45 P.M. made all plain sail.

Distance at noon from Prince Edward Island, 997 miles. Made good 95 miles. Amount of current 16 miles, direction N.

[illegible]

The following species are recorded in the Zoological Reports from the dredge at this Station :—

ASTEROIDEA (Sladen, Zool. pt. 51).

Pararchaster pedicifer, n.g., n.sp. One small specimen (young of this species?); obtained also at Station 147, 1600 fathoms.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophioglypha irrorata, n.sp. Obtained also at Station 164B, 410 fathoms.

HOLOTHURIOIDEA (Théel, Zool. pt. 13).

Scotoplanes albida, n.g., n.sp. One injured specimen; obtained at no other locality.

The Station-book records also :—Gorgonacea and *Primnoa*.

[illegible]

FORAMINIFERA (Brady, Zool. pt. 22) :—The following species of Foraminifera were observed in the deposit from this Station; the pelagic species, which make up about 77 per cent. of the carbonate of lime present in the deposit, are marked thus × :—

Biloculina bulloides, d'Orbigny.
,, *depressa*, d'Orbigny.
Spiroloculina crenata, Karrer.
Miliolina agglutinans (d'Orbigny).
,, *circularis* (Bornemann).
Miliolina separans, Brady.
,, *venusta*, Karrer.
Astrorhiza angulosa, Brady.
Psammosphæra fusca, Schulze.
Saccammina sphærica, Sars.

STATION 143.

Hyperammina friabilis, Brady.
Marsipella cylindrica, Brady.
,, *elongata*, Norman.
Rhabdammina abyssorum, Sars.
Reophax dentaliniformis, Brady.
,, *distans*, Brady.
,, *pilulifera*, Brady.
Haplophragmium globigeriniforme (Parker and Jones).
,, *rotulatum*, Brady.
,, *turbinatum*, Brady.
Thurammina papillata, Brady.
Ammodiscus charoides (Jones and Parker).
Trochammina trullissata, Brady.
Webbina clavata, Jones and Parker.
Textularia agglutinans, d'Orbigny, var. *porrecta*, Brady.
,, *sagittula*, Defrance.
,, *turris*, d'Orbigny.
Verneuilina pygmæa (Egger).
Gaudryina pupoides, d'Orbigny.
Clavulina communis, d'Orbigny.
Bulimina aculeata, d'Orbigny.
,, *buchiana*, d'Orbigny.
Bolivina ænariensis (Costa).
,, *dilatata*, Reuss.
Cassidulina lævigata, d'Orbigny.
,, *subglobosa*, Brady.
Ehrenbergina hystrix, Brady.
,, *serrata*, Reuss.
Lagena acuta (Reuss).
,, *acuticosta*, Reuss.
,, *alveolata*, Brady, var. *substriata*, Brady.
,, *formosa*, Schwager, var. *comata*, Brady.
,, *globosa* (Montagu).
,, *lævis* (Montagu).
,, *orbignyana* (Seguenza).
,, *seminuda*, Brady (?).
,, *striata* (d'Orbigny).
,, *sulcata* (Walker and Jacob).
,, sp. (?).
Nodosaria filiformis, d'Orbigny.
,, *mucronata* (Neugeboren).
,, *obliqua* (Linné).
,, (*Glandulina*) *rotundata*, Reuss.
,, *scalaris* (Batsch).
,, *vertebralis* (Batsch).
Nodosaria sp. (?).
Marginulina costata (Batsch).
Cristellaria articulata, Reuss.
,, *convergens*, Bornemann.
,, *gibba*, d'Orbigny.
Polymorphina elegantissima, Parker and Jones.
Uvigerina angulosa, Williamson, var. *spinipes*, Brady.
,, *brunnensis*, Karrer.
,, *pygmæa*, d'Orbigny.
,, *schwageri*, Brady.
× *Globigerina æquilateralis*, Brady.
× ,, *bulloides*, d'Orbigny.
× ,, *conglobata*, Brady.
× ,, *dubia*, Egger.
× ,, *inflata*, d'Orbigny.
× ,, *rubra*, d'Orbigny.
× ,, *sacculifera*, Brady.
× *Orbulina universa*, d'Orbigny.
× *Pullenia obliquiloculata*, Parker and Jones.
,, *sphæroides* (d'Orbigny).
Sphæroidina bulloides, d'Orbigny.
× ,, *dehiscens*, Parker and Jones.
Truncatulina dutemplei (d'Orbigny).
,, *haidingerii* (d'Orbigny) (?).
,, *lobatula* (Walker and Jacob).
,, *pygmæa*, Hantken.
,, *refulgens* (Montfort).
,, *variabilis*, d'Orbigny.
,, *wuellerstorfi* (Schwager).
,, sp. (?).
Anomalina ammonoides (Reuss).
,, *ariminensis* (d'Orbigny).
Carpenteria monticularis, Carter.
Rupertia stabilis, Wallich.
× *Pulvinulina canariensis* (d'Orbigny).
× ,, *crassa* d'Orbigny.
,, *lateralis* (Terquem).
× ,, *menardii* (d'Orbigny).
× ,, *micheliniana* (d'Orbigny).
× ,, *patagonica* (d'Orbigny).
× ,, *tumida*, Brady.
Rotalia orbicularis, d'Orbigny.
,, *soldanii*, d'Orbigny.
,, sp. (?).
Nonionina umbilicatula (Montagu).
Polystomella verriculata, Brady.

Amphibelone pyramidata, Haeckel, was also observed among the Radiolaria.

Station 143. Organisms from Surface-Nets.

Surface Organisms.—The following species are recorded from the surface at this Station :—

Radiolaria (Haeckel, Zool. pt. 40).
Coelaspis hydrotomica, Haeckel.

Schizopoda (Sars, Zool. pt. 37).
Euphausia pellucida, Dana.
Thysanoëssa gregaria, n.sp.
Nematoscelis tenella, n.g., n.sp.

Pteropoda (Pelseneer, Zool. pt. 65).
Cavolinia inflexa (Lesueur).

Tunicata (Herdman, Zool. pt. 76).
Salpa democratica-mucronata, Forskåhl.

Hauls of the tow-net were taken at 100 fathoms, and at the surface in the morning, afternoon, and at night; in the afternoon more animals were caught than in the morning, while at night there were very few. The following are recorded in the note-books :—*Peridinium*, many *Globigerinæ* and *Orbulinæ*, some with long spines and of a bright red or pink colour, many *Acanthometræ* and other Radiolarians, *Diphyes*, *Sagitta*, larvæ of *Terebella*, young Aphroditacean, Cypridinidæ, Calanid, small Copepods, *Phronima*, *Euphausia* (very abundant), Pteropod (Cymbulian ?) larva, *Cleodora* [= *Clio*], and small fish.

December 20 to 23, 1873.

On these dates there was a strong westerly wind. On the 20th the screw was taken up, and on it were found Cirripeds (*Balanus*), specimens of a Hydroid, belonging to the genus *Tubularia* (*Tubularia polycarpa* ?), 2 inches in length, along with the following species of Amphipods (see Stebbing, Zool. pt. 67) :—

Atyloides assimilis, n.g., n.sp.
Caprella equilibra, Say.
Podocerus falcatus (Montagu).

Albatrosses and three species of Petrels were following the ship. On the 22nd a piece of sea-weed (*Durvillea*) was hauled in on the log-line, and was found to be covered with specimens of *Lepas*, which had many Diatoms and spines of Radiolaria in their stomachs.

Station 144.

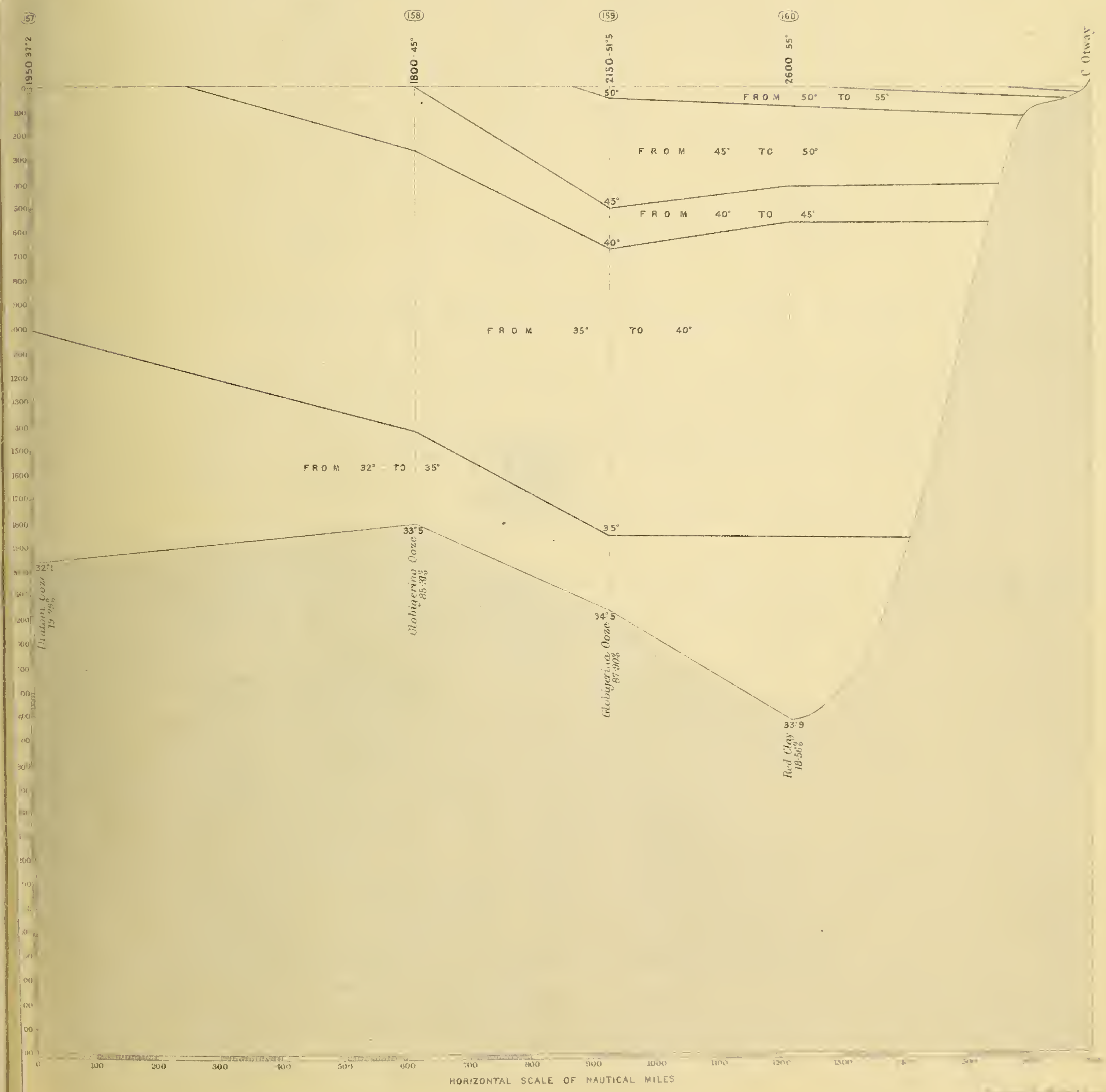
Station 144 (Sounding 234), Cape of Good Hope to Marion Island (see Chart 18 and Diagram 8).

December 24, 1873; lat. 45° 57′ S., long. 34° 39′ E.
Temperature of air at noon, 44°·3; mean for the day, 42°·7.

SOUTHERN INDIAN OCEAN

Diagonal Temperature Section. From a Position in Lat. 53°55'S. Long. 108°35'E. to C. Otway.

For explanation of Symbols see Appendix 1.



Temperature of water :— STATION 144.

Surface,	43·0°	800 fathoms,	37·0°
100 fathoms,	41·6	900 ,,	36·9
200 ,,	38·5	1000 ,,	36·8
300 ,,	38·0	1100 ,,	36·6
400 ,,	37·8	1200 ,,	36·4
500 ,,	37·6	1300 ,,	36·2
600 ,,	37·4	1400 ,,	36·1
700 ,,	37·2	Bottom,	35·8

Density at 60° F. :—

Surface,	1·02516	300 fathoms,	1·02532
100 fathoms,	1·02524	400 ,,	1·02537
200 ,,	1·02533	Bottom,	1·02525

Depth, 1570 fathoms; deposit, Globigerina Ooze, containing 92·34 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 9.30 A.M. shortened and furled sails. At 9.45 A.M. proceeded under steam and sounded in 1570 fathoms. Obtained serial temperatures at intervals of 100 fathoms down to 1400 fathoms. At 2 P.M. completed temperatures, and at 2.20 P.M. made all plain sail. A few albatrosses, terns, petrels, one penguin, Mother Carey's chickens, and Cape hens were seen.

Distance at noon from Prince Edward Island, 121 miles. Made good 155 miles. Amount of current 13 miles, direction N.E.

ORGANISMS FROM THE DEPOSIT.

FORAMINIFERA (Brady, Zool. pt. 22).—The following species of Foraminifera were observed in the deposit from this Station; the pelagic species, which make up about 87 per cent. of the carbonate of lime present in the deposit, are marked thus × :—

Biloculina depressa, d'Orbigny.
Spiroloculina tenuis (Czjzek).
Miliolina oblonga (Montagu).
,, *seminulum* (Linné).
Hyperammina elongata, Brady.
Rhizammina algæformis, Brady.
Reophax adunca, Brady.
,, *cylindrica*, Brady.
,, *dentaliniformis*, Brady.
,, *distans*, Brady.
Thurammina papillata, Brady.
Ammodiscus charoides (Jones and Parker).
Trochammina trullissata, Brady.
Webbina clavata, Jones and Parker.
Verneuilina pygmæa (Egger).
Bulimina rostrata, Brady.
Virgulina schreibersiana, Czjzek.
Bolivina punctata, d'Orbigny.
,, *reticulata*, Hantken.
Cassidulina lævigata, d'Orbigny.
Lagena acuta (Reuss).
,, *feildeniana*, Brady.
,, *gracilis*, Williamson.
,, *hexagona* (Williamson).
,, *lævigata* (Reuss).
,, *orbignyana* (Seguenza).
,, *stelligera*, Brady.
,, *striata* (d'Orbigny).
,, *sulcata* (Walker and Jacob).
Nodosaria mucronata, Neugeboren.

Station 144

Uvigerina pygmæa, d'Orbigny.
× *Globigerina bulloides*, d'Orbigny.
× „ *dubia*, Egger.
× „ *inflata*, d'Orbigny.
× *Orbulina universa*, d'Orbigny.
Pullenia quinqueloba, Reuss.
Sphæroidina bulloides, d'Orbigny.
Truncatulina haidingerii (d'Orbigny).
„ *pygmæa*, Hantken.
„ *wuellerstorfi* (Schwager).
× *Pulvinulina micheliniana* d'Orbigny.
× „ *patagonica* (d'Orbigny).
Nonionina pompilioides (Fichtel and Moll).
„ *umbilicatula* (Montagu).

Organisms from Surface Nets

Surface Organisms.—The following are recorded in the note-books from the surface and down to 100 fathoms :—Many Foraminifera of small size with long flexible spines, compound Radiolaria, Ctenophoræ, great numbers of *Sagitta* of large size, some over two inches in length, *Tomopteris*, Cytherid, Copepods, many small specimens of *Euphausia*, Pteropods (*Limacina*?), and *Cranchia*, a few specimens of the last being taken in every haul.

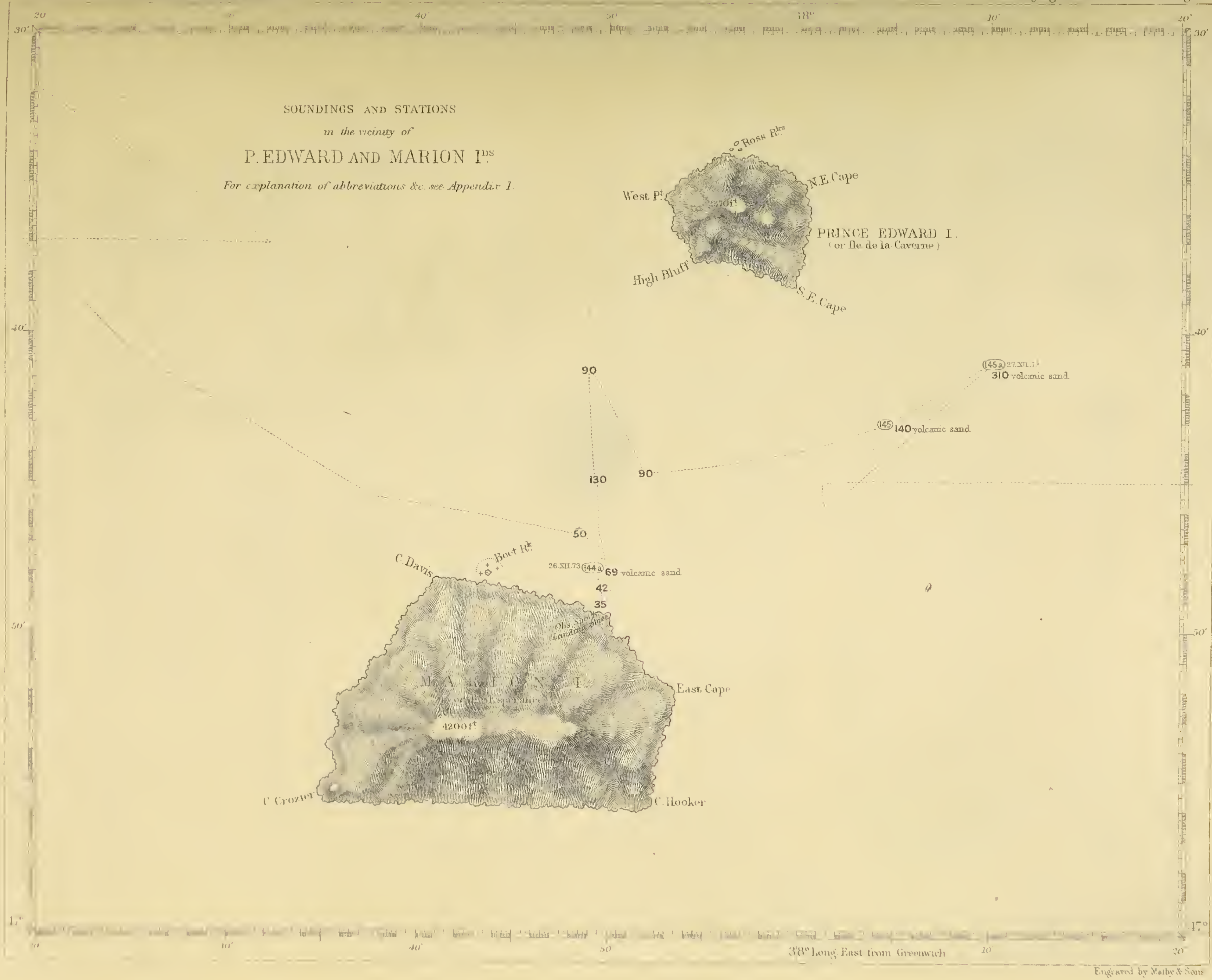
Stations 144A to 145A

Stations 144A to 145A (Soundings 235 to 237), off Marion and Prince Edward Islands (see Chart 19).

December 26 and 27, 1873.

At 6.15 A.M. on December 26, shortened and furled sails, and proceeded under steam along the N. side of Marion Island. At 8.10 A.M. stopped off the N.E. side of the island, and at 8.45 A.M. landed surveying and exploring parties. At 9 A.M. proceeded under steam to sound and dredge between Marion and Prince Edward Islands. During the day officers observing on shore and naturalists exploring Marion Island. Made four successful hauls with the dredge in depths varying from 50 to 100 fathoms, deposit Volcanic Sand, containing 26·13 per cent. of carbonate of lime (Station 144A); the bottom seemed to be covered with Polyzoa. At 5 P.M. stopped off landing-place; surveying and exploring parties returned on board with numerous specimens of birds and plants. At 6.15 P.M. made sail, and continued under sail during the night between the islands. Soundings were taken hourly during the night in depths varying from 90 to 130 fathoms. Temperature of air at noon, 42°·8; mean for the day, 40°·8. Temperature of surface water, 41°·0. Numerous terns, albatrosses, and shags were seen.

At 8 A.M. on December 27, brought ship to wind and laid to, the S.E. cape of Prince Edward Island bearing N. 39° 30′ E., about 7 miles off. At 8.30 A.M. shortened and furled sails, and proceeded under steam to sound and dredge. During the forenoon made two successful hauls with the dredge in 85 to 140 fathoms, deposit Volcanic Sand (Station 145). At 1 P.M. sounded in 310 fathoms, deposit Volcanic Sand (Station 145A). Put over dredge, which brought up numerous specimens,—a most successful haul. At 5.45 P.M. made sail and proceeded towards the Crozet Islands. Temperature of air at noon, 44°·3; mean for the day, 43°·5. Temperature of surface water, 41°·5. During the


SOUNDINGS AND STATIONS
in the vicinity of
P. EDWARD AND MARION I^DS
For explanation of abbreviations &c. see Appendix I.
PRINCE EDWARD I.
(or Île de la Caverne)
Ross R^ks
N.E. Cape
West P^t
High Bluff
S.E. Cape
(145a) 27.XII.73
310 volcanic sand
(145) 140 volcanic sand
90
130
90
50
26.XII.73 (144a) 69 volcanic sand
42
35
Boot R^k
C. Davis
East Cape
C. Hooker
C. Crozier
4200 f^t
38° Long. East from Greenwich
17°
Engraved by Malby & Sons

day petrels, terns, prions, albatrosses, penguins, a shoal of grampus or whales, and a seal were seen. STATIONS 144A TO 145A.

From the above it will be seen that on December 26 and 27, 1873, the Challenger sounded and dredged in the vicinity of Marion and Prince Edward Islands (for description of the islands see *Narr. Chall. Exp.*, vol. i. pp. 291–301). Four hauls with the dredge were taken on the 26th—twice in 50 fathoms, once in 75 fathoms, once in 100 fathoms (Station 144A); and on the 27th three hauls with the dredge were taken in 85, 140, and 310 fathoms (Stations 145 and 145A). In the following list of species recorded in the Zoological Reports the Stations are combined, the depth given being indicated :—

ANIMALS FROM DREDGE.

MONAXONIDA (Ridley and Dendy, Zool. pt. 59).

Halichondria sp. (?). Two fragmentary specimens (50 to 75 fathoms).

Gellius carduus, n.sp. Four specimens (50 to 150 fathoms); obtained also at Station 148, 210 to 550 fathoms.

,, *glacialis*, n.sp., var. *nivea*, nov. One specimen (140 fathoms); the species obtained also at Station 142.

,, *flagellifer*, n.sp. Two specimens (50 to 75 fathoms); obtained at no other locality.

Esperiopsis symmetrica, n.sp. Three pieces (310 fathoms); obtained at no other locality.

Desmacidon (?) *ramosa*, n.sp. One specimen (50 to 75 fathoms); obtained also at Station 142.

Iophon chelifer, n.sp. One specimen (310 fathoms); obtained also at Stations 142 and 148.

,, *laminalis*, n.sp. One specimen (310 fathoms); obtained at no other locality.

,, *abnormalis*, n.sp. Two fragments (50 to 75 fathoms); obtained at no other locality.

Amphilectus pilosus, n.sp. One specimen (50 to 75 fathoms); obtained also at Station 149, 70 fathoms.

Myxilla mariana, n.sp. A few fragments (50 to 75 fathoms); obtained at no other locality.

Phakellia papyracea, n.sp. Numerous fragments (310 fathoms); obtained also at Station 148, 210 fathoms.

Axinella mariana, n.sp. One specimen (50 to 75 fathoms); obtained at no other locality.

,, *erecta* (Carter). One specimen (310 fathoms); obtained also at Stations 135, 147, and 148.

Suberites caminatus, n.sp. One specimen (50 to 75 fathoms); obtained also at Station 320, 600 fathoms.

STATIONS 144A TO 145A

Stylocordyla stipitata (Carter), var. *globosa*, nov. Three specimens (140 fathoms); obtained also at Station 149, 10 to 100 fathoms.

HEXACTINELLIDA (Schulze, Zool. pt. 53).

Aulascus johnstoni, n.g., n.sp. Two fragmentary specimens (310 fathoms); obtained at no other locality. Only species of the genus.

Rossella antarctica, Carter. Several specimens (140 fathoms); obtained also at Stations 149, 150, and 320, shallow water to 600 fathoms. Recorded from Antarctic.

Aulocalyx irregularis, n.g., n.sp. Several specimens (310 fathoms); obtained also at Station 147, 1600 fathoms. Only species of the genus.

CALCAREA (Poléjaeff, Zool. pt. 24).

Amphoriscus elongatus, n.sp. One specimen (150 or 310 fathoms); obtained at no other locality.

Leuconia levis, n.sp. Two specimens (150 fathoms); obtained at no other locality.

ALCYONARIA (Wright and Studer, Zool. pt. 64).

Pleurocorallium secundum, Dana. One specimen (310 fathoms); obtained also at Stations 192 and 194, 140 and 200 fathoms.

Primnoisis antarctica (Studer). Several specimens (310 fathoms); obtained at no other locality by the Challenger. Recorded from Kerguelen ("Gazelle").

,, *sparsa*, n.g., n.sp. (85 fathoms); obtained at no other locality.

Stenella spinosa, n.sp. (310 fathoms); obtained at no other locality.

Thouarella variabilis, n.sp. Several specimens (310 fathoms); obtained also at Station 150, 150 fathoms (var. *gracilis*).

,, ,, var. *brevispinosa*, nov. (310 fathoms); obtained at no other locality.

Primnoides sertularoides, n.g., n.sp. Several specimens (310 fathoms); obtained at no other locality. Only species of the genus.

Acanthogorgia ramosissima, n.sp. (310 fathoms); obtained at no other locality.

Lophogorgia lutkeni, n.sp. (310 fathoms); obtained at no other locality.

,, *flammea* (Ellis and Solander). One specimen (doubtful whether from this locality or Simon's Bay, Cape).

ANTIPATHARIA (Brook, Zool. pt. 80).

Schizopathes conferta, n.g., n.sp. (310 fathoms); obtained at no other locality.

Cladopathes plumosa, n.g., n.sp. Two specimens (310 fathoms); obtained at no other locality. Only species of the genus.

CORALS (Moseley, Zool. pt. 7).

Flabellum apertum, n.sp. Six specimens (310 fathoms); obtained also at Station III.

Solenosmilia variabilis, Duncan. Numerous specimens (310 fathoms); obtained also at Stations 135 and 344.

HYDROIDA (Allman, Zool. pts. 20 and 70).

Plumularia flabellum, n.sp. (50 to 75 fathoms); obtained at no other locality.

„ *insignis*, n.sp. One specimen (150 or 310 fathoms); obtained at no other locality.

„ *abietina*, n.sp. One specimen (150 fathoms ?); obtained at no other locality.

Halecium flexile, n.sp. (50 fathoms); obtained also at Station 312, 9 fathoms.

Grammaria insignis, n.sp. (50 to 75 fathoms); obtained at no other locality.

Staurotheca dichotoma, n.g., n.sp. (85 to 150 fathoms); obtained at no other locality. Only species of the genus.

CRINOIDEA (Carpenter, Zool. pt. 60).

Antedon exigua, n.sp. Three specimens (50 to 140 fathoms); obtained at no other locality.

„ *hirsuta*, n.sp. One specimen (140 fathoms); obtained at no other locality.

ASTEROIDEA (Sladen, Zool. pt. 51).

Leptoptychaster kerguelenensis, Smith. (50 fathoms); obtained also at Station 149, 10 to 100 fathoms. Recorded from Kerguelen.

Gnathaster meridionalis (Smith). (50 fathoms); obtained also at Stations 149, 150, and 151, 28 to 150 fathoms. Recorded from Kerguelen.

„ *elongatus*, n.g., n.sp. (50 fathoms); obtained also at Stations 149, 150, and 151, 75 to 150 fathoms.

Porania antarctica, Smith. (50 to 150 fathoms); obtained also at Station 147, 1600 fathoms. Recorded from Kerguelen and South Georgia.

Crossaster penicillatus, n.sp. (?). One specimen too small for accurate determination (140 fathoms); obtained also at Station 135.

Pteraster semireticulatus, n.sp. (69 fathoms); obtained at no other locality.

Cribrella simplex, n.sp. (50 and 310 fathoms); obtained also at Stations 135 and 148.

STATIONS 144A TO 145A.

Pedicellaster hypernotius, n.sp. (140 fathoms); obtained at no other locality.

Asterias meridionalis, Perrier. (50 fathoms); obtained also at Station 149, 25 to 127 fathoms. Recorded from Kerguelen and Heard Island.

,, *(Smilasterias) scalprifera*, n.sp. (50 fathoms); obtained also at Station 151, 75 fathoms.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophioglypha hexactis, Smith. (50 to 75 fathoms); obtained also at Station 149, 20 to 75 fathoms.

,, *elevata*, n.sp. (310 fathoms); obtained at no other locality.

,, *intorta*, n.sp. (50 to 75 fathoms); obtained at no other locality.

Ophiocten sericeum, Ljungman (?). Two specimens (50 to 75 fathoms); obtained at no other locality by the Challenger.

,, *amitinum*, n.sp. (?). (85 to 150 fathoms); obtained also at Stations 146, 149, 152, and 157, 120 to 1950 fathoms.

Ophioconis antarctica, n.sp. (50 to 150 fathoms); obtained also at Station 150, 150 fathoms.

Amphiura studeri, Lyman. (50 to 150 and 310 fathoms [young]); obtained also at Stations 149 and 151, 20 to 75 fathoms.

,, *antarctica* (Ljungman). (Young, depth not given); obtained at no other locality by the Challenger. Recorded from Magellan Strait.

Ophiacantha rosea, n.sp. (310 fathoms); obtained also at Stations 236 and 308, 175 to 775 fathoms.

,, *vivipara*, Ljungman. (50 to 75 fathoms); obtained also at Stations 149, 151, 313, 314, and 320, 20 to 600 fathoms.

Ophiolebes scorteus, n.g., n.sp. (310 fathoms); obtained also at Station 147, 1600 fathoms.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Echinus magellanicus, Phil. (50 and 310 fathoms); obtained also at Stations 147, 304, 308, 312, and 315, 5 to 1600 fathoms.

HOLOTHURIOIDEA (Théel, Zool. pt. 39).

Chirodota contorta, Ludwig. Several specimens (50 to 75 fathoms); obtained also at Stations 149, 313, and 314, 20 to 120 fathoms.

Cucumaria serrata, n.sp., var. *marionensis*, nov. Numerous specimens (50 to 75 fathoms); the species obtained also at Stations 148, 150, and 151, 75 to 550 fathoms.

Psolus ephippifer, Wyville Thomson, n.sp. Numerous specimens (depth not given), and one specimen (310 fathoms); obtained also at Stations 149, 150, and 151, 20 to 150 fathoms. STATIONS 144A TO 145A.

Pseudostichopus mollis, n.g., n.sp. Two specimens (50 to 75 fathoms); obtained also at Stations 309 and 311, 140 and 245 fathoms.

NEMERTEA (Hubrecht, Zool. pt. 54).

Amphiporus marioni, n.sp. One specimen (69 fathoms); obtained also at Station 149, 120 fathoms.

Cerebratulus longifissus, n.sp. Two specimens (69 fathoms); obtained at no other locality.

ANNELIDA (M'Intosh, Zool. pt. 34).

Lætmonice producta, Grube, var. *wyvillei*, nov. Several specimens (50 to 150 fathoms); obtained also at Station 157, 1950 fathoms.

Polyeunoa lævis, n.g., n.sp. Numerous specimens (310 fathoms); obtained also at Station 310, 400 fathoms. Only species of the genus.

Lagisca antarctica, n.sp. Numerous specimens (69 fathoms); obtained also at Station 149, 127 fathoms.

,, *magellanica*, n.sp., var. *grubei*, nov. Several specimens (310 fathoms); the species obtained also at Stations 149, 308, and 310, 127 to 400 fathoms.

Exogone heterosetosa, n.sp. One specimen (69 fathoms); obtained at no other locality.

Nereis (*Platynereis*) *eatoni*, M'Intosh. One fragmentary specimen (69 fathoms); obtained also at Station 149, Fernando Noronha, and Falkland Islands.

Eunice œrstedi, Stimpson (?). Several specimens (69 fathoms); obtained also at Stations 45 and 49.

,, *edwardsi*, n.sp. One specimen (140 fathoms); obtained at no other locality.

Terebella (*Lanice*) *flabellum*, Baird. (69 and 150 fathoms); obtained also at Station 163A, 150 fathoms. Recorded from Narçon Island.

Neottis antarctica, M'Intosh. (69 fathoms); obtained also at Stations 149, 150, 151, and 313, 20 to 150 fathoms.

Serpula narconensis, Baird. Numerous specimens (69 fathoms); obtained also at Stations 149, 151, and 308, 60 to 175 fathoms. Recorded from Narçon Island, Kerguelen, and Magellan Strait.

STATIONS 144A TO 145A

OSTRACODA (Brady, Zool. pt. 3).

Macrocypris maculata, Brady. (50 to 150 fathoms); obtained also at Stations 149, 162, Simon's Bay, Cape, and Amboina.

Bythocypris reniformis, n.g., n.sp. (50 to 150 fathoms); for distribution see Station 24.

Bairdia villosa, n.sp. (50 to 150 fathoms); obtained also at Stations 135, 149, and 162, 38 to 150 fathoms.

Cythere securifer, n.sp. Numerous specimens (50 to 150 fathoms); obtained at no other locality.

" *kerguelenensis*, n.sp. (50 to 150 fathoms); obtained also at Stations 149, 162, and Port Jackson, 2 to 50 fathoms.

" *subrufa*, n.sp. (50 to 150 fathoms); obtained also at Station 149, 20 to 50 fathoms.

" *parallelogramma*, n.sp. (50 to 150 fathoms); obtained at no other locality.

" *polytrema*, Brady. A few detached valves (depth not given); obtained at no other locality by the Challenger. Fossil—Antwerp Crag.

" *suhmi*, n.sp. (50 to 150 fathoms); obtained also at Station 241, 2300 fathoms.

Krithe producta, n.sp. (50 to 150 fathoms); widely distributed (see Station 70).

Xestoleberis setigera, n.sp. (50 to 150 fathoms); obtained also at Stations 149 and 151, 120 and 75 fathoms.

Pseudocythere caudata, Sars. (50 to 150 fathoms); obtained also at Stations 149 and 323, 20 to 1900 fathoms.

AMPHIPODA (Stebbing, Zool. pt. 67).

Acontiostoma marionis, n.g., n.sp. One specimen (50 to 75 fathoms); obtained at no other locality.

Amphilochus marionis, n.sp. One specimen (100 fathoms); obtained at no other locality.

Atylopsis emarginatus, n.g., n.sp. Two specimens (310 fathoms); obtained at no other locality.

Pardalisca marionis, n.sp. One specimen (100 fathoms); obtained at no other locality.

ISOPODA (Beddard, Zool. pts. 33 and 48).

Serolis septemcarinata, Miers. Many specimens with young in the pouches (50 and 140 fathoms); obtained also at Station 149, 25 to 60 fathoms. Recorded from Crozets and Kerguelen.

Jæropsis marionis, n.sp. One specimen (140 fathoms); obtained at no other locality. STATIONS 144A TO 145A.

Astacilla marionensis, n.sp. One specimen (100 fathoms); obtained also at Station 149, surface and shallow water.

Arcturides cornutus, Studer. Several specimens (310 fathoms); obtained at no other locality by the Challenger. Recorded from Kerguelen.

Tanais hirsutus, n.sp. Several specimens (50 to 150 fathoms); obtained at no other locality.

Six other specimens, genus and species undetermined.

MACRURA (Spence Bate, Zool. pt. 52).

Nauticaris marionis, n.g., n.sp. Numerous specimens (69 and 140 fathoms); obtained also at Station 315, 12 fathoms.

Chorismus tuberculatus, n.g., n.sp. Fifteen specimens (310 fathoms); obtained at no other locality. Only species of the genus.

Campylonotus capensis, n.g., n.sp. Five specimens (140 fathoms); obtained also at Station 122, 350 fathoms.

ANOMURA (Henderson, Zool. pt. 69).

Lithodes murrayi, n.sp. Two specimens (310 fathoms); obtained at no other locality.

Paralomis aculeatus, n.sp. One specimen (310 fathoms); obtained at no other locality.

Parapagurus dimorphus (Studer). One specimen (140 or 310 fathoms); obtained also at Stations 135, 142, and 311.

Munida spinosa, n.sp. Many specimens (310 fathoms); obtained also at Station 320, 600 fathoms.

Uroptychus insignis, n.sp. Several specimens (310 fathoms); obtained at no other locality.

BRACHYURA (Miers, Zool. pt. 49).

Halicarcinus planatus (Fabricius). Two specimens (50 to 150 fathoms); obtained also at Kerguelen and Falkland Islands, shore and shallow water, and New Zealand (presented). Recorded from the Antarctic or Austral region.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Neæra fragilissima, n.sp. (300 fathoms); obtained at no other locality.

Thracia meridionalis, n.sp. (50 to 150 fathoms); obtained also at Station 149, 20 to 60 fathoms.

Saxicava arctica, Linné. (100 and 150 fathoms); for distribution see Station 75.

Stations 145 to 145A

Davila (?) *umbonata*, n.sp. (100 and 150 fathoms); obtained also at Station 149, 20 to 60 fathoms.

Cryptodon marionensis, n.sp. (100 to 150 fathoms); obtained at no other locality.

Kellia nuculina, Martens. (50 to 150 fathoms); obtained also at Station 149, 20 to 120 fathoms.

Astarte magellanica, Smith. (100 and 150 fathoms); obtained at no other locality by the Challenger. Recorded from Magellan Strait.

Limopsis marionensis, n.sp. (100 to 150 fathoms); obtained at no other locality.

Mytilus meridionalis, n.sp. (100 to 150 fathoms); obtained also at Station 150 150 fathoms.

Crenella marionensis, n.sp. (140 fathoms); obtained at no other locality.

Modiolarca trapezina (Lamarck). (50 to 100 fathoms); obtained also at Stations 149, 311, and 315, surface to 245 fathoms.

Dacrydium meridionalis, n.sp. (100 to 150 fathoms); obtained at no other locality.

Lima (*Limatula*) *pygmæa*, Philippi. (50 to 150 fathoms); obtained also at Station 149, 28 to 60 fathoms. Recorded from South Patagonian region.

Pecten distinctus, n.sp. (100 fathoms); obtained at no other locality.

„ *aviculoides*, n.sp. (100 to 150 fathoms); obtained at no other locality.

Scaphopoda and Gasteropoda (Watson, Zool. pt. 42).

Dentalium entalis, Linné, var. *orthrum*, nov. (140 fathoms); obtained also at Stations II. and 75.

Emarginula sp. (?). (50 to 150 fathoms).

Puncturella noachina (Linné), var. *princeps*, Mighels. (69, 140, and 310 fathoms); obtained also at Stations 149 and 312, 10 to 60 fathoms. A widely-distributed species. Fossil—Miocene (?) of Sicily, Pliocene onwards of Europe, Labrador, and Nova Zembla.

Trochus (*Photinula*) *expansus* (Sowerby). (50 to 140 fathoms); obtained also at Station 149 and Falkland Islands, surface to 60 fathoms. Recorded from Magellan Strait.

Scissurella crispata, Fleming. (140 fathoms); obtained also at Station 24.

Homalogyra atomus (Philippi). (140 fathoms); obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil—later glacial beds of Norway and Scotland.

Cyclostrema (?) sp. (50 to 150 fathoms).

Trophon declinans, n.sp. (69 fathoms); obtained also at Station 150, 150 fathoms.

Fusus (*Neptunea*) *edwardiensis*, n.sp. (140 fathoms); obtained at no other locality.

Pleurotoma (*Thesbia*) *translucida*, n.sp. (140 fathoms); obtained also at Station 149, 25 and 28 fathoms.

Triton (*Lagena*) *magellanicus* (Chemnitz). (69 fathoms); obtained also at Station 309 (?), 40 fathoms. Recorded from Magellan Strait and Cape Horn.

,, (,,) n.sp. One young specimen (140 fathoms).

Natica fartilis, n.sp. (50 to 140 fathoms); obtained also at Stations 149 and 150, 60 and 150 fathoms.

Turritella austrina, n.sp. (50 to 100 fathoms); obtained also at Station 149, 28 fathoms.

Odostomia rissoïdes, Hanley. One specimen (50 to 140 fathoms); obtained at no other locality by the Challenger. Recorded from North Atlantic and Mediterranean. Fossil—Upper Pliocene onwards.

Eulima amblia, n.sp. One specimen and fragment (50 to 150 fathoms); obtained at no other locality.

Cerithium sp. (?). (100 fathoms).

Alaba (*Diala*) *limnæiformis*, n.sp. (50 to 150 fathoms); obtained at no other locality.

Jeffreysia edwardiensis, n.sp. (310 fathoms); obtained at no other locality.

Rissoa (*Ceratia*) *transenna*, n.sp. (140 fathoms); obtained at no other locality.

,, (*Setia*) *marionensis*, n.sp. (50 to 140 fathoms); obtained at no other locality.

,, (,,) *principis*, n.sp. (140 fathoms); obtained also at Kerguelen, shore.

,, (,,) *edwardiensis*, n.sp. (50 to 150 fathoms); obtained at no other locality.

Lamellaria sp. (?). (50 to 75 fathoms).

POLYPLACOPHORA (Haddon, Zool. pt. 43).

Lepidopleurus dorsuosus, n.sp. (310 fathoms); obtained at no other locality.

MARSENIADÆ (Bergh, Zool. pt. 41).

Marseniopsis murrayi, n.g., n.sp. One specimen (50 to 75 fathoms); obtained at no other locality.

POLYZOA (Busk, Zool. pts. 30 and 50; Waters, pt. 79).

Menipea flagellifera, n.sp. (50 to 75 fathoms); obtained also at Stations 149, 313, and 314, 20 to 127 fathoms.

,, *marionensis*, n.sp. (50 to 75 fathoms); obtained also at Station 142.

Caberea darwinii, Busk. (50 to 150 fathoms); for distribution see Station 135.

Bicellaria pectogemma, Goldstein. (150 to 310 fathoms); obtained also at Stations 150 and 151, 50 and 75 fathoms.

Bugula sinuosa, n.sp. One specimen (80 to 150 fathoms); obtained at no other locality.

Farciminaria hexagona, n.sp. (140 to 310 fathoms); obtained also at Stations 195 and 196, 1425 and 825 fathoms.

Carbasea ovoidea, Busk. (50 to 150 fathoms); obtained also at Stations 149, 303, 312, and 315, 5 to 1325 fathoms. Recorded from Magellan Strait, Patagonia, and Kerguelen.

Membranipora galeata, Busk, var. *furcata*, nov. (50 to 75 fathoms); for distribution see Station 75. [Waters calls it *Membranipora cervicornis*, Busk].

Vincularia gothica, d'Orbigny. (80 to 150 fathoms); obtained at no other locality by the Challenger. Recorded from Marion Island. [Waters calls it *Thalamoporella steganoporoides* (Goldstein)].

Electra cylindracea, n.sp. (80 to 250 fathoms); obtained at no other locality.

Salicornaria clavata, n.sp. (Depth not given); obtained also at Stations 149, 151, 162, 163, and 304, 28 to 75 fathoms. [Waters calls it *Cellaria australis*, MacGillivray].

,, *malvinensis*, Busk. (50 to 75 fathoms); obtained also at Stations 149, 176, 304, 315, and Falkland Islands, 5 to 1450 fathoms. Recorded from South Patagonia and Falkland Islands. Fossil—Mount Gambier.

Cribrilina philomela, n.sp. (50 to 75 fathoms).

,, ,, var. *adnata*, nov. (50 to 75 fathoms); obtained also at Station 151, 75 fathoms. Recorded from Curtis Island (?).

,, *monoceros* (Busk). (Depth not given); obtained also at Stations 163, 253, 303, 313, 315, and 320, 12 to 3125 fathoms.

Flustramorpha marginata (Krauss). (50 to 75 fathoms); obtained also at Station 142.

Smittia marionensis, Busk. (80 to 150 fathoms); obtained also at Station 149, 28 fathoms. Recorded from Marion Island.

,, *jacobensis*, n.sp. (50 to 75 fathoms); obtained also at Cape Verdes.

Mucronella rostrigera, n.sp. (80 to 150 fathoms); obtained at no other locality.

,, *tricuspis*, Hincks. (80 to 150 fathoms); obtained also at Station 315 and Simon's Bay, Cape.

,, *ventricosa*, var. *multispinata*, Busk. (80 to 150 fathoms); obtained also at Station 148, 210 fathoms.

Schizoporella marsupifera, n.sp. (50 to 75 fathoms); obtained also at Station 167, 150 fathoms. STATIONS 144A TO 145A.

Myriozoum marionense, n.sp. (50 to 150 fathoms); obtained also at Stations 148 and 151, 75 to 500 fathoms.

Cellepora pustulata, n.sp. (50 to 75 fathoms); obtained also at Station 167, 150 fathoms.

„ *bicornis*, n.sp. (50 to 150 fathoms); obtained also at Stations 150, 151, 313, and 314, 55 to 150 fathoms.

Crisia holdsworthii, Busk. (50 to 150 fathoms); obtained at no other locality by the Challenger. Recorded from Ceylon.

Idmonea marionensis, Busk. (50 to 150 fathoms); obtained also at Stations 147, 151, and 320, 75 to 1600 fathoms. Recorded from Mediterranean, Marion Island, and Australia. Fossil—New Zealand (?).

„ *australis*, MacGillivray. (50 to 75 fathoms); obtained also at Station 163, 30 to 35 fathoms. Recorded from Australia.

„ *milneana*, d'Orbigny. (80 to 150 fathoms); obtained also at Stations 75 and 151.

Pustulopora proboscidea, M.-Edwards. (80 to 150 fathoms); obtained also at Station 151, 75 fathoms. Recorded from North Atlantic, Mediterranean, and Australia.

„ *proboscidioides* (Smitt). (50 to 75 fathoms); obtained at no other locality by the Challenger.

BRACHIOPODA (Davidson, Zool. pt. 1).

Terebratulina caput-serpentis, Linné, var. *septentrionalis*, Couthouy. (150 fathoms); for distribution see Station 48.

Waldheimia kerguelenensis, n.sp. Several specimens (100 fathoms); obtained also at Stations 149 and 150, 20 to 150 fathoms.

Platydia anomioides (Scacchi). Seven specimens (100 fathoms); obtained at no other locality by the Challenger. Recorded from Mediterranean and coast of Portugal. Fossil—Pliocene of Sicily.

TUNICATA (Herdman, Zool. pt. 38).

Sidnyum pallidum, n.sp. Two colonies (50 to 75 fathoms); obtained at no other locality.

FISHES (Günther, Zool. pts. 6 and 57).

Notothenia marionensis, n.sp. One specimen (50 to 75 fathoms); obtained at no other locality.

Stations 144a to 145a.

Harpagifer bispinis, Forst. (50 to 75 fathoms); obtained at no other locality by the Challenger. Recorded from Kerguelen, Cape Horn, and Falkland Islands.

Macrurus carinatus, n.sp. One specimen (310 fathoms); obtained at no other locality.

Lepidopsetta maculata, n.g., n.sp. One specimen (310 fathoms); obtained at no other locality. Only species of the genus.

The Station-book records also an Actinian and other species of Brachyura (besides the one noted above).

In the foregoing list 192 species are enumerated, of which 129 are new to science, including representatives of 19 new genera; 65 of the new species and 6 new genera were not obtained elsewhere. From the dredging in 310 fathoms, about 250 specimens were obtained, belonging to 46 species, of which 36 are new to science, including representatives of 10 new genera; 23 of the new species and 5 new genera were not obtained elsewhere.

Organisms from the Deposit.

Diatomaceæ.—The following species of Diatoms were observed by Mr. Comber in the deposit from Station 145 (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.):—

Amphora proteus, Gregory.
,, *angusta*, Gregory.
,, *plicata*, Gregory.
,, *cuneata*, Cleve (= *A. decora*, Castracane).
Navicula distans, Ralfs.
,, *arenaria*, Donkin.
,, *oscitans*, A. Schmidt, var. *subundulata*, Cleve and Grunow.
,, *brasiliensis*, Grunow.
,, *aspera*, Ehrenberg, var. *oblonga*, Cleve.
,, ,, var. *rhombica*, Cleve.
,, *consors*, A. Schmidt.
,, *smithii*, Brebisson.
,, *splendida*, Gregory.
,, *multicostata*, Grunow.
,, *gemmata*, Greville, var. *minuta*, Cleve.
,, *constricta*, Grunow.
,, *apis*, Donkin.
,, *nitescens*, Gregory, var.
Rhabdonema belliana, Grunow.
Plagiogramma kerguelense, Grunow.
Rhoicosigma arcticum, Cleve.
Amphiprora duplex, Donkin.
,, *kryophila*, Cleve.
,, *lepidoptera*, Gregory.
Cocconeis scutellum, Ehrenberg.
Cocconeis scutellum, var. *ampliata*, Grunow.
,, ,, var. *distans*, Grunow.
,, ,, var. *minutissima*, Grunow.
,, *costata*, Gregory.
,, ,, var. *kerguelensis*, Petit.
,, *decipiens*, Cleve.
,, *cyclophora*, Grunow, var.
,, *dirupta*, Gregory, var. *fulgur*, Brun.
,, ,, var. *sigma*, Pantocsek.
,, sp. (?).
Orthoneis wrightii (= *Cocconeis*, O'Meara).
Achnanthes brevipes, Agardh.
,, ,, var. *subsessilis*, Grunow.
,, *parvula*, Kutzing.
Gephyria incurvata, Arnott.
,, *gigantea*, Greville.
Nitzschia distans, Gregory, var.
,, *apiculata*, Smith, var.
,, *insignis*, Gregory.
Synedra sp. (?).
Clavicula delicata, Tempère. and Brun.
Licmophora jurgensii, Grunow, var.
,, *australis*, Grunow.
,, *californica*, Grunow.
Fragilaria linearis, Castracane.
,, *capensis*, Grunow.

STATIONS 144A TO 145A.

Fragilaria pliocena, Brun.
Trachysphenia australis, Petit.
Thalassiothrix nitzschioides, Grunow.
  „ *nordenskioldii*, Cleve.
Grammatophora maxima, Grunow, var. *genuina*, Grunow.
  „ *angulosa*, var. *islandica*, Ehrenberg.
  „ „ var. *hamulifera*, Grunow.
  „ *stricta*, Ehrenberg.
  „ *oceanica*, Ehrenberg.
  „ *subundulata*, Grunow.
Biddulphia roperiana, Greville.
Hemiaulus antarcticus, Ehrenberg.
Triceratium antediluvianum, van Heurck.
  „ *arcticum*, Brightwell, var. *kerguelensis*, Grunow.
Hemidiscus cuneiformis, Wallich.
Auliscus cœlatus, Bailey.
Coscinodiscus excentricus, Ehrenberg.
  „ *lineatus*, Ehrenberg.
  „ *tumidus*, Janisch.
Coscinodiscus symbolophorus, Grunow.
  „ *rothii*, Grunow.
  „ *denarius*, A. Schmidt.
  „ *curvatulus*, Grunow, var. *recta*, Rattray.
  „ *kutzingii*, A. Schmidt, var. *glacialis*, Grunow.
  „ *lentiginosus*, Janisch.
  „ *nodulifer*, A. Schmidt.
  „ *radiosus*, Grunow, var.
  „ *africanus*, Janisch, var. *wallichiana*, Grunow.
Hyalodiscus subtilis, Ehrenberg.
Podosira maxima, Kutzing.
  „ *hormoides*, Montagnè.
Cyclotella castracanei, Brun.
Melosira sol, Kutzing.
Actinocyclus oliverianus, O'Meara.
Actinoptychus sp. (?).
Asteromphalus brookei, Bailey.
  „ *hookerii*, Ehrenberg.

ORGANISMS FROM SURFACE-NETS.

Surface Organisms.—On the night of December 27, off Prince Edward Island, the tow-net procured:—Many *Salpæ*, larvæ of *Euphausia*, Copepods, several specimens of *Lepas* on a piece of pumice, many specimens of *Hyperia* and *Gammarus*, probably commensalistic and feeding on the *Salpæ*.

Station 146 (Sounding 238), Marion Island to Crozet Islands (see Chart 18).

STATION 146.

December 29, 1873; lat. 46° 46′ S., long. 45° 31′ E.
Temperature of air at noon, 48°·8; mean for the day, 46°·0.
Temperature of water:—

	°		
Surface,	43·0	400 fathoms,	38·2
50 fathoms,	41·1	600 „	37·8
100 „	39·2	800 „	37·2
150 „	39·0	1000 „	36·6
200 „	38·8	Bottom,	35·6

Density at 60° F. at surface, 1·02512; bottom, 1·02555.
Depth, 1375 fathoms; deposit, Globigerina Ooze, containing 86·36 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 9.20 A.M. shortened and furled sails, and proceeded under steam to sound and trawl. Put trawl over. At noon sounded in 1375 fathoms. At 1 P.M. took serial

STATION 146. temperatures down to 1000 fathoms. The carbonic acid was determined in bottom water, and amounted to 59·5 milligrammes per litre. At 3.30 P.M. commenced heaving in trawl, which came up at 4.50 P.M. with a great many animals,—probably the most successful haul up to the present date as regards number, variety, novelty, size, and beauty of the specimens. At 5.10 P.M. made all plain sail. At 4 A.M. the sea was of a dark blue colour; in the afternoon the colour was, as usual, greenish. Cape pigeons, stormy petrels, albatrosses, crested penguins, and prions about the ship.

Distance at noon from Hog Island, 206 miles. Made good 198 miles. Amount of current 9 miles, direction S. 64° E.

ANIMALS FROM TRAWL. The following species are recorded in the Zoological Reports from the trawl at this Station:—

HEXACTINELLIDA (Schulze, Zool. pt. 53).

Holascus fibulatus, n.g., n.sp. One specimen; obtained also at Stations 147 and 160, 1600 and 2600 fathoms.

Malacosaccus vastus, n.g., n.sp. One specimen; obtained at no other locality.

PENNATULIDA (Kölliker, Zool. pt. 2).

Umbellula magniflora, n.g., n.sp. Two fragments; obtained also at Station 147, 1600 fathoms.

ACTINIARIA (Hertwig, Zool. pts. 15 and 73).

Corallimorphus rigidus, Moseley, n.g., n.sp. Three specimens; obtained also at Stations 195 and 299, 1425 and 2160 fathoms.

CRINOIDEA (Carpenter, Zool. pt. 32).

Bathycrinus aldrichianus, Wyville Thomson, n.sp. Obtained also at Station 147, 1600 fathoms; and other Stations (?). According to Sir Wyville Thomson fragments were taken at, at least, six or seven Stations in the Atlantic and Southern Sea.

ASTEROIDEA (Sladen, Zool. pt. 51).

Pontaster forcipatus, n.g., n.sp., var. *echinata*, nov. The species obtained also at Stations 44, 45, 46, and 50.

Hymenaster graniferus, n.sp. Obtained at no other locality.

,, *coccinatus*, n.sp. Obtained at no other locality.

,, *praecoquis*, n.sp. Obtained also at Station 147, 1600 fathoms.

Brisinga membranacea, n.sp. Obtained also at Station 147, 1600 fathoms.

Freyella fragilissima, n.sp. Obtained also at Station 156, 1975 fathoms.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophiernus vallincola, n.g., n.sp. Obtained also at Stations 78 and 156. Only species of the genus.

Ophioglypha loveni, n.sp. Obtained also at Stations 147, 157, 158 (?), and 160, 1600 to 2600 fathoms.

,, *minuta*, n.sp. Obtained also at Station 158, 1800 fathoms.

Ophiocten amitinum, n.sp. Obtained also at Stations 145, 149, 152, and 157.

,, *hastatum*, n.sp. Obtained also at Stations 78 and 168.

Ophiacantha cosmica, n.sp. For distribution see Station 122.

Ophiomitra sarsii, n.sp. Obtained at no other locality.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Urechinus naresianus, n.g., n.sp. Numerous specimens; obtained also at Stations 147, 158, and 302, 1450 to 1800 fathoms. Only species of the genus.

Cystechinus wyvillii, n.g., n.sp. Obtained also at Stations 147, 158, 296, 299, and 300, 1375 to 2160 fathoms.

Schizaster moseleyi, n.sp. Obtained also at Stations 149, 305, 307, 309, 310, and 311, 40 to 400 fathoms.

HOLOTHURIOIDEA (Théel, Zool. pts. 13 and 39).

Oneirophanta mutabilis, n.g., n.sp. Obtained also at Stations 157, 160, 241, 244, 281, 299, and 325, 1950 to 2900 fathoms. Only species of the genus.

Psychropotes loveni, n.g., n.sp. One specimen; obtained at no other locality.

Pseudostichopus villosus, n.g., n.sp. One injured specimen; for distribution see Station 61.

ANNELIDA (M'Intosh, Zool. pt. 34).

Lætmonice producta, Grube, var. *willemoesi*, nov. Obtained also at Stations 70, 133, 169, and 184.

Polynoë (*Admetella*) *longipedata*, n.sp. Two specimens; obtained at no other locality.

Maldanella antarctica, n.g., n.sp. Numerous specimens; obtained also at Stations 152 and 157, 1260 and 1950 fathoms.

MYZOSTOMIDA (Graff, Zool. pt. 27).

Myzostoma compressum, n.sp. (On *Bathycrinus aldrichianus*).

,, *coronatum*, n.sp. (On *Bathycrinus aldrichianus*).

Station 146 OSTRACODA (Brady, Zool. pt. 3).

Cythere viminea, n.sp. Single valve; obtained at no other locality.

,, *dictyon*, n.sp. Widely distributed (see Station 24).

,, *acanthoderma*, n.sp. Obtained also at Stations 64, 73, 191, 246, 296, and 302.

,, *dasyderma*, n.sp. Widely distributed (see Station 5).

Krithe producta, n.sp. Widely distributed (see Station 70).

CIRRIPEDIA (Hoek, Zool. pt. 25).

Scalpellum brevicarinatum, n.sp. One specimen; obtained also at Station 147, 1600 fathoms.

,, *tenue*, n.sp. One specimen; obtained at no other locality.

,, *flavum*, n.sp. Three specimens; obtained at no other locality.

AMPHIPODA (Stebbing, Zool. pt. 67).

Andania gigantea, n.sp. One specimen; obtained also at Station 147, 1600 fathoms.

ISOPODA (Beddard, Zool. pts. 33 and 48).

Serolis antarctica, n.sp. Obtained also at Stations 122 and 147.

Eurycope sarsii, n.sp. Two specimens; obtained also at Station 147, 1600 fathoms.

Arcturus spinosus, n.sp. Eleven specimens; obtained at no other locality.

PHYLLOCARIDA (Sars, Zool. pt. 56).

Nebaliopsis typica, n.g., n.sp. One fragmentary specimen; obtained also at Station 289, 2550 fathoms.

SCHIZOPODA (Sars, Zool. pt. 37).

Eucopia australis, Dana. For distribution see Station 50.

MACRURA (Spence Bate, Zool. pt. 52).

Petalidium foliaceum, n.g., n.sp. Four specimens; obtained also at Station 159, 2150 fathoms. Only species of the genus.

Glyphocrangon podager, n.sp. One specimen; obtained at no other locality.

Nematocarcinus proximatus, n.sp. Two specimens; obtained also at Stations 188, 237, 300, and 302, 28 to 1875 fathoms.

ANOMURA (Henderson, Zool. pt. 69).

Pagurodes inarmatus, n.g., n.sp. Three specimens; obtained also at Station 168, 1100 fathoms.

Munidopsis subsquamosa, n.sp., var. *aculeata*, nov. One specimen; the species obtained also at Stations 237 and 302, 1875 and 1450 fathoms. STATION 146.

PYCNOGONIDA (Hoek, Zool. pt. 10).

Nymphon hamatum, n.sp. Obtained also at Station 147, 1600 fathoms.
Ascorhynchus glaber, n.sp. Two specimens; obtained at no other locality.
Colossendeis gigas, n.sp. Obtained also at Stations 147 and 300, 1600 and 1375 fathoms.
,, *leptorhynchus*, n.sp. Obtained also at Stations 147, 300, and 310, 400 to 1600 fathoms.
,, *gracilis*, n.sp. One or two specimens; obtained also at Station 147, 1600 fathoms.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Pecten pudicus, n.sp. Obtained at no other locality.
Amussium meridionale, n.sp. Obtained also at Stations 158 and 302, 1800 and 1450 fathoms.

GASTEROPODA (Watson, Zool. pt. 42).

Trochus (Margarita) infundibulum, n.sp. Obtained also at Station 56.
Fusus (Neptunea) setosus, n.sp. Obtained also at Station 147, 1600 fathoms.
Pleurotoma (Surcula) staminea, n.sp. Obtained also at Station 149, 105 fathoms.
Lamellaria sp. (?).
Pleurobranchus sp. (?).

CEPHALOPODA (Hoyle, Zool. pt. 44).

Cirroteuthis magna, n.sp. One specimen; obtained also at Station 298, 2225 fathoms.

TUNICATA (Herdman, Zool. pt. 17).

Culeolus recumbens, n.g., n.sp. Eight specimens; obtained at no other locality. Recorded subsequently from Indian Ocean ("Investigator") (?).
Corynascidia suhmi, n.g., n.sp. Two specimens; obtained also at Station 299, 2160 fathoms.

FISHES (Günther, Zool. pt. 57).

Melamphaës microps, n.sp. One specimen; obtained at no other locality.
,, *crassiceps*, n.sp. One specimen; obtained also at Stations 107, 120, and 220.

Station 146

Antimora rostrata, n.g., n.sp. One specimen; obtained also at Station 320, 600 fathoms.

Macrurus filicauda, n.sp. Twelve specimens; obtained also at Stations 157, 158, 299, 323, and 325, 1800 to 2650 fathoms.

,, *armatus*, Hector. Six specimens; obtained also at Stations 147, 157, 158, 246, and 271, 1600 to 2425 fathoms. Recorded from New Zealand.

Halosaurus macrochir,[1] n.sp. Four specimens; obtained also at Station V.

Synaphobranchus bathybius, n.sp. One specimen; obtained also at Stations 237 and 246, 1875 and 2050 fathoms.

In addition to the foregoing, the following are recorded in the Station-book:—*Euplectella* and several other Sponges (only two species reported), a few Hydroids, several Comatulæ, *Stylifer* on Echini, Nudibranch, and several species of Polyzoa.

Excluding Protozoa, about 200 specimens of invertebrates and fishes were obtained at this Station, belonging to about 78 species, of which 66 are new to science, including representatives of 17 new genera; 15 of the new species were not obtained elsewhere, while other 9 new species were taken also only at the neighbouring Station 147.

Willemoes-Suhm writes: "The trawl brought up a rich harvest. On the whole it is important that the fauna in this southern latitude of the Indian Ocean has been found to be essentially the same as in the deep water of the tropics. The great apparent frequency and size of the Pycnogonids is new, for they have hitherto been taken only three times in deep water, and then only small specimens. Of the other animals at least ten have been obtained in the tropical deep sea, especially on the coast of Brazil, viz., *Euplectella*, *Umbellula*, the soft Holothurian, *Brisinga*, *Serolis*, *Chalaraspis* [= *Eucopia*], and four of the fishes. The large *Arcturus* and gigantic Amphipod remind one very much of the features said to be peculiar to deep-sea (or even shallow-water) forms of the north. One of the fishes, the whitish eel-like animal [= *Synaphobranchus bathybius*], had in its stomach several specimens of the little *Echinolampas* [= *Urechinus naresianus*], which came up in such quantities, evidently proving that it had fed at the bottom."

FORAMINIFERA (Brady, Zool. pt. 22).—The following species of Foraminifera were observed in the deposit from this Station (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.); the pelagic species, which make up about 87 per cent. of the carbonate of lime present in the deposit, are marked thus × :—

[1] On the specimen of this species from Station V., 1090 fathoms, a new species of *Distomum* (*Distomum* [illegible], n.sp.) has been found (see F. J. Bell, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. xix. pp. 116–17, 1887).

STATION 146.

Biloculina bulloides, d'Orbigny.
,, *depressa*, d'Orbigny.
,, ,, var. *murrhyna*, Schwager.
,, ,, var. *serrata*, Brady.
,, *irregularis*, d'Orbigny.
,, *ringens* (Lamarck).
,, *sphæra*, d'Orbigny.
,, *tubulosa*, Costa.
Miliolina auberiana (d'Orbigny).
,, *seminulum* (Linné).
,, *tricarinata* (d'Orbigny).
Ophthalmidium inconstans, Brady.
Planispirina celata (Costa).
Cornuspira foliacea (Philippi).
Orbitolites tenuissima, Carpenter.
Astrorhiza angulosa, Brady (?).
,, *arenaria*, Norman (?).
Pelosina cylindrica, Brady.
Psammosphæra fusca, Schulze.
Saccammina sphærica, Sars.
Hyperammina ramosa, Brady.
Marsipella cylindrica, Brady.
Rhabdammina abyssorum, Sars.
Aschemonella catenata (Norman).
Rhizammina algæformis, Brady.
Reophax distans, Brady.
,, *guttifera*, Brady.
,, *scorpiurus*, Montfort.
Haplophragmium globigeriniforme (Parker and Jones).
,, *latidorsatum* (Bornemann).
,, *scitulum*, Brady.
Placopsilina bulla, Brady.
Ammodiscus charoides (Jones and Parker).
,, *tenuis*, Brady.
Trochammina trullissata, Brady.
Webbina clavata, Jones and Parker.
Verneuilina pygmæa (Egger).
Gaudryina pupoides, d'Orbigny.
Clavulina communis, d'Orbigny.
Bulimina aculeata, d'Orbigny.
,, *marginata*, d'Orbigny.
Bulimina subteres, Brady.
Cassidulina crassa, d'Orbigny.
,, *subglobosa*, Brady.
Lagena auriculata, Brady.
,, ,, var. *substriata*, Brady.
,, *globosa* (Montagu).
,, *lævigata* (Reuss).
,, *lævis* (Montagu).
,, *longispina*, Brady.
,, *orbignyana* (Seguenza).
Nodosaria (*Glandulina*) *lævigata*, d'Orbigny.
,, *obliqua* (Linné).
,, (*Glandulina*) *rotundata*, Reuss.
Marginulina costata (Batsch).
Vaginulina legumen (Linné).
Polymorphina angusta, Egger.
,, *lanceolata*, Reuss.
,, *sororia*, Reuss.
,, ,, var. *cuspidata*, Brady.
Uvigerina pygmæa, d'Orbigny.
,, sp. (?).
× *Globigerina bulloides*, d'Orbigny.
× ,, *inflata*, d'Orbigny.
Pullenia quinqueloba, Reuss.
,, *sphæroides* (d'Orbigny).
Sphæroidina bulloides, d'Orbigny.
Spirillina limbata, Brady.
Discorbina araucana (d'Orbigny).
Truncatulina grosserugosa (Gümbel).
,, *lobatula*, Walker and Jacob.
,, *tenera*, Brady.
,, *wuellerstorfi* (Schwager).
× *Pulvinulina crassa* (d'Orbigny).
,, *elegans* (d'Orbigny).
× ,, *micheliniana* (d'Orbigny).
× ,, *patagonica* (d'Orbigny).
,, *pauperata*, Parker and Jones.
,, *umbonata*, Reuss.
Rotalia soldanii, d'Orbigny.
Nonionina pompilioides (Fichtel and Moll).
,, *umbilicatula* (Montagu).

ORGANISMS FROM SURFACE NETS.

Surface Organisms.—The following species are recorded from the surface at this Station :—

COPEPODA (Brady, Zool. pt. 23).
Calanus propinquus, n.sp.
Eucalanus attenuatus, Dana.
Heterochæta spinifrons, Claus.
Scolecithrix minor, n.g., n.sp.
Euchæta prestandreæ, Philippi.
Candace truncata, Dana.
Ætidius armatus, n.g., n.sp.

STATION 146

AMPHIPODA (Stebbing, Zool. pt. 67).
Euthemisto thomsoni, Stebbing.

SCHIZOPODA (Sars, Zool. pt. 37).
Thysanoëssa macrura, n.sp.

MACRURA (Spence Bate, Zool. pt. 52).
Caricyphus angulatus, n.g., n.sp.

PTEROPODA (Pelseneer, Zool. pt. 65).
Limacina australis (Eydoux and Souleyet).

The tow-net was sent down to 80 fathoms, and brought up :—*Globigerina*, very much smaller than in the Atlantic, compound Radiolaria, many *Sagittæ*, small Copepods, a large species of *Hyperia*, Pteropods, and *Cranchia*.

STATION 147

Station 147 (Sounding 239), Marion Island to Crozet Islands (see Chart 18).

December 30, 1873 ; lat. 46° 16′ S., long. 48° 27′ E.
Temperature of air at noon, 48°·3 ; mean for the day, 45°·5.
Temperature of water :—

	°		°
Surface,	41·0	600 fathoms,	36·2
50 fathoms,	40·0	800 ,,	36·0
100 ,,	37·4	1000 ,,	35·8
200 ,,	37·1	Bottom,	34·2
400 ,,	36·4		

Density at 60° F. :—

Surface,	1·02515	300 fathoms,	1·02534
100 fathoms,	1·02512	400 ,,	1·02536
200 ,,	1·02535	Bottom,	1·02550

Depth, 1600 fathoms ; deposit, Diatom Ooze, containing 34·63 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 8 A.M. got up steam. At 9.20 A.M. shortened and furled sails, and proceeded under steam to sound and trawl. At 10 A.M. put trawl over, veering 2000 fathoms. At 11 A.M. sounded in 1600 fathoms. At 1.20 P.M. obtained serial temperatures. The carbonic acid was determined in water from the surface and 100 fathoms, and amounted respectively to 54·2 and 56·9 milligrammes per litre. At 4.45 P.M. the trawl came up with numerous specimens,—even a more remarkable haul than yesterday's. A tow-net was sent down on the trawl line, but did not work successfully. At 4.50 P.M. made all plain sail. At 10.15 P.M. observed Hog Island on port bow. In the course of the day saw several albatrosses, Cape pigeons, many prions, and a few petrels. About 7 P.M. several whales were in sight.

Distance at noon from Hog Island, 84 miles. Made good 130 miles. Amount of current 13 miles, direction N. 81° E. STATION 147.

The following species are recorded in the Zoological Reports from the trawl at this Station :— ANIMALS FROM TRAWL.

MONAXONIDA (Ridley and Dendy, Zool. pt. 59).

Esperella mammiformis, n.sp. Six specimens ; obtained at no other locality.
Esperiopsis profunda, n.sp. Two specimens ; obtained at no other locality.
Cladorhiza (?) *tridentata*, n.sp. Three specimens ; obtained at no other locality.
Meliiderma stipitata, n.g., n.sp. Two specimens ; obtained at no other locality. Only species of the genus.
Axinella erecta (Carter). Two specimens ; obtained also at Stations 135, 145, and 148.
Stylocordyla stipitata (Carter). Three specimens ; obtained also at Station 49 and Bahia.

TETRACTINELLIDA (Sollas, Zool. pt. 63).

Thenea delicata, n.sp. Three specimens ; obtained at no other locality.

HEXACTINELLIDA (Schulze, Zool. pt. 53).

Holascus fibulatus, n.g., n.sp. One specimen; obtained also at Stations 146 and 160.
Caulophacus latus, n.g., n.sp. One specimen ; obtained at no other locality.
Bathydorus spinosus, n.g., n.sp. One specimen ; obtained at no other locality.
Aulocalyx irregularis, n.g., n.sp. Several fragments ; obtained also at Station 145. Only species of the genus.
Hyalonema (*Stylocalyx*) *clavigerum*, n.sp. One fragmentary specimen ; obtained at no other locality.
Farrea sp. (?).

PENNATULIDA (Kölliker, Zool. pt. 2).

Umbellula magniflora, n.sp. One specimen ; obtained also at Station 146.

ACTINIARIA (Hertwig, Zool. pts. 15 and 73).

Liponema multiporum, n.g., n.sp. One specimen ; obtained also at Stations 237 and 305, 1875 and 120 fathoms.
Bunodes minuta, n.sp. One specimen ; obtained at no other locality.
Sicyonis crassa, n.g., n.sp. One specimen ; obtained at no other locality.

Station 147. CORALS (Moseley, Zool. pt. 7).

Bathyactis symmetrica (Pourtalès). For distribution see Station 24.

Leptopenus discus, n.g., n.sp. Obtained also at Stations 157 and 323, 1950 and 1900 fathoms.

CRINOIDEA (Carpenter, Zool. pts. 32 and 60).

Hyocrinus bethellianus, Wyville Thomson, n.g., n.sp. Two specimens and fragments; obtained also at Stations 106 and 223 (?).

Bathycrinus aldrichianus, Wyville Thomson, n.sp. Obtained also at Station 146, and other Stations (?).

Antedon bispinosa, n.sp. One specimen; obtained at no other locality.

,, *remota*, n.sp. Five damaged specimens; obtained at no other locality.

,, *abyssorum*, n.sp. Eleven specimens; obtained at no other locality.

Promachocrinus abyssorum, n.g., n.sp. Three specimens; obtained also at Station 158, 1800 fathoms.

ASTEROIDEA (Sladen, Zool. pt. 51).

Pararchaster pedicifer, n.g., n.sp. Obtained also at Station 143 (?).

Porania antarctica, Smith. Obtained also at Station 145.

Hymenaster præcoquis, n.sp. Obtained also at Station 146.

Brisinga membranacea, n.sp. Obtained also at Station 146.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophioglypha loveni, n.sp. Obtained also at Stations 146, 157, 158 (?), and 160.

Ophiacantha cosmica, n.sp. For distribution see Station 122.

Ophiolebes scorteus, n.g., n.sp. Obtained also at Station 145.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Goniocidaris canaliculata, Agassiz. Obtained also at Stations 149, 150, 151, 153, 156, 313, 315, and Falkland Islands, 5 to 1975 fathoms.

Echinus magellanicus, Phil. Obtained also at Stations 145, 304, 308, 312, and 315.

Pourtalesia carinata, n.sp. Obtained also at Stations 157 and 298, 1950 and 2225 fathoms.

,, *hispida*, n.sp. Obtained also at Station 156, 1975 fathoms.

Spatagocystis challengeri, n.g., n.sp. Obtained also at Station 157, 1950 fathoms. Only species of the genus.

Echinocrepis cuneata, n.g., n.sp. Two specimens; obtained at no other locality. Only species of the genus.

Urechinus naresianus, n.g., n.sp. Obtained also at Stations 146, 158, and 302. Only species of the genus.

Cystechinus wyvillii, n.g., n.sp. Obtained also at Stations 146, 158, 296, 299, and 300. STATION 147

HOLOTHURIOIDEA (Théel, Zool. pts. 13 and 39).

Elpidia purpurea, n.sp. One specimen; obtained also at Station 157, 1950 fathoms.

Peniagone affinis, n.g., n.sp. Numerous specimens; obtained at no other locality.

Achlyonice lactea, n.g., n.sp. Four specimens; obtained at no other locality.

Lætmogone wyville-thomsoni, n.g., n.sp. Three specimens; obtained also at Stations 158, 232, and 300, 345 to 1800 fathoms.

Cucumaria abyssorum, n.sp. Seven specimens; obtained also at Station 156, 1975 fathoms.

" " var. *hyalina*, nov. Three specimens; obtained also at Station 300, 1375 fathoms.

Pseudostichopus villosus, n.g., n.sp. One specimen; for distribution see Station 61.

ENTOZOA (Linstow, Zool. pt. 71).

Ascaris macruroidei, n.sp. Three fragments from stomach of Macrurid.

ANNELIDA (M'Intosh, Zool. pt. 34).

Lætmonice producta, Grube, var. *benthaliana*, nov. Obtained also at Stations 157, 241, and 244, 1950 to 2900 fathoms.

Lagisca crosetensis, n.sp. Two specimens; obtained at no other locality.

Petta assimilis, n.sp. One specimen; obtained at no other locality.

Amphicteis wyvillei, n.sp. One specimen; obtained at no other locality.

MYZOSTOMIDA (Graff, Zool. pts. 27 and 61).

Stelechopus hyocrini, n.g., n.sp. (On *Hyocrinus bethellianus*).

CIRRIPEDIA (Hoek, Zool. pt. 25).

Scalpellum brevicarinatum, n.sp. Three specimens; obtained also at Station 146.

AMPHIPODA (Stebbing, Zool. pt. 67).

Andania gigantea, n.sp. One specimen; obtained also at Station 146.

Pleustes abyssorum, n.sp. One specimen; obtained at no other locality.

ISOPODA (Beddard, Zool. pts. 33 and 48).

Serolis antarctica, n.sp. A few specimens; obtained also at Stations 122 and 146.

Munnopsis australis, n.sp. One specimen; obtained at no other locality.

Eurycope sarsii, n.sp. Three specimens; obtained also at Station 146.

Station 147

Eurycope fragilis, n.sp. One specimen; obtained also at Stations 152, 158, and 237, 1260 to 1875 fathoms.

,, sp. (?) (*Eurycope atlantica*, n.sp.?) One fragmentary specimen.

Arcturus brunneus, n.sp. Four specimens; obtained at no other locality.

SCHIZOPODA (Sars, Zool. pt. 37).

Boreomysis scyphops, Sars. Several specimens; obtained also at Stations 157 and 158, 1950 and 1800 fathoms. Recorded from North Atlantic and Arctic.

Amblyops crozetii, Willemoes-Suhm, MS., n.sp. One specimen; obtained at no other locality.

MACRURA (Spence Bate, Zool. pt. 52).

Hymenodora duplex, n.sp. One specimen; obtained at no other locality.

PYCNOGONIDA (Hoek, Zool. pt. 10).

Nymphon hamatum, n.sp. Obtained also at Station 146.

Colossendeis gigas, n.sp. Obtained also at Stations 146 and 300.

,, *leptorhynchus*, n.sp. Obtained also at Stations 146, 300, and 310.

,, *gracilis*, n.sp. One or two specimens; obtained also at Station 146.

Phoxichilidium pilosum, n.sp. One or two specimens; obtained also at Station 157, 1950 fathoms.

GASTEROPODA (Watson, Zool. pt. 42).

Fusus (*Neptunea*) *calathiscus*, n.sp. Obtained at no other locality.

,, (,,) *setosus*, n.sp. Obtained also at Station 146.

Guivillea alabastrina, n.g., n.sp. One specimen; obtained at no other locality. Only species of the genus.

Pleurotoma (*Pleurotomella*) *papyracea*, n.sp. Obtained at no other locality.

CEPHALOPODA (Hoyle, Zool. pt. 44).

Bathyteuthis abyssicola, n.g., n.sp. One specimen; obtained at no other locality.

POLYZOA (Busk, Zool. pts. 30 and 50).

Bicellaria infundibulata, n.sp. Obtained also at Station 156, 1975 fathoms.

Bugula reticulata, n.sp. Obtained also at Stations 299, 303, and 320, 600 to 2160 fathoms.

Foveolaria orbicularis, n.g., n.sp. Obtained at no other locality.

Idmonea marionensis, Busk. Obtained also at Stations 145, 151, and 320.

Tunicata (Herdman, Zool. pts. 17 and 38).

Culeolus perlucidus, n.g., n.sp. Three specimens ; obtained at no other locality.

Fungulus cinereus, n.g., n.sp. One specimen ; obtained at no other locality. Only species of the genus.

Bathyoncus mirabilis, n.g., n.sp. One specimen ; obtained at no other locality.

Pharyngodictyon mirabile, n.g., n.sp. Six specimens ; obtained at no other locality. Only species of the genus.

Fishes (Günther, Zool. pt. 57).

Macrurus armatus, Hector. Three specimens ; obtained also at Stations 146, 157, 158, 246, and 271.

In addition to the foregoing, the following are recorded in the Station-book :—*Primnoa*, Sipunculid, *Balanoglossus*, *Chalaraspis ungnifera* [= *Eucopia australis*], and several Nudibranchs.

Excluding Protozoa, about 200 specimens of invertebrates and fishes were obtained at this Station, belonging to about 89 species, of which 73 are new to science, including representatives of 28 new genera ; 35 of the new species and 6 new genera were not obtained elsewhere.

Willemoes-Suhm writes : "To-day's haul was still richer than yesterday's, and included many typical deep-sea forms. An Amphipod was found in the new Crinoid, a larger specimen of which was taken closely attached to a Pycnogonid. Among the worms I found an animal apparently belonging to the northern genus *Terebellides*, one species of which (*Terebellides stroemii*) ranges to the Baltic, and is one of the animals looked upon by Lovén as evidence that the Baltic was formerly closed towards the North Sea and communicated with the northern icy sea. A small Sipunculid was found in a tube made up especially of Sponge spicules bound together by mud. Large reddish fragments of a *Balanoglossus* were taken, in one of which the collar was preserved. They were similar to those obtained in the deep sea of the tropics, where the head was also present. The complete animal must have been 3 to 5 inches in length and nearly three-quarters of an inch across the body. The most interesting things were among the Schizopods. There was a female of *Chalaraspis*, which seems to be the commonest representative of the group in deep water, also numerous females and two males of a new species of *Petalophthalmus*, the females of which are much larger than those of *Petalophthalmus armiger* and the breeding lamellæ much shorter. The main difference is in the males ; in the first-described species the male was described as having very big inner antennæ, mandibular palpi, maxillipeds, and first gnathopods, all of which were transformed into seizing organs, as in an Ostracode or Phyllopod. In this species such is

Station 147.

not the case; all these parts are of the ordinary size, the breeding lamellæ are, of course, wanting, and the pleopods are stronger than in the female. There would be no male character were it not for the presence of a pair of small styliform penes behind the last pair of pereiopods, as in the higher Decapods. I have not been able to make out what parts of the body are used in this transformation, as the pleopoda, the first pair of which assumes this function in the Macrura, seem to be normal in size and number. This species will be described as *Petalophthalmus inermis* [= *Boreomysis scyphops*]. The same modification of male characters was found in another Schizopod taken to-day, in which the pleopoda were fully developed; the gills, however, were absent, and the number of ambulatory pereiopoda was the same as in the Mysidæ, so that it may be regarded as a very aberrant Mysid near *Petalophthalmus*, connecting that genus with the rest of the Schizopods. I think I shall call it *Crozetia mysidiformis* [= *Amblyops crozetii*]. The large size of the Fusoid reminds one of the dimensions attained by certain groups of animals in extreme climates. Some of the Macruri seem to me to be the same as those taken in deep water between Gibraltar and Madeira."

Station 147A.

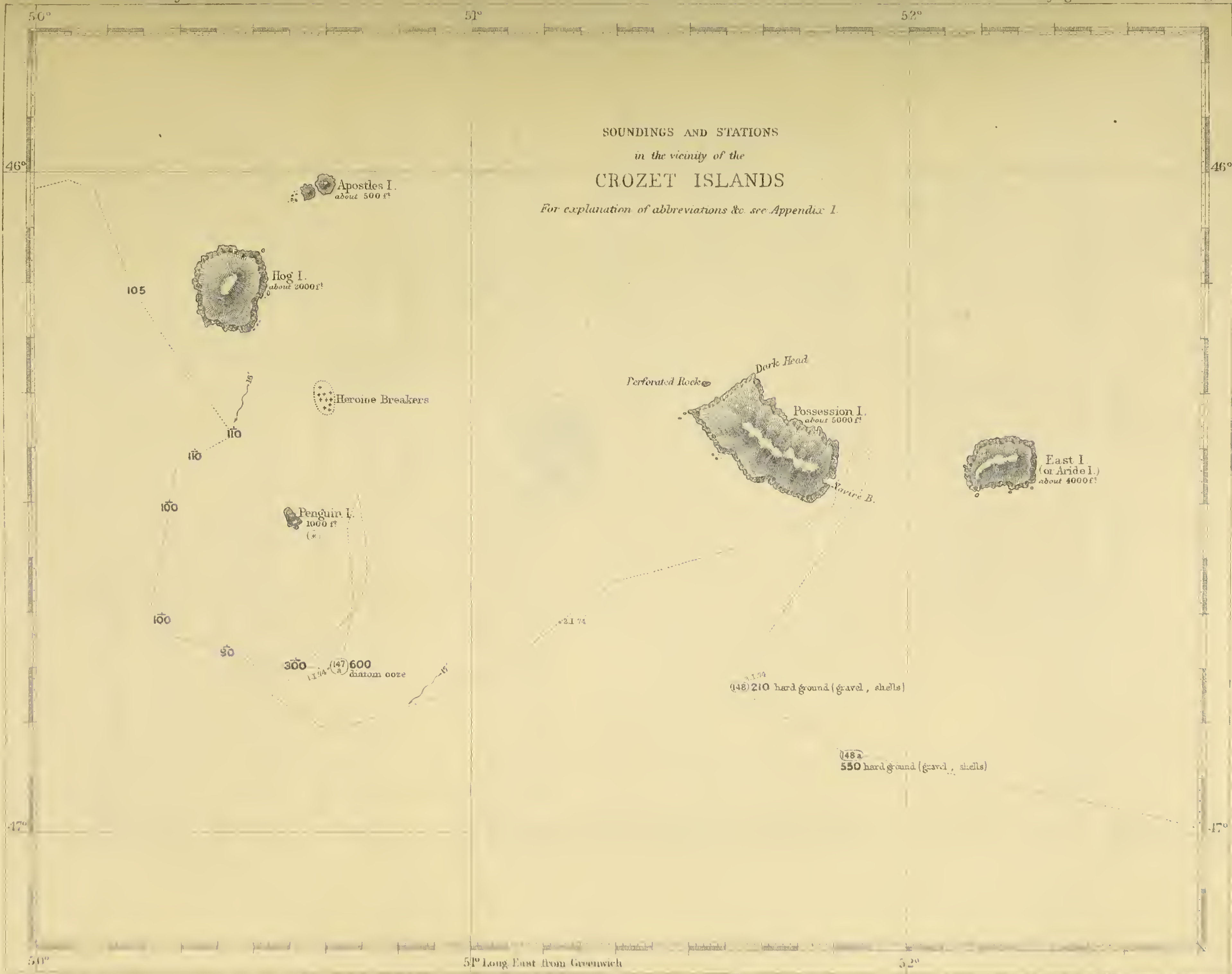
Station 147A (Sounding 240), off Crozet Islands (see Chart 20).

January 1, 1874; lat. 46° 45′ S., long. 50° 42′ E.
Temperature of air at noon, 41°·8; mean for the day, 41°·9.
Temperature of water at surface, 41°·0.
Density at 60° F. at surface, 1·02503.
Depth, 600 fathoms; deposit, Diatom Ooze, containing 36·34 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 2 A.M. sounded in 100 fathoms, no bottom. At 4.30 A.M. sounded in 90 fathoms, no bottom. At 10.45 A.M. sounded in 300 fathoms, no bottom. The land was obscured by a thick fog. At 2 P.M. sounded in 600 fathoms. At 4 P.M. lost sight of Penguin Island in a fog. During the day white and black albatrosses, carrion gulls, king and numerous other penguins, prions, and stormy petrels round the ship.

Distance at noon from Penguin Island, 19 miles (?). Made good 53 miles. Amount of current 16 miles, direction S. 20° E.

Surface Organisms.—The water was quite red-coloured, due to innumerable red Copepods, which were captured in so thick a mass that it was impossible to see the other animals; *Sagitta*, *Hyperia*, and other organisms were, however, present. The red colour of the water, mentioned in the Indian Ocean Directory as occurring among the islands in these latitudes, is probably due to these small Copepods.


SOUNDINGS AND STATIONS
in the vicinity of the
CROZET ISLANDS
For explanation of abbreviations &c. see Appendix I.
50°
51°
52°
46°
47°
Apostles I.
about 500 ft
Hog I.
about 2000 ft
Heroine Breakers
Penguin I.
1000 ft
Perforated Rock
Dark Head
Possession I.
about 5000 ft
Navire B.
East I.
(or Aride I.)
about 4000 ft
105
110
110
100
100
90
300
(147) 600
diatom ooze
(148) 210 hard ground (gravel, shells)
(148a)
550 hard ground (gravel, shells)
51° Long. East from Greenwich
Engraved by Malby & Sons

Stations 148 and 148A (Soundings 241 and 242), off Crozet Islands (see Chart 20). STATIONS 148 AND 148A.

January 3, 1874.
Temperature of air at noon, 44°·3 ; mean for the day, 44°·1.
Temperature of water at surface, 41°·0.
Density at 60° F. at surface, 1·02504.

At 2.30 A.M. land obscured by mist, which continued nearly all day. At 8 A.M. got up steam, and at 8.30 A.M. shortened and furled sails to sound and dredge. At 10 A.M. sounded in 210 fathoms, deposit Hard Ground, gravel, shells (Station 148). Put dredge over. Observed land to N.E. from masthead. At 11.30 A.M. hove up dredge with several specimens. The carbonic acid was determined in surface water, and amounted to 47·4 milligrammes per litre. At 1.30 P.M. sounded in 550 fathoms, deposit Hard Ground, gravel, shells (Station 148A). Sent down dredge, which came up 3.30 P.M. with a few specimens. At 4 P.M. made sail, and proceeded with a good breeze from the N.W. Cape pigeons, prions, and Mother Carey's chickens were seen in great numbers, also white albatrosses, stormy petrels, large black petrels, and penguins.

Distance at noon from Bligh's Cap, Kerguelen Island, 700 miles. Made good 16 miles.

On January 3, 1874, near the Crozet Islands, four dredgings were taken, the soundings giving depths of 210 and 550 fathoms (Stations 148 and 148A). In the following list of species recorded in the Zoological Reports the two Stations are combined, the depth being indicated :—

MONAXONIDA (Ridley and Dendy, Zool. pt. 59). ANIMALS FROM DREDGE.

Gellius carduus, n.sp. One specimen (210 to 550 fathoms); obtained also at Station 145.

Iophon chelifer, n.sp. One specimen (550 fathoms); obtained also at Stations 142 and 145.

Myxilla nobilis, n.sp. One fragmentary specimen (210 to 550 fathoms); obtained also at Station 320, 600 fathoms.

Phakellia papyracea, n.sp. Two or three pieces (210 fathoms); obtained also at Station 145.

Axinella erecta (Carter). Twenty-six specimens (550 fathoms); obtained also at Stations 135, 145, and 147.

Suberites mollis, n.sp. One specimen (210 to 550 fathoms); obtained at no other locality.

Stations 148 and 148A

Hexactinellida (Schulze, Zool. pt. 53).

Acanthascus grossularia, n.g., n.sp. One specimen (210 fathoms); obtained at no other locality.

Chonelasma lamella, n.g., n.sp. One specimen (550 fathoms); obtained also at Stations 56 and 170.

,, sp. (?). One fragment (550 fathoms).

Alcyonaria (Wright and Studer, Zool. pt. 64).

Thouarella antarctica (Valenciennes). Several specimens (550 fathoms); obtained at no other locality by the Challenger. Recorded from Falkland Islands.

Asteroidea (Sladen, Zool. pt. 51).

Leptoptychaster antarcticus, n.sp. (210 fathoms); obtained at no other locality.

Cribrella præstans, n.sp. Several specimens (210 fathoms); obtained at no other locality. Recorded subsequently from Indian Ocean ("Investigator").

,, *simplex*, n.sp. Several specimens (210 fathoms); obtained also at Stations 135 and 145.

Ophiuroidea (Lyman, Zool. pt. 14).

Astrotoma agassizii, Lyman. Young specimens (210 fathoms); obtained also at Stations 150, 307, 308, 309, 313, and Magellan Strait, 40 to 175 fathoms.

Holothurioidea (Théel, Zool. pt. 39).

Cucumaria serrata, n.sp., var. *marionensis*, nov. One specimen (550 fathoms); obtained also at Station 145.

Stichopus challengeri, n.sp. One specimen (550 fathoms); obtained at no other locality.

Isopoda (Beddard, Zool. pt. 33).

Serolis latifrons, White. Two specimens (210 fathoms); obtained also at Station 149, 5 to 40 fathoms. Recorded from Auckland Islands and Kerguelen.

Polyzoa (Busk, Zool. pt. 30; Waters, pt. 79).

Nellia oculata, Busk. (210 to 550 fathoms); obtained also at Stations 151, 188, 190, 208, and Bahia.

Caberea darwinii, Busk. (210 to 550 fathoms); for distribution see Station 135.

Retepora gigantea, n.sp. (210 to 550 fathoms); obtained at no other locality. STATIONS 148 AND 148A.

,, *cavernosa*, n.sp. (210 to 550 fathoms); obtained at no other locality.

Reteporella myriozoides, n.g., n.sp. (210 to 550 fathoms); obtained at no other locality.

Escharoides occlusa, n.sp. (210 fathoms); obtained also at Station 186 and Philippines, 8 to 10 fathoms. [Waters calls it *Lepralia occlusa* (Busk)].

Smittia graciosa, n.sp. (210 fathoms); obtained at no other locality.

Mucronella ventricosa, var. *multispinata*, Busk. (210 fathoms); obtained also at Station 145.

Schizoporella elegans (d'Orbigny). (210 to 550 fathoms); obtained also at Station 142.

Myriozoum marionense, n.sp. (210 to 550 fathoms); obtained also at Stations 145 and 151.

Cellepora vagans, n.sp. (210 fathoms); obtained also at Sandwich Islands, 20 to 40 fathoms.

,, *mamillata*, var. *atlantica*, Busk. (210 fathoms); obtained also at Bahia.

BRACHIOPODA (Davidson, Zool. pt. 1).

Terebratula moseleyi, n.sp. Five specimens (210 fathoms); obtained at no other locality.

The Station-book records also :—Several other Ophiurids, several Annelids, and a Chiton.

Excluding Protozoa, about 100 specimens of invertebrates were obtained at this place, belonging to about 33 species, of which 20 are new to science, including representatives of 3 new genera ; 10 of the new species were not obtained elsewhere.

Willemoes-Suhm writes: "*Cribrella* was common in the dredgings from 210 fathoms; most of the Alcyonarians were inhabited by an Annelid, and one of them by a *Hemieuryale* [= *Astrotoma*]; on the stones there was, besides *Terebratula*, a small white Chiton, an animal which probably does not extend to much deeper water."

Surface Organisms.—A tow-net was sent down on the dredge rope, and another was towed behind the ship at a depth of about 80 fathoms, and yielded many Diatoms and small *Globigerinæ*, *Sagitta*, *Halocypris*, Copepods, *Hyperia*, Pteropods and Pteropod larvæ, and *Salpæ*. ORGANISMS FROM SURFACE-NETS.

January 4 to 6, 1874.—The ship was running before a strong wind for Kerguelen, arriving in Christmas Harbour, Kerguelen, on the morning of January 7.

Stations 149 to 149 to 149K (Kerguelen).

Stations 149 to 149K (Soundings 243 to 253), off Kerguelen Island (see Chart 21).

January 9 to 29, 1874.

Depth, 20 to 150 fathoms; deposit, Green Muds, containing about 1 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

From January 9 to 29, 1874, a great many soundings, dredgings, and trawlings were taken off the coast of Kerguelen, in depths varying between 20 and 150 fathoms (Stations 149 to 149K). For description of Kerguelen see *Narr. Chall. Exp.*, vol. i. pp. 332–361. The dredgings and trawlings were very successful, and as it would be almost impossible to give a list of the species from each Station, they are all combined, the depth given in the Reports being indicated :—

Animals from Kerguelen.

Monaxonida (Ridley and Dendy, Zool. pt. 59).

Halichondria panicea, Johnston. Numerous specimens (10 to 100 fathoms); obtained also at Japan. Recorded from Atlantic, Ceylon, and Torres Strait.

Petrosia hispida, n.sp. Two specimens (25 fathoms); obtained at no other locality.

Pachychalina (?) *pedunculata*, n.sp. One specimen (10 to 100 fathoms); obtained at no other locality.

Desmacidon (*Homœodictya*) *kerguelenensis*, n.sp. Two specimens (25 fathoms); obtained at no other locality.

Amphilectus apollinis, n.sp. Two specimens (20 to 60 fathoms); obtained at no other locality.

„ *pilosus*, n.sp. One specimen (70 fathoms); obtained also at Station 145.

Axinella balfourensis, n.sp. One specimen (20 to 60 fathoms); obtained at no other locality.

Suberites antarcticus, Carter. One specimen (70 fathoms); obtained at no other locality by the Challenger. Recorded from Antarctic.

Stylocordyla stipitata (Carter), var. *globosa*, nov. Fifty specimens (10 to 100 fathoms); obtained also at Station 145.

Latrunculia apicalis, n.sp. One specimen (70 fathoms); obtained also at Station 320, 600 fathoms.

„ *bocagei*, n.sp. Two specimens (10 to 70 fathoms); obtained at no other locality.


SOUNDINGS AND STATIONS
in the vicinity of
KERGUELEN I.
For explanation of abbreviations &c see Appendix I
69° Long. East from Greenwich
Engraved by Malby & Sons

TETRACTINELLIDA (Sollas, Zool. pt. 63).

Tetilla grandis, n.sp. Fifty specimens (10 to 100 fathoms); obtained at no other locality.

„ „ var. *alba*, nov. (120 fathoms); obtained also at Station 150, 150 fathoms.

Cinachyra barbata, n.g., n.sp. Over sixty specimens (25 to 60 fathoms); obtained at no other locality. Only species of the genus.

HEXACTINELLIDA (Schulze, Zool. pt. 53).

Rossella antarctica, Carter. Several specimens (Christmas Harbour, various depths); obtained also at Stations 145, 150, and 320.

CALCAREA (Poléjaeff, Zool. pt. 24).

Leuconia ovata, n.sp. One specimen (70 fathoms); obtained at no other locality.

„ *fruticosa* (Haeckel). Two specimens (20 to 60 fathoms); obtained also at Station 150, 150 fathoms.

Leucetta vera, n.sp. One specimen (10 to 100 fathoms); obtained at no other locality.

ALCYONARIA (Wright and Studer, Zool. pt. 64).

Primnoisis ambigua, n.g., n.sp. (10 to 80 fathoms); obtained at no other locality.

ACTINIARIA (Hertwig, Zool. pts. 15 and 73).

Leiotealia nymphæa (Drayton). One specimen (120 fathoms); obtained at no other locality by the Challenger. Recorded from Valparaiso.

Halcampa clavus (Quoy and Gaimard). Three specimens (25 to 120 fathoms); obtained at no other locality by the Challenger.

„ *kerguelensis*, n.sp. Eighteen specimens (25 to 127 fathoms); obtained at no other locality.

HYDROIDA (Allman, Zool. pts. 20 and 70).

Schizotricha unifurcata, n.g., n.sp. (10 to 100 fathoms); obtained at no other locality. The only other species of the genus (*Schizotricha multifurcata*) was taken at Station 151.

Eudendrium rameum (Pallas). (105 fathoms); obtained at no other locality by the Challenger. Recorded from Europe.

Halecium arboreum, n.sp. (105 fathoms); obtained at no other locality.

Obelia geniculata (Linné). (20 to 26 fathoms); obtained also at Station 315, 5 to 12 fathoms. Recorded from Arctic, European seas, east and west coasts of North America.

Hypanthea aggregata, n.sp. (20 to 26 fathoms); obtained at no other locality.

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Grammaria stentor, n.sp. (28 to 60 fathoms); obtained at no other locality.

Sertularia secunda, n.sp. (20 fathoms); obtained at no other locality.

,, *echinocarpa*, n.sp. (28 to 60 fathoms); obtained at no other locality.

,, *articulata*, n.sp. (28 to 60 fathoms); obtained at no other locality.

CRINOIDEA (Carpenter, Zool. pt. 60).

Promachocrinus kerguelensis, n.g., n.sp. Seven specimens (10 to 127 fathoms); obtained also at Station 151, 75 fathoms.

ASTEROIDEA (Sladen, Zool. pt. 51).

Leptoptychaster kerguelenensis, Smith. (10 to 100 fathoms); obtained also at Station 145.

Bathybiaster loripes, n.sp., var. *obesa*, nov. (127 fathoms); the species obtained also at Stations 151 and 311, 75 and 245 fathoms.

Gnathaster meridionalis, Smith. (28 to 127 fathoms); obtained also at Stations 145, 150, and 151.

,, *elongatus*, n.g., n.sp. (127 fathoms); obtained also at Stations 145, 150, and 151.

Porania glaber, n.sp. (30 to 127 fathoms); obtained at no other locality.

Pteraster affinis, Smith. (28 fathoms); obtained at no other locality by the Challenger. Recorded from Kerguelen.

Retaster peregrinator, n.sp. (127 fathoms); obtained at no other locality.

Cribrella simplex, n.sp., var. *granulosa*, nov. (10 to 50 fathoms); the species obtained also at Stations 135, 145, and 148.

Perknaster fuscus, n.g., n.sp. (25 fathoms); obtained also at Station 151, 75 fathoms.

,, *densus*, n.g., n.sp. (127 fathoms); obtained at no other locality.

Echinaster spinulifer, Smith. (28 to 127 fathoms); obtained at no other locality by the Challenger. Recorded from Kerguelen.

Pedicellaster scaber, Smith. (20 to 25 fathoms); obtained at no other locality by the Challenger. Recorded from Kerguelen.

Asterias meridionalis, Perrier. (10 to 127 fathoms); obtained also at Station 145.

,, *perrieri*, Smith. (25 to 110 fathoms); obtained at no other locality by the Challenger. Recorded from Kerguelen.

Labidiaster annulatus, n.sp. (127 fathoms); obtained also at Stations 150, 151, and 191, 75 to 800 fathoms.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophioglypha hexactis, Smith. (20 to 75 fathoms); obtained also at Station 145.

Ophioglypha brevispina, Smith (?). (20 to 120 fathoms); obtained at no other locality by the Challenger. KERGUELEN.

,, *ambigua*, n.sp. (25 to 120 fathoms); obtained at no other locality.

,, *deshayesi*, n.sp. (28 to 120 fathoms); obtained also at Stations 150 and 151, 150 and 75 fathoms.

Ophiocten amitinum, n.sp. (120 fathoms); obtained also at Stations 145, 146, 152, and 157.

Amphiura studeri, Lyman. (20 to 60 fathoms); obtained also at Stations 145 and 151.

,, *tomentosa*, n.sp. (20 to 60 fathoms); obtained at no other locality.

Ophiacantha vivipara, Ljungman. (20 to 120 fathoms); for distribution see Station 145.

,, *imago*, n.sp. (25 to 120 fathoms); obtained also at Stations 150, and 151, 150 and 75 fathoms.

Gorgonocephalus pourtalesii, Lyman. (75 to 120 fathoms); obtained also at Stations 150, 151, 307, 308, and 313, 55 to 175 fathoms. Recorded from East Patagonia.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Goniocidaris canaliculata, Agassiz. (20 to 120 fathoms); for distribution see Station 147.

Echinus margaritaceus, Lamarck. (50 to 120 fathoms); obtained also at Stations 150, 151, 308, and 311, 75 to 245 fathoms.

Hemiaster cavernosus (Phil.). (10 to 250 [?] fathoms); obtained also at Stations 151 and 310, 75 and 400 fathoms.

Schizaster moseleyi, n.sp. (110 to 120 fathoms); obtained also at Stations 146, 305, 307, 309, 310, and 311.

HOLOTHURIOIDEA (Théel, Zool. pt. 39).

Trochostoma violaceum, Studer. Numerous specimens (20 to 120 fathoms); obtained also at Station 169, 700 fathoms. Recorded from Kerguelen.

Cucumaria lævigata (Verrill). Numerous specimens (25 to 120 fathoms); obtained also at Station 151, 75 fathoms. Recorded from Kerguelen.

,, *kerguelensis*, n.sp. Six specimens (25 fathoms); obtained at no other locality.

Psolus incertus, n.sp. One specimen (60 fathoms); obtained also at Stations 150 and 151, 150 and 75 fathoms.

Kerguelen.

Psolus ephippifer, Wyville Thomson, n.sp. One specimen (20 to 60 fathoms); obtained also at Stations 145, 150, and 151.

Thyone recurvata, n.sp. One specimen (10 to 100 fathoms); obtained at no other locality.

ENTOZOA (Linstow, Zool. pt. 71).

Ascaris simplex, Rudolphi. Thirteen specimens from stomach of seal (*Otaria jubata*).

,, *spiculigera*, Rudolphi. Thirty-six specimens from stomach of shag (*Phalacrocorax verrucosus*).

NEMERTEA (Hubrecht, Zool. pt. 54).

Drepanophorus serraticollis, Hubrecht (?). One fragmentary specimen (depth not given); obtained also at Station 162, 38 to 40 fathoms. Recorded from Mediterranean.

Amphiporus moseleyi, n.sp. Several specimens (shallow water to 20 fathoms); obtained at no other locality.

,, *marioni*, n.sp. One specimen (120 fathoms); obtained also at Station 145.

Cerebratulus corrugatus (M'Intosh). Numerous specimens (25 to 120 fathoms); obtained also at Station 151, 75 fathoms.

,, sp. (?) (*medullatus*, n.sp. ?). One fragmentary specimen (depth not given).

GEPHYREA (Selenka, Zool. pt. 36).

Phascolosoma pudicum, n.sp. Numerous specimens (10 to 127 fathoms); obtained at no other locality.

ANNELIDA (M'Intosh, Zool. pt. 34).

Laetmonice producta, Grube. Numerous specimens (20 to 120 fathoms); obtained also at Station 151, 75 fathoms. Recorded from Kerguelen.

Lagisca antarctica, n.sp. Several specimens (127 fathoms); obtained also at Station 145.

,, *magellanica*, n.sp. (127 fathoms); obtained also at Station 308, 175 fathoms.

Evarne kerguelensis, n.sp. Several specimens (30 to 127 fathoms); obtained at no other locality.

Eupolynoe mollis, M'Intosh. One fragmentary specimen (100 fathoms); obtained at no other locality by the Challenger.

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Hermadion kerguelensis, n.sp. Numerous specimens (20 to 60 fathoms); obtained also at Falkland Islands, 5 to 10 fathoms.

Nephthys trissophyllus, Grube. Numerous specimens (20 to 60 fathoms); obtained also at Station 151, 75 fathoms. Recorded from Kerguelen.

Salvatoria kerguelensis, n.g., n.sp. One specimen (45 to 120 fathoms); obtained at no other locality. Only species of the genus.

Eusyllis kerguelensis, n.sp. Several specimens (127 fathoms); obtained at no other locality.

Syllis gigantea, n.sp. (10 to 100 fathoms); obtained at no other locality.

Sphærosyllis kerguelensis, n.sp. One specimen (127 fathoms); obtained at no other locality.

Autolytus maclearanus, n.sp. One specimen (30 fathoms); obtained at no other locality.

Nereis (Platynereis) eatoni, M'Intosh. (20 fathoms); obtained also at Station 145, Fernando Noronha, and Falkland Islands.

,, *kerguelensis*, Baird (?), and var. (?). (10 to 100 fathoms); obtained at no other locality. Recorded from Kerguelen.

Lumbriconereis kerguelensis, Grube. (110 fathoms); obtained at no other locality by the Challenger.

Eunice magellanica, n.sp. (?) (young ?). One specimen (20 fathoms); obtained also at Stations 308 and 311, 175 and 245 fathoms.

Glycera kerguelensis, n.sp. One specimen (127 fathoms); obtained at no other locality.

Scoloplos kerguelensis, n.sp. Several specimens (110 to 120 fathoms); obtained at no other locality.

Travisia kerguelensis, n.sp. Several specimens (25 fathoms); obtained at nó other locality.

Trophonia kerguelarum, Grube. Numerous specimens (127 fathoms); obtained at no other locality. Recorded from Kerguelen.

Brada mammillata, Grube. Numerous specimens (20 to 40 fathoms); obtained at no other locality. Recorded from Kerguelen.

Scolecolepis cirrata, Sars, var. (?). One specimen (110 fathoms); obtained also at Station 23.

Notomastus (?) sp. One fragmentary specimen (127 fathoms).

Praxilla kerguelensis, n.sp. Several specimens (110 fathoms); obtained at no other locality.

,, *assimilis*, n.sp. One fragmentary specimen (127 fathoms); obtained at no other locality.

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Ampharete kerguelensis, n.sp. Two specimens (127 fathoms); obtained at no other locality.

Amphitrite kerguelensis, M'Intosh. Numerous specimens (20 to 110 fathoms); obtained at no other locality. Recorded from Kerguelen.

Neottis antarctica, M'Intosh. Several specimens (20 to 120 fathoms); obtained also at Stations 145, 150, 151, and 313.

Erentho kerguelensis, n.sp. Two specimens (110 fathoms); obtained at no other locality.

Polycirrus kerguelensis, n.sp. One fragmentary specimen (127 fathoms); obtained at no other locality.

Artacama challengeriæ, n.sp. Several specimens (25 to 110 fathoms); obtained at no other locality.

Terebellides strœmi, Sars, var. *kerguelensis*, nov. Several specimens (110 to 127 fathoms); obtained also at Station 47 (var. ?).

Serpula narconensis, Baird. Several specimens (60 fathoms); obtained also at Stations 145, 151, and 308.

Spirorbis sp. (?). Fragment (110 fathoms).

OSTRACODA (Brady, Zool. pt. 3).

Aglaia (?) *obtusata*, n.sp. (20 to 50 fathoms); obtained at no other locality.

Argillœcia eburnea, n.sp. (20 to 120 fathoms); obtained also at Station 323, 1900 fathoms.

Macrocypris tumida, n.sp. (28 fathoms); obtained also in Wellington Harbour, N.Z.

,, *decora*, Brady. (120 fathoms); for distribution see Station 24.

,, *maculata*, Brady. (20 to 50 fathoms); obtained also at Stations 145, 162, the Cape, and Amboina.

Bairdia villosa, n.sp. (20 to 120 fathoms); obtained also at Stations 135, 145, and 162.

,, *victrix*, Brady. (120 fathoms); for distribution see Station 24.

Cythere foveolata, n.sp. (127 fathoms); obtained also at Station 151, 75 fathoms.

,, *kerguelenensis*, n.sp. (20 to 50 fathoms); obtained also at Stations 145, 162, and Port Jackson.

,, *subrufa*, n.sp. (20 to 50 fathoms); obtained also at Station 145.

,, *wyville-thomsoni*, n.sp. (20 to 120 fathoms); obtained also at Stations 150, 151, and 185, 75 to 155 fathoms.

,, *audei*, Brady (?). Single valve (depth not given); obtained also off Ascension, 7 fathoms. Recorded from Mauritius and Colon-Aspinwall.

Krithe bartonensis (Jones). (120 fathoms); obtained also at Station 191A, 580 fathoms. KERGUELEN.

Xestoleberis depressa, Sars. (20 to 25 fathoms); obtained also at Station 150, 150 fathoms. Recorded from Europe, Spitzbergen, and North America. Fossil—Post-Tertiary of Europe and Canada.

,, *setigera*, n.sp. (120 fathoms); obtained also at Stations 145 and 151.

,, *curta*, Brady. (28 fathoms); for distribution see Station 33.

Cytherura obliqua, n.sp. (20 to 50 fathoms); obtained at no other locality.

,, *lilljeborgi*, n.sp. (20 to 50 fathoms); obtained at no other locality.

,, *costellata*, n.sp. (20 to 50 fathoms); obtained at no other locality.

Cytheropteron scaphoides, n.sp. (20 to 50 fathoms); obtained at no other locality.

,, (?) *angustatum*, n.sp. (20 to 50 fathoms); obtained also at Station 185, 155 fathoms.

,, *assimile*, n.sp. (120 fathoms); obtained also at Station 151, 75 fathoms.

,, *fenestratum*, n.sp. (120 fathoms); obtained also at Station 335, 1425 fathoms.

Bythocythere pumilio, n.sp. (20 to 50 fathoms); obtained at no other locality.

Pseudocythere caudata, Sars. (20 to 120 fathoms); obtained also at Stations 145 and 323.

Sclerochilus contortus (Norman). (20 to 50 fathoms); obtained also at Station 151, 75 fathoms, and Wellington Harbour, N.Z.

Xiphichilus complanatus, n.sp. (120 fathoms); obtained at no other locality.

Paradoxostoma abbreviatum, Sars. (20 to 50 fathoms); obtained at no other locality by the Challenger. Recorded from Europe.

Cypridina danæ, n.sp. One specimen (120 fathoms); obtained at no other locality.

Polycope orbicularis, Sars (?). (120 fathoms); obtained also at Stations 142 (?), 185, and Vigo Bay.

AMPHIPODA (Stebbing, Zool. pt. 67).

Anonyx cicadoides, n.sp. Several specimens (20 to 127 fathoms); obtained at no other locality.

Tryphosa barbatipes, n.sp. Three specimens (shallow water to 127 fathoms); obtained at no other locality.

Hippomedon kergueleni (Miers). Several specimens (20 to 127 fathoms); obtained at no other locality by the Challenger. Recorded from Kerguelen.

Hippomedon trigonicus, n.g., n.sp. One specimen (depth not given); obtained at no other locality.

Cheirimedon crenatipalmatus, n.g., n.sp. One specimen (127 fathoms); obtained at no other locality. Only species of the genus.

Sophrosyne murrayi, n.g., n.sp. One specimen (depth not given); obtained at no other locality. Only species of the genus.

Orchomene cavimanus, n.sp. Three specimens (shallow water to 127 fathoms); obtained at no other locality.

Lepidepecreum foraminiferum, n.sp. Five specimens (127 fathoms); obtained at no other locality.

Socarnoides kergueleni, n.g., n.sp. Three specimens (30 to 127 fathoms); obtained at no other locality. Only species of the genus.

Ambasia integricauda, n.sp. One specimen (28 fathoms); obtained at no other locality.

Acontiostoma pepinii, n.g., n.sp. Three specimens (28 fathoms); obtained at no other locality.

,, *kergueleni*, n.g., n.sp. One specimen (28 fathoms); obtained at no other locality.

Metopa nasutigenes, n.sp. Three specimens (127 fathoms); obtained at no other locality.

Cardenio paurodactylus, n.g., n.sp. Four specimens (depth not given); obtained at no other locality. Only species of the genus.

Phoxocephalus kergueleni, n.sp. Several specimens (120 fathoms); obtained also at Station 145.

Harpinia obtusifrons, n.sp. Four specimens (30 to 120 fathoms); obtained at no other locality.

Urothoe lachneëssa, n.sp. Five specimens (120 fathoms); obtained at no other locality.

Halimedon schneideri, n.sp. One specimen (shallow water); obtained at no other locality.

Oediceroides rostrata, n.g., n.sp. Five specimens (127 fathoms); obtained also at Station 150, 150 fathoms.

Iphimedia pacifica, n.sp. One specimen (127 fathoms); obtained also at Station 150, 150 fathoms.

Atyloides australis (Miers). Several specimens (25 fathoms); obtained at no other locality by the Challenger. Recorded from Kerguelen and Port Jackson.

Harpinioides drepanocheir, n.g., n.sp. Three specimens (shallow water to 127 fathoms); obtained at no other locality. Only species of the genus.

Tritæta kergueleni, n.sp. Three specimens (28 to 127 fathoms); obtained at no other locality. KERGUELEN.

Rhachotropis kergueleni, n.sp. Two specimens (depth not given); obtained at no other locality.

Eusirus longipes, Boeck. One specimen (depth not given); obtained also at Station 150, 150 fathoms. Recorded from North Atlantic.

Liljeborgia consanguinea, n.sp. One specimen (20 fathoms); obtained also at Station 151, 75 fathoms.

Photis macrocarpus, n.sp. Several specimens (depth not given); obtained at no other locality.

Aora kergueleni, n.sp. Three specimens (30 to 38 fathoms); obtained at no other locality.

,, *trichobostrychus*, n.sp. Two specimens (depth not given); obtained at no other locality.

Autonoe kergueleni, n.sp. Two specimens (127 fathoms); obtained at no other locality.

Gammaropsis exsertipes, n.sp. Three specimens (depth not given); obtained at no other locality.

Amphithoë kergueleni, n.sp. One specimen (depth not given); obtained at no other locality.

Podocerus falcatus (Montagu). One specimen (30 fathoms); taken also from screw after leaving the Cape.

Cerapus sismithi, n.sp. Three specimens (120 fathoms); obtained at no other locality.

Haplocheira plumosa, n.sp. Two specimens (shallow water to 127 fathoms); obtained at no other locality.

Platophium danæ, n.sp. Nine specimens (127 fathoms); obtained at no other locality.

Neohela serrata, n.sp. Two specimens (127 fathoms); obtained at no other locality.

Kerguelenia compacta, n.g., n.sp. Two specimens (127 fathoms); obtained at no other locality. Only species of the genus.

Dodecas elongata, n.g., n.sp. Several specimens (95 to 110 fathoms); obtained at no other locality. Only species of the genus.

Protellopsis kergueleni, n.g., n.sp. Two specimens (30 fathoms); obtained at no other locality. Only species of the genus.

Euthemisto thomsoni, n.n. One specimen (25 fathoms); obtained at the surface on several occasions in the Antarctic.

KERGUELEN. ISOPODA (Beddard, Zool. pts. 33 and 48).

Serolis latifrons, White. Numerous specimens (5 to 40 fathoms); obtained also at Station 148.

,, *septemcarinata*, Miers. Numerous specimens (25 to 60 fathoms); obtained also at Station 145.

,, *cornuta*, Studer. Several specimens (25 to 45 fathoms); obtained at no other locality. Recorded from Kerguelen.

Jaera pubescens, Dana. Several specimens, semiparasitic on *Sphæroma gigas* (rock-pools); obtained at no other locality by the Challenger. Recorded from Patagonia and Kerguelen.

Munna maculata, n.sp. One specimen (28 fathoms); obtained at no other locality.

,, *pallida*, n.sp. One specimen (30 fathoms); obtained at no other locality.

Pleurogonium albidum, n.sp. One specimen (120 fathoms); obtained at no other locality.

,, *serratum*, n.sp. One specimen (120 fathoms); obtained at no other locality.

Neasellus kerguelenensis, n.g., n.sp. One specimen (120 fathoms); obtained also at Station 320, 600 fathoms. Only species of the genus.

Astrurus crucicauda, n.g., n.sp. Numerous specimens (120 fathoms); obtained at no other locality. Only species of the genus.

Ilyarachna quadrispinosa, n.sp. Several specimens (127 fathoms); obtained at no other locality.

Arcturus furcatus, Studer. Numerous specimens (7 to 127 fathoms); obtained also at Stations 151 and 153, 75 and 1675 fathoms. Recorded from Kerguelen.

,, *studeri*, n.sp. Several specimens (25 to 127 fathoms); obtained at no other locality.

,, *stebbingi*, n.sp. One specimen (30 fathoms); obtained at no other locality.

Astacilla marionensis, n.sp. Two specimens (surface and shallow water); obtained also at Station 145.

Apseudes spectabilis, Studer. One specimen (depth not given); obtained at no other locality by the Challenger. Recorded from Kerguelen.

,, *antarctica*, n.sp. Several specimens (127 fathoms); obtained at no other locality.

Tanais willemoesii, Studer. Numerous specimens (45 fathoms); obtained at no other locality by the Challenger. Recorded from Kerguelen.

Typhlotanais kerguelenensis, n.sp. Several specimens (127 fathoms); obtained also at Station 246 (?), 2050 fathoms.

Leptognathia australis, n.sp. One specimen (127 fathoms); obtained at no other locality. KERGUELEN.

Paratanais dimorphus, n.sp. Numerous specimens (127 fathoms); obtained at no other locality.

Anceus gigas, n.sp. Several specimens (127 fathoms); obtained at no other locality.

„ *tuberculosus*, n.sp. Three specimens (30 to 127 fathoms); obtained at no other locality.

Paranthura neglecta, n.sp. One specimen (127 fathoms); obtained at no other locality.

Cymodocea darwini, Cunningham. Several specimens (127 fathoms); obtained at no other locality by the Challenger. Recorded from Patagonia.

Fifty-one other specimens, belonging to about 9 species undetermined.

CUMACEA (Sars, Zool. pt. 55).

Vaunthompsonia meridionalis, n.sp. One specimen (127 fathoms); obtained at no other locality.

Paralamprops serrato-costata, n.g., n.sp. Numerous specimens (127 fathoms); obtained at no other locality. Only species of the genus.

Leucon assimilis, n.sp. A few specimens (127 fathoms); obtained at no other locality.

Diastylis horrida, n.sp. Several specimens (127 fathoms); obtained at no other locality.

Campylaspis nodulosa, n.sp. Four specimens (127 fathoms); obtained at no other locality.

SCHIZOPODA (Sars, Zool. pt. 37).

Euphausia murrayi, n.sp. One specimen (96 fathoms); obtained also at Station 154, surface (?).

Pseudomma sarsii, Willemoes-Suhm, n.sp. Several specimens (120 fathoms); obtained also at Station 153, 1675 fathoms.

BRACHYURA (Miers, Zool. pt. 49).

Halicarcinus planatus (Fabricius). Two specimens (rock-pools); obtained also at Stations 145, 316, and Falkland Islands.

PYCNOGONIDA (Hoek, Zool. pt. 10).

Nymphon brachyrhynchus, n.sp. Numerous specimens (45 to 120 fathoms); obtained at no other locality.

„ *fuscum*, n.sp. Three specimens (25 fathoms); obtained at no other locality.

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Nymphon brevicaudatum, Miers. Numerous specimens (25 to 120 fathoms); obtained at no other locality by the Challenger. Recorded from Kerguelen.

Colossendeis robusta, n.sp. One specimen (120 fathoms); obtained at no other locality.

,, *megalonyx*, n.sp. Two or three specimens (120 fathoms); obtained also at Stations 313 and 314, 55 and 70 fathoms.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Neæra kerguelenensis, n.sp. (120 fathoms); obtained at no other locality.

Thracia meridionalis, n.sp. (20 to 60 fathoms); obtained also at Station 145.

Anatina elliptica, King and Broderip, juv. (15 to 28 fathoms); obtained at no other locality by the Challenger. Recorded from Kerguelen and New South Shetland.

Davila (?) *umbonata*, n.sp. (25 fathoms); obtained also at Station 145.

,, ,, var. (?). (20 to 60 fathoms).

Kellia suborbicularis (Montagu). Two specimens (28 fathoms); obtained at no other locality by the Challenger. Recorded from North Atlantic.

,, *nuculina*, Martens. (20 to 120 fathoms); obtained also at Station 145.

,, *cardiformis*, n.sp. (28 fathoms); obtained at no other locality.

Cardita astartoides, Martens. (20 to 60 fathoms); obtained also at Station 150, 150 fathoms.

Yoldia isonata, Martens. (15 to 110 fathoms); obtained at no other locality by the Challenger.

,, *subæquilateralis*, Smith. (28 fathoms); obtained at no other locality by the Challenger.

Malletia gigantea, Smith. (Shallow water to 60 fathoms); obtained at no other locality by the Challenger.

Mytilus magellanicus, Chemnitz. (Shore); obtained also at Station 315, 12 fathoms, and Fiji. Recorded from New Zealand.

,, *kerguelensis*, n.sp. (Shore); obtained at no other locality.

Modiolarca trapezina (Lamarck). (28 fathoms); obtained also at Stations 145, 311, and 315.

,, *kerguelensis*, n.sp. (25 fathoms); obtained at no other locality.

Lima (*Limatula*) *pygmæa*, Philippi. (28 to 60 fathoms); obtained also at Station 145.

Pecten cluthratus, Martens. (120 fathoms); obtained at no other locality by the Challenger.

SCAPHOPODA and GASTEROPODA (Watson, Zool. pt. 42). KERGUELEN.

Dentalium ægeum, n.sp. (110 fathoms); obtained at no other locality.

Patella fuegiensis, Reeve. (Rocks and 20 to 60 fathoms); obtained at no other locality by the Challenger. Recorded from Tierra del Fuego, Falklands, and Kerguelen.

,, *kerguelensis*, Smith. (Rocks and 40 fathoms); obtained also at Heard Island, shore. Recorded from Kerguelen.

Puncturella noachina (Linné), var. *princeps*, Mighels. (60 fathoms); for distribution see Station 145.

Trochus (*Photinula*) *expansus* (Sowerby). (25 to 60 fathoms); obtained also at Station 145 and Falkland Islands.

,, (*Margarita*) *charopus*, n.sp. (105 fathoms); obtained also at Station 151, 75 fathoms (var. *cæruleus*).

Scissurella obliqua, n.sp. (Shore); obtained at no other locality.

Trophon albolabratus, Smith. (25 to 60 fathoms); obtained at no other locality by the Challenger. Recorded from Kerguelen.

,, *septus*, n.sp. (28 fathoms); obtained at no other locality.

Fusus (*Neptunea*) *regulus*, n.sp. (28 fathoms); obtained at no other locality.

,, (*Euthria*) *chloroticus*, Martens. (20 to 105 fathoms); obtained at no other locality by the Challenger. Recorded from Kerguelen.

,, (,,) *fuscatus* (Bruguière). (25 fathoms); obtained also at Stations 315 and 316, 4 to 12 fathoms. Recorded from Peru.

Buccinum albozonatum, n.sp. (28 fathoms); obtained at no other locality.

Neobuccinum eatoni, Smith. (Rocks and 20 to 25 fathoms); obtained also at Station 151, 75 fathoms. Recorded from Kerguelen.

,, *vestitum* (Martens). (20 to 28 fathoms); obtained also at Station 151, 75 fathoms. Recorded from Kerguelen.

Provocator pulcher, n.g., n.sp. (105 fathoms); obtained also at Station 150, 150 fathoms. Only species of the genus.

Volutomitra fragillima, n.sp. (28 fathoms); obtained at no other locality.

Cancellaria (*Admete*) *specularis*, n.sp. (25 fathoms); obtained also at Station 151, 75 fathoms.

,, (,,) *carinata*, n.sp. (28 fathoms); obtained at no other locality.

,, (,,) sp. (?) (*specularis*?). One broken specimen (60 fathoms).

Pleurotoma (*Surcula*) *staminea*, n.sp. (105 fathoms); obtained also at Station 146.

,, (*Typhlomangelia*) *fluctuosa*, n.sp., var. *cariosa*, nov. One specimen (28 fathoms); the species obtained also at Station 151, 75 fathoms.

Pleurotoma (*Spirotropis*) *studeriana*, Martens. (25 to 30 fathoms); obtained at no other locality by the Challenger. Recorded from Kerguelen.

,, (*Thesbia*) *translucida*, n.sp. (25 and 28 fathoms); obtained also at Station 145.

,, (,,) *corpulenta*, n.sp. (28 fathoms); obtained at no other locality.

,, (,,) *platamodes*, n.sp. (28 fathoms); obtained at no other locality.

,, sp. (?). (28 fathoms).

Struthiolaria mirabilis, Smith. (20 to 60 fathoms); obtained also at Station 151, 75 fathoms. Recorded from Kerguelen.

Natica grisea, Martens. (25 to 95 fathoms); obtained at no other locality by the Challenger.

,, *fertilis*, n.sp. (60 fathoms); obtained also at Stations 145 and 150.

,, (*Lunatia*) *prasina*, n.sp. (28 and 60 fathoms); obtained at no other locality.

Natica (*Amauropsis*) *perscalpta*, Martens. (20 and 28 fathoms); obtained at no other locality by the Challenger. Recorded from Kerguelen.

,, (,,) *suturalis*, n.sp. (60 fathoms); obtained at no other locality.

Turritella austrina, n.sp. (28 fathoms); obtained also at Station 145.

,, *incolor*, Smith, n.sp. (28 fathoms) [see *Proc. Zool. Soc. Lond.*, 1891, p. 437].

Alaba (*Diala*) sp. (?). (127 fathoms).

Littorina setosa, Smith. (60 fathoms); obtained at no other locality by the Challenger. Recorded from Kerguelen.

Rissoa (*Setia*) *principis*, n.sp. (Shore); obtained also at Station 145.

,, (,,) *australis*, n.sp. (Shore); obtained at no other locality.

,, (,,) *sinapi*, n.sp. (Shore); obtained at no other locality.

Hydrobia caliginosa (Gould). (Shore); obtained at no other locality by the Challenger. Recorded from Tierra del Fuego and Kerguelen.

Eatoniella caliginosa (Smith). (Shore); obtained at no other locality by the Challenger. Recorded from Kerguelen.

,, *subrufescens* (Smith). (25 fathoms); obtained at no other locality by the Challenger. Recorded from Kerguelen.

Skenea subcanaliculata, Smith. (Shore); obtained at no other locality by the Challenger. Recorded from Kerguelen

Actaeon (*Actaeonina*) *edentulus*, n.sp. One injured specimen (60 fathoms); obtained at no other locality.

POLYPLACOPHORA (Haddon, Zool. pt. 43). KERGUELEN.

Leptochiton kerguelensis, n.sp. One specimen (60 fathoms); obtained at no other locality.

Hemiarthrum setulosum, Carpenter, MS. One specimen (shore); obtained at no other locality by the Challenger. Recorded from Kerguelen.

NUDIBRANCHIATA (Bergh, Zool. pt. 26).

Archidoris kerguelenensis, n.sp. One specimen (25 fathoms); obtained at no other locality.

,, *australis*, n.sp. One specimen (95 fathoms); obtained at no other locality.

MARSENIADÆ (Bergh, Zool. pt. 41).

Marseniopsis pacifica, n.g., n.sp. One specimen (10 to 100 fathoms); obtained at no other locality.

POLYZOA (Busk, Zool. pts. 30 and 50; Waters, pt. 79).

Cellularia quadrata, n.sp. (28 fathoms); obtained also at Station 151, 75 fathoms.

,, *elongata*, n.sp. (?). (28 fathoms); obtained at no other locality.

Menipea benemunita, n.sp. (45 to 127 fathoms); obtained also at Stations 303, 313, 314, and 315, 5 to 1325 fathoms.

,, *flagellifera*, n.sp. (20 to 127 fathoms); obtained also at Stations 145, 313, and 314.

Caberea darwinii, Busk. (45 to 127 fathoms); for distribution see Station 135.

Bugula longissima, n.sp. (28 fathoms); obtained also at Station 151, 75 fathoms.

Flustra crassa, n.sp. (28 fathoms); obtained at no other locality.

Carbasea ovoidea, Busk. (28 to 127 fathoms); for distribution see Station 145.

Diachoris inermis, Busk. (20 to 60 fathoms); obtained at no other locality by the Challenger. Recorded from New Zealand and Magellan Strait.

Membranipora galeata, Busk. (28 fathoms); obtained also at Stations 75, 145, 150, 320, and Simon's Bay, Cape.

Amphiblestrum cristatum, n.sp. (28 fathoms); obtained at no other locality.

Salicornaria clavata, n.sp. (28 fathoms); obtained also at Stations 145, 151, 162, 163B, and 304. [Waters calls it *Cellaria australis*, MacGillivray].

,, *variabilis*, n.sp. (25 fathoms); obtained also at Stations 304 and 314, 45 and 70 fathoms.

,, *malvinensis*, Busk. (28 fathoms); for distribution see Station 145.

Onchopora sinclairii, Busk. (28 fathoms); obtained also at Stations 150, 151, and 157, 75 to 1950 fathoms. Recorded from New Zealand, Australia, and Marion Island. [Waters calls it *Calwellia sinclairii* (Busk)].

Chorizopora hyalina, var. *bougainvillei*, d'Orbigny. (28 fathoms); obtained also at Stations 145 and 315.

Smittia marionensis, Busk. (28 fathoms); obtained also at Station 145.

Cellepora eatonensis, n.sp. (28 to 127 fathoms); obtained also at Stations 303 and 315, 1325 and 5 to 12 fathoms.

Crisia eburnea (Linné), var. *laxa*, nov. (28 to 105 fathoms); obtained at no other locality by the Challenger. Recorded from Arctic and North Atlantic.

Idmonea atlantica, Forbes. (30 fathoms); obtained also at Stations 49, 135, and the Cape.

Brachiopoda (Davidson, Zool. pt. 1).

Waldheimia kerguelenensis, n.sp. Numerous specimens (20 to 60 fathoms); obtained also at Stations 145 and 150.

Terebratella dorsata (Gmelin). Three specimens (20 to 30 fathoms); obtained at no other locality by the Challenger. Recorded from coast of Chili to Magellan Strait.

Tunicata (Herdman, Zool. pts. 17 and 38).

Eugyra kerguelenensis, n.sp. Three specimens (10 to 100 fathoms); obtained at no other locality.

Styela lactea, n.sp. Three specimens (10 to 100 fathoms); obtained at no other locality.

Ascidia challengeri, n.sp. Thirteen specimens (10 to 60 fathoms); obtained at no other locality.

,, *vasculosa*, n.sp. One test (28 fathoms); obtained at no other locality.

,, *translucida*, n.sp. Three specimens (28 fathoms); obtained at no other locality.

,, *despecta*, n.sp. One specimen (10 to 100 fathoms); obtained at no other locality.

Colella pedunculata (Quoy and Gaimard). Four specimens (10 to 60 fathoms); obtained also at Stations 151, 313, 314, and 315, 12 to 75 fathoms. Recorded from Australia and Magellan Strait.

Colella quoyi, n.g., n.sp. Three specimens (25 fathoms); obtained at no other locality. KERGUELEN.

„ *concreta*, n.g., n.sp. Several specimens (10 to 60 fathoms); obtained at no other locality.

——— (?) *pyriformis*, n.sp. Ten specimens without Ascidiozooids, therefore the genus is doubtful (attached to *Macrocystis pyrifera*); obtained at no other locality.

Tylobranchion speciosum, n.g., n.sp. Three specimens (10 to 100 fathoms); obtained at no other locality. Only species of the genus.

Morchellioides affinis, n.g., n.sp. Two specimens (10 to 60 fathoms); obtained at no other locality. Only species of the genus.

Morchellium giardi, n.sp. Four specimens (20 to 60 fathoms); obtained at no other locality.

Polyclinum pyriformis, n.sp. Two specimens (10 to 60 fathoms); obtained at no other locality.

„ *minutum*, n.sp. One specimen (20 to 60 fathoms); obtained at no other locality.

Aplidium fuscum, n.sp. One specimen (20 to 60 fathoms); obtained at no other locality.

„ *leucophæum*, n.sp. One specimen (10 to 60 fathoms); obtained at no other locality.

„ *fumigatum*, n.sp. Four specimens (10 to 100 fathoms); obtained also at Philippines.

Amaroucium variabile, n.sp. Numerous specimens (10 to 100 fathoms); obtained at no other locality.

„ „ var. *tenerum*, nov. Five specimens (10 to 60 fathoms); obtained at no other locality.

„ *globosum*, n.sp. Two specimens (10 to 60 fathoms); obtained at no other locality.

„ *complanatum*, n.sp. Five specimens (50 to 120 fathoms); obtained at no other locality.

„ *nigrum*, n.sp. One specimen (28 fathoms); obtained at no other locality.

Psammaplidium retiforme, n.g., n.sp. One specimen and fragments (50 to 120 fathoms); obtained at no other locality.

Leptoclinum subflavum, n.sp. One specimen (28 fathoms); obtained at no other locality.

„ *rubicundum*, n.sp. One specimen (20 to 60 fathoms); obtained at no other locality.

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Chorizocormus reticulatus, n.g., n.sp. Several specimens (28 to 30 fathoms); obtained at no other locality. Only species of the genus.

FISHES (Günther, Zool. pt. 6).

Raja eatoni, Günther. One specimen (depth not given); obtained at no other locality by the Challenger. Recorded from Kerguelen.

" *murrayi*, n.sp. Five specimens (depth not given); obtained at no other locality.

Zanclorhynchus spinifer, n.g., n.sp. One specimen (depth not given); obtained at no other locality. Only species of the genus.

Chaenichthys rhinoceratus, Richards. (Depth not given); obtained at no other locality by the Challenger.

Notothenia cyaneobrancha, Richards. (Depth not given); obtained at no other locality by the Challenger.

" *microps*, n.sp. Several specimens (120 fathoms); obtained at no other locality.

" *squamifrons*, n.sp. Several specimens (depth not given); obtained at no other locality.

" *acuta*, n.sp. One specimen (depth not given); obtained at no other locality.

Muraenolepis marmoratus, n.g., n.sp. One specimen (depth not given); obtained at no other locality. Only species of the genus.

In the foregoing list 343 species are enumerated, of which 224 are new to science, including representatives of 30 new genera; 162 of the new species and 15 of the new genera were not obtained elsewhere during the cruise.[1]

Willemoes-Suhm writes, with reference to these dredgings around Kerguelen:—"The prevailing animals in the shallow-water dredging on January 17 were Echinodermata, next to which Sponges and Polyzoa were represented by a considerable number of genera and species. There were also a large simple Ascidian and a small composite one; simple Ascidians were apparently far from numerous here, nor, indeed, were they abundant at any place where we have dredged in shallow water,—an interesting fact, if confirmed as we go on. Annelids were represented especially by numerous Aphroditaceans, belonging probably to the genera *Aphrodita* and *Hermione*, and a few Terebellids; there were also two Nemerteans, one a particularly large one with immense mouth. The almost total absence of higher Crustacea in the shallow-water fauna of these Antarctic islands is very astonishing. Near Marion Island a caridid shrimp was taken in great numbers, while

[1] Many of the Challenger discoveries were anticipated by the publication of the results of the subsequent "Transit of Venus" and "Gazelle" expeditions.

here at Kerguelen not a single Decapod was found. An Amphipod, the *Gammarus* which in water takes the place of flies on land, was very common. For Isopods this seemed to be a favourite territory, *Serolis* being probably the most numerous in specimens and species, though small Sphæromidæ were not uncommon, and several specimens of a spiny *Arcturus* were taken; most of these Isopods had eggs or young in their breeding pouches. A species of *Tanais* obtained to-day was very interesting on account of its method of reproduction; it had no breeding lamellæ, as in all Isopods hitherto known, but instead two sacs at the base of the fifth pair of legs, which contained the young ones, reminding one very much of the well-known sacs at the base of the last pair of feet in Copepods. They were in every way similar, but here rounded and not elongated, about $2\frac{1}{2}$ inches in diameter, and containing each about twenty embryos, which evidently remain there, as they do in the breeding pouches of other species, until they have attained their full development. Among the Molluscs there was a large white Nudibranch and a few Gasteropoda and Lamellibranchiata, all indicating great uniformity in the Molluscan fauna of the place. On January 20, the dredge brought up some specimens of *Siphonostomum*, a genus very common in the north and in the Mediterranean, which has a great resemblance to the northern species. These worms have, besides two long tentacles, a quantity of branchial filaments and papillæ surrounding the mouth; at the first segment there are also very strong and long setæ standing erect in front, and having a peculiar structure; in the skin are many glands that exude a slimy secretion, by which they are generally surrounded. On January 21, the dredge brought up large specimens of *Serolis*, and in the trawl were great quantities of a *Caprella*, the male of which is very much elongated, and has enormously long anterior claws; the female had eggs in its pouch. On January 29, the dredge brought up many Echinoderms, a singular round simple Ascidian, and among the worms *Clymenia* and *Terebella*, along with *Dentalium* and other Molluscs. The trawl procured in the afternoon a prodigious quantity of animals, including specimens of a large *Rossella*, a smaller siliceous Sponge, and a stalked one; small Planarians and Nemerteans; many Annelids, among which were large quantities of *Aphrodita* and *Siphonostomum*, and also a small *Sipunculus*; quantities of Polyzoa, also simple and composite Ascidians; among Crustacea, an Ostracode belonging to the Cypridinidæ, some of the big members of which seem to inhabit deeper water, many Pycnogonids, among which were a small *Nymphon*, a large red *Nymphon*, and *Pycnogonum* (several of these spiders were overgrown by an *Alcyonium*, which much enlarged their appearance), two female specimens of *Nebalia*, differing only slightly from the Mediterranean *Nebalia geoffroyi*, several male and female specimens of a Petalophthalmid, an inch long, apparently belonging to my genus *Crozetia* [= *Amblyops*, Sars], established on a much larger species from deep water (these specimens with their larvæ show that the animals undergo the *Mysis*-development, and that the genus is more nearly allied to the ordinary *Mysis* than to the deep-sea Petalophthalmids); among the

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Isopods were quantities of *Serolis*, old and young in all stages of development, a few specimens of the *Tanais* taken on the 17th, and males and ovigerous females of *Praniza* (*Anceus*), showing hardly any differences from the species studied by Dohrn at Plymouth and described by Spence Bate in his British Sessile-Eyed Crustacea; Amphipods were represented by several small species, and a large one distinguished by a bright-red process at the front of the carapace, containing, under a simple chitinous layer, pigment arranged in hexagons (I could discover no trace of bodies entitling them to be called eyes, of which they were very probably the rudiments); of Cumacea a little *Cuma* was very abundant, in the males of which the second antennæ seem to remain in the same state of development as in the female. Except the Schizopod already mentioned, not a single member of the higher stalk-eyed Crustacea was taken, and probably no others exist here in shallow water. Three specimens of a *Raia*, not mentioned in Günther's Catalogue of Fishes, were also obtained."

Organisms from the Deposit.

The following species of Foraminifera and Diatoms were observed in the deposits off Kerguelen in 20 to 120 fathoms (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.):—

Foraminifera (Brady, Zool. pt. 22).—The only pelagic species is *Globigerina bulloides*.

Nubecularia inflata, Brady.
Biloculina depressa, d'Orbigny.
,, *elongata*, d'Orbigny.
,, *ringens* (Lamarck).
,, *sphæra*, d'Orbigny.
Miliolina bucculenta, Brady.
,, *circularis* (Bornemann).
,, *oblonga* (Montagu).
,, *seminulum* (Linné).
Articulina funalis, Brady.
,, ,, var. *inornata*, Brady.
Ophthalmidium inconstans, Brady.
Cornuspira involvens, Reuss.
Technitella legumen, Norman.
Saccammina sphærica, Sars.
Hyperammina vagans, Brady.
Rhabdammina discreta, Brady.
Reophax ampullacea, Brady.
,, *dentaliniformis*, Brady.
,, *difflugiformis*, Brady.
,, *scorpiurus*, Montfort.
,, *spiculifera*, Brady.
Haplophragmium canariense (d'Orbigny).
,, *glomeratum*, Brady.
Ammodiscus charoides (Jones and Parker).
,, *gordialis* (Jones and Parker).
,, *schoneanus*, Siddall.
Cassidulina crassa, d'Orbigny.
,, *subglobosa*, Brady.
Lagena acuta (Reuss).
,, *distoma*, Parker and Jones.
,, *gracillima* (Seguenza).
,, *interrupta*, Williamson.
,, *lævigata* (Reuss).
,, *lævis* (Montagu).
,, *lineata* (Williamson).
,, *marginata* (Walker and Boys).
,, *quadricostulata*, Reuss.
,, *semistriata*, Williamson.
,, *squamosa* (Montagu).
,, *staphyllearia* (Schwager).
,, *stelligera*, Brady.
,, *striata* (d'Orbigny).
,, *sulcata* (Walker and Jacob).
Nodosaria calomorpha, Reuss.
,, *communis*, d'Orbigny.
Vaginulina legumen (Linné).
Cristellaria cultrata (Montfort).

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Uvigerina angulosa, Williamson.
,, *asperula*, Czjzek.
,, *brunnensis*, Karrer.
Sagrina raphanus, Parker and Jones.
× *Globigerina bulloides*, d'Orbigny.
Pullenia quinqueloba, Reuss.
Spirillina obconica, Brady.
,, *tuberculata*, Brady.
Spirillina vivipara, Ehrenberg.
Patellina corrugata, Williamson.
Discorbina araucana (d'Orbigny).
,, *parisiensis* (d'Orbigny).
Truncatulina lobatula (Walker and Jacob).
Polystomella crispa (Linné).
,, *macella* (Fichtel and Moll).
,, *striatopunctata* (Fichtel and Moll).

DIATOMACEÆ.—The following species of Diatoms were observed by Mr. Comber in the deposit from Royal Sound:—

Amphora proteus, Gregory.
,, *cuneata*, Cleve (= *A. decora*, Castracane).
Navicula jejuna, A. Schmidt.
,, *distans*, Ralfs.
,, *multicostata*, Grunow.
,, *aspera*, Ehrenberg, var. *rhombica*, Cleve.
Pleurosigma delicatulum, Smith.
Cocconeis costata, Gregory.
,, ,, var. *kerguelensis*, Petit.
,, *scutellum*, Ehrenberg, var. *ampliata*, Grunow.
,, ,, var. *fulgur*, Cleve.
,, *dirupta*, var. *minutissima*, Grunow.
Nitzschia constricta, Ralfs, var. *similis*, Grunow.
,, *distans*, Gregory.
Grammatophora marina, Kutzing.
,, *angulosa*, var. *islandica*, Ehrenberg.
Rhabdonema minutum, Kutzing.
,, *adriaticum*, Kutzing.
Gephyria incurvata, Arnott.
,, *gigantea*, Greville.
Trachysphenia australis, Grunow.
Isthmia enervis, Ehrenberg.
Biddulphia roperiana, Greville.
Hemiaulus antarcticus, Ehrenberg.
Triceratium arcticum, Brightwell, var. *kerguelensis*, Grunow.
Coscinodiscus excentricus, Ehrenberg, var. *sublineatus*, Grunow.
Coscinodiscus curvatulus, Grunow, var. *genuina*, Grunow.
,, ,, var. *subocellata*, Grunow.
,, *lentiginosus*, Janisch.
,, *atlanticus*, Castracane.
,, *radiatus*, Ehrenberg.
,, *centralis*, Ehrenberg.
,, *convexus*, A. Schmidt.
,, *perforatus*, Ehrenberg, var. *cellulosa*, Grunow.
,, *radiosus*, Grunow, var. *kerguelensis*, Grunow.
,, *antarcticus*, Grunow.
,, *africanus*, Janisch, var. *wallichiana*, Grunow.
,, *concinnus*, Smith, var. *kerguelensis*, Castracane.
Hyalodiscus radiatus, Petit.
Podosira maxima, Kutzing.
,, *hormoides*, Kutzing.
,, *montagei*, Kutzing. n
Melosira borreri, Greville.
Paralia sulcata, Cleve.
Stephanopyxis turris, Ralfs, var. *inermis*, Grunow.
Actinocyclus oliverianus, O'Meara.
Actinoptychus campanulifer, A. Schmidt.
Asteromphalus hookerii, Ehrenberg.
Rhizosolenia hastata, Grunow.

Royal Sound being landlocked, it is not surprising that the following fresh-water species should be found in this sounding:—

Navicula rhomboides, Ehrenberg.
,, *firma*, Kutzing, var. *tumescens*, Grunow.
,, *serians*, Brebisson.
,, *viridis*, Ehrenberg.
Stauroneis phenicenteron, Ehrenberg.
Epithemia sp. (?).
Tabellaria fenestrata, Kutzing.
Melosira arenaria, Moore.

Kerguelen Organisms from Surface Nets.

Surface Organisms.—The following species are recorded from the surface :—

Radiolaria (Haeckel, Zool. pt. 40).
Lychnaspis cataplasta, Haeckel.

Copepoda (Brady, Zool. pt. 23).
Drepanopus pectinatus, n.g., n.sp.
Pseudothalestris imbricata, n.g., n.sp.
Zaus spinatus, Goodsir.
Machairopus idyoides, n.g., n.sp.

Amphipoda (Stebbing, Zool. pt. 67).
Halimedon schneideri, n.sp.
Zaramilla kergueleni, n.g., n.sp.
Atyloides australis (Miers).
Euthemisto gaudichaudii (Guérin).

Schizopoda (Sars, Zool. pt. 37).
Thysanoëssa macrura, n.sp.

Lamellibranchiata (Smith, Zool. pt. 35).
Modiolarca trapezina (Lamarck).

Pteropoda (Pelseneer, Zool. pt. 65).
Limacina australis (Eydoux and Souleyet).

In addition, the following are recorded in the note-books :—Hydromedusæ (*Oceania*), small Planarians, small Tomopterids, *Peltidium*, Calanids and other Copepods, *Gammarus* and another Amphipod, small Isopod, Zoëæ (probably of the Brachyurous crab inhabiting the pools) very small and having just left the eggs. On the floating masses of *Macrocystis* were found Foraminifera, Hydroids, Holothurians, small bivalve shells, *Patella*, and Polyzoa. Occasionally the tow-net was completely filled with various species of Diatoms, at other times with Amphipods (*Hyperia*) and numerous Copepods ; Pteropods (*Limacina*) were also at times very abundant.

Station 150.

Station 150 (Sounding 254), between Kerguelen and Heard Islands (see Charts 18 and 22).

February 2, 1874 ; lat. 52° 4′ S., long. 71° 22′ E.
Temperature of air at noon, 41°·5, mean for the day, 41°·6.
Temperature of water :—

Surface,	37°·5	100 fathoms,	35°·2
50 fathoms,	36·3	Bottom,	35·2

Density at 60° F. at surface, 1·02515.
Depth, 150 fathoms ; deposit, Coarse Gravel, containing about 20 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 9.20 A.M. shortened and furled sails, and got up steam to sound and dredge. Sounded in 150 fathoms, and obtained serial temperatures. Put dredge over. At noon hove up dredge, which contained numerous specimens. At 1.15 P.M. made sail. At 3 P.M. a dense fog came on. At 4.45 P.M. sounded in 220 fathoms, no bottom; at 5.40 P.M. in 425 fathoms, no bottom; at 10 P.M. in 175 fathoms, no bottom; and at midnight in 92 fathoms. STATION 150.

Distance at noon from Heard Island, about 93 miles. Made good 140 miles. Amount of current 13 miles, direction S. 81° E.

The following species are recorded in the Zoological Reports from the dredge at this Station:— ANIMALS FROM DREDGE.

MONAXONIDA (Ridley and Dendy, Zool. pt. 59).

Petrosia similis, n.sp. Small piece; obtained also at Station 142.
Myxilla fusca, n.sp. Two specimens; obtained at no other locality.
Suberites microstomus, n.sp. One specimen; obtained at no other locality.

TETRACTINELLIDA (Sollas, Zool. pt. 63).

Tetilla coronida, n.sp. One specimen; obtained at no other locality.
„ *grandis*, n.sp., var. *alba*, nov. Obtained also at Station 149.
Pœcillastra schulzii, n.sp. Two specimens and fragments; obtained at no other locality.

HEXACTINELLIDA (Schulze, Zool. pt. 53).

Rossella antarctica, Carter. Many specimens; obtained also at Stations 145, 149, and 320.

CALCAREA (Poléjaeff, Zool. pt. 24).

Leuconia fruticosa (Haeckel). One specimen; obtained also at Station 149.

ALCYONARIA (Wright and Studer, Zool. pt. 64).

Thouarella variabilis, n.sp., var. *gracilis*, nov. Obtained also at Station 145.

ACTINIARIA (Hertwig, Zool. pt. 15).

Scytophorus striatus, n.g., n.sp. Two specimens; obtained at no other locality. Only species of the genus.

HYDROIDA (Allman, Zool. pt. 70).

Campanularia tulipifera, n.sp. Obtained at no other locality.

CRINOIDEA (Carpenter, Zool. pt. 60).

Antedon australis, n.sp. Eight specimens; obtained at no other locality.

STATION 150.

ASTEROIDEA (Sladen, Zool. pt. 51).

Gnathaster meridionalis (Smith). Obtained also at Stations 145, 149, and 151.

" *elongatus*, n.g., n.sp. Obtained also at Stations 145, 149, and 151.

Porania spiculata, n.sp. Obtained also at Stations 151 and 191, 75 and 80 fathoms.

Solaster subarcuatus, n.sp. Obtained at no other locality.

Pteraster rugatus, n.sp. Obtained at no other locality.

Asterias (*Smilasterias*) *triremis*, n.sp. Obtained at no other locality.

Labidiaster annulatus, n.sp. Obtained also at Stations 149, 151, and 191.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophioglypha deshayesi, n.sp. Obtained also at Stations 149 and 151.

Ophioconis antarctica, n.sp. Obtained also at Station 145.

Amphiura angularis, n.sp. Obtained at no other locality.

Ophiacantha vivipara, Ljungman. For distribution see Station 145.

" *imago*, n.sp. Obtained also at Stations 149 and 151.

Gorgonocephalus pourtalesii, Lyman. For distribution see Station 149.

Astrotoma agassizii, Lyman. For distribution see Station 148.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Goniocidaris canaliculata, Agassiz. For distribution see Station 147.

Echinus margaritaceus, Lamarck. Obtained also at Stations 149, 151, 308, and 311.

HOLOTHURIOIDEA (Théel, Zool. pt. 39).

Cucumaria serrata, n.sp. Several specimens; obtained also at Stations 145, 148, and 151.

" " var. *intermedia*, nov. Several specimens; obtained also at Station 151, 75 fathoms.

Psolus incertus, n.sp. One specimen; obtained also at Stations 149 and 151.

" *ephippifer*, Wyville Thomson, n.sp. Two specimens; obtained also at Stations 145, 149, and 151.

ANNELIDA (M'Intosh, Zool. pt. 34).

Eulagisca corrientis, n.g., n.sp. One fragmentary specimen; obtained also at Station 320, 600 fathoms. Only species of the genus.

Neottis antarctica, M'Intosh. Several specimens; obtained also at Stations 145, 149, 151, and 313.

OSTRACODA (Brady, Zool. pt. 3).

Cythere wyville-thomsoni, n.sp. Obtained also at Stations 149, 151, and 185.

Cythere dictyon, n.sp. Widely distributed (see Station 24). STATION 150.

„ *normani*, Brady. A few detached valves; obtained also at Station 296 (?), 1825 fathoms.

Xestoleberis depressa, Sars. Obtained also at Station 149 (?).

CIRRIPEDIA (Hoek, Zool. pt. 25).

Scalpellum recurvirostrum, n.sp. Numerous specimens; obtained at no other locality.

Balanus corolliformis, n.sp. Six specimens; obtained at no other locality.

AMPHIPODA (Stebbing, Zool. pt. 67).

Tryphosa antennipotens, n.sp. One specimen; obtained at no other locality.

Œdiceroides rostrata, n.g., n.sp. One specimen; obtained also at Station 149.

Acanthechinus tricarinatus, n.g., n.sp. One specimen; obtained at no other locality. Only species of the genus.

Iphimedia pacifica, n.sp. One specimen; obtained also at Station 149.

Eusirus longipes, Boeck. One specimen; obtained also at Station 149.

LAMELLIBRANCHIATA (Smith, Zool. pt. 35).

Saxicava arctica, Linné. For distribution see Station 75.

Cardita astartoides, Martens. Obtained also at Station 149.

Limopsis straminea, n.sp. Obtained at no other locality.

Mytilus meridionalis, n.sp. Obtained also at Station 145.

GASTEROPODA (Watson, Zool. pt. 42).

Trophon declinans, n.sp. Obtained also at Station 145.

„ *scolopax*, n.sp. Obtained at no other locality.

„ sp. (?).

Fusus (*Sipho*) *futile*, n.sp. Obtained at no other locality.

Provocator pulcher, n.g., n.sp. Obtained also at Station 149. Only species of the genus.

Pleurotoma (*Surcula*) *trilix*, n.sp. Three specimens; obtained at no other locality.

Natica xantha, n.sp. Obtained at no other locality.

„ *fartilis*, n.sp. Obtained also at Stations 145 and 149.

POLYZOA (Busk, Zool. pt. 30; Waters, pt. 79).

Bicellaria pectogemma, Goldstein. Obtained also at Stations 145 and 151.

Membranipora galeata, Busk, var. *furcata*, nov. Obtained also at Station 145. [Waters calls it *Membranipora cervicornis*, Busk].

Onchopora sinclairii, Busk. Obtained also at Stations 149, 151, and 157. [Waters calls it *Calwellia sinclairii* (Busk)].

Cellepora bicornis, n.sp. Obtained also at Stations 145, 151, 313, and 314.

Station 150.

Brachiopoda (Davidson, Zool. pt. 1).

Terebratula uva, Broderip. Two fragments; obtained also at Stations 163 and 320, 150 and 600 fathoms. Recorded from Guatemala and Falkland Islands.

Waldheimia kerguelenensis, n.sp. Numerous specimens; obtained also at Stations 145 and 149.

Rhynchonella nigricans (Sowerby), var. *pixydata*, Watson, nov. Six specimens; obtained at no other locality. The species recorded from New Zealand. Fossil—Tertiary of Tasmania.

Tunicata (Herdman, Zool. pt. 17).

Ascopera gigantea, n.g., n.sp. One specimen; obtained at no other locality.

,, *pedunculata*, n.g., n.sp. One specimen; obtained at no other locality. These are the only two species of the genus.

Molgula pedunculata, n.sp. One specimen; obtained at no other locality.

Styela grandis, n.sp. Two specimens; obtained at no other locality.

,, *convexa*, n.sp. One specimen; obtained at no other locality.

Polycarpa minuta, n.sp. One specimen; obtained at no other locality.

Ascidia plaçenta, n.sp. Two specimens; obtained at no other locality.

The Station-book records also:—*Primnoa* and another Alcyonarian (only one reported) *Arcturus*, and several small fishes.

Excluding Protozoa, about 200 specimens of invertebrates and fishes were obtained at this Station, belonging to about 74 species, of which 53 are new to science, including representatives of 7 new genera; 28 of the new species and 3 new genera were not obtained elsewhere.

Willemoes-Suhm remarks that the animals procured were very interesting from a zoo-geographical point of view, including many northern genera and perhaps species, but presented no peculiarities in their morphology.

Observations from the Deposit.

Foraminifera (Brady, Zool. pt. 22).—The following species of Foraminifera were observed in the deposit from this Station (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.); the two pelagic species, which make up about 15 per cent. of the carbonate of lime present in the deposit, are marked thus × :—

Biloculina depressa, d'Orbigny.
,, *sphaera*, d'Orbigny.
Cassidulina crassa, d'Orbigny.
,, *subglobosa*, Brady.
Lagena formosa, Schwager, var. *favosa*, Brady.
,, *laevigata*, Reuss.
,, *laevis* (Montagu).
,, *lineata* (Williamson).
Lagena squamosa (Montagu).
,, *sulcata* (Walker and Jacob).
Uvigerina angulosa, Williamson.
,, *asperula*, Czjzek.
× *Globigerina bulloides*, d'Orbigny.
× ,, *dutertrei*, d'Orbigny.
Pullenia quinqueloba, Reuss.
Truncatulina lobatula (Walker and Jacob).

Surface Organisms.—The following species are recorded from the surface in the vicinity of this Station :— STATION 150. ORGANISMS FROM SURFACE-NETS.

ANNELIDA (M'Intosh, Zool. pt. 34).

Tomopteris carpenteri, Quatrefages (?).

AMPHIPODA (Stebbing, Zool. pt. 67).

Vibilia antarctica, n.sp.
Euthemisto thomsonii, Stebbing.

PTEROPODA (Pelseneer, Zool. pt. 65).

Limacina australis (Eydoux and Souleyet).
Clio sulcata (Pfeffer).

TUNICATA (Herdman, Zool. pt. 76).

Salpa cylindrica, Cuvier.

In addition, the following are recorded in the note-books :—Ctenophoræ, *Sagitta* young Aphroditaceans, Copepods, *Hyperia*, and *Euphausia*. At times the surface net was full of living Diatoms, in masses forming a yellowish slime, among which could be distinguished small *Globigerinæ* and Radiolarians. When dragged at a depth of 100 fathoms, the tow-nets produced similar results.

The ship anchored in Corinthian Bay, Heard Island, at 3.40 P.M. on February 6, and one boat's party landed, but the weather became unfavourable, and anchor was weighed at 4.30 A.M. on February 7, as it was considered unadvisable to remain longer at anchor in such an exposed position (for description of Heard Island, see *Narr. Chall. Exp.*, vol. i. pp. 369–378). AT HEARD ISLAND.

Station 151 (Sounding 255), off Heard Island (see Chart 22). STATION 151.

February 7, 1874 ; lat. 52° 59′ 30″ S., long. 73° 33′ 30″ E.
Temperature of air at noon, 37°·8 ; mean for the day, 36°·6.
Temperature of water at surface, 36°·2.
Density at 60° F. at surface 1·02515.
Depth, 75 fathoms ; deposit, Volcanic Sand, containing 2·58 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 4 A.M. got up steam, and at 4.30 A.M. weighed anchor and proceeded out of Corinthian Bay, Heard Island. Shaped course E. by N. for Shag Rock. At 7 A.M. stopped and sounded in 75 fathoms near Shag Rock. At 7.30 A.M. put over dredge, which came up at 8.45 A.M. containing many specimens. In these cold regions the bottom of the sea seemed to be teeming with animal life. Proceeded N.W. by W., and at 9.50 A.M. sounded in 60 fathoms. At 10.30 A.M. sounded in 75 fathoms. At 11.45 A.M. stopped engines, made all plain sail, and proceeded, shaping course towards the South Pole in the track

Station 151

of Captain Cook, who was here in February 1773. At noon, sounded in 50 fathoms, no bottom; distance from Red Island, 4½ miles. The wind rose to a gale in the afternoon, and the consequent heavy seas and a rolling ship seriously interfered with work. Snow fell between 4 and 6 A.M. Several Cape pigeons, puffins, a large black petrel, penguins, prions, and stinkers were seen from the ship.

Animals from Dredge.

The following species are recorded in the Zoological Reports from the dredge at this Station :—

ALCYONARIA (Wright and Studer, Zool. pt. 64).

Alcyonium antarcticum, n.sp. Obtained at no other locality.

HYDROIDA (Allman, Zool. pts. 20 and 70).

Schizotricha multifurcata, n.g., n.sp. Obtained at no other locality. The only other species of the genus (*Schizotricha unifurcata*) was obtained at Station 149.

Eudendrium vestitum, n.sp. One specimen; obtained at no other locality.

Sertularia exserta, n.sp. Several specimens; obtained at no other locality.

CRINOIDEA (Carpenter, Zool. pt. 60).

Antedon antarctica, n.sp. Several specimens; obtained at no other locality.

Promachocrinus kerguelensis, n.g., n.sp. One specimen; obtained also at Station 149.

ASTEROIDEA (Sladen, Zool. pt. 51).

Bathybiaster loripes, n.sp., var. *obesa*, nov. Two specimens; obtained also at Stations 149 and 311.

Gnathaster meridionalis (Smith). Obtained also at Stations 145, 149, and 150.

,, *elongatus*, n.g., n.sp. Obtained also at Stations 145, 149, and 150.

Porania spiculata, n.sp. Obtained also at Stations 150 and 191.

Perknaster fuscus, n.g., n.sp. One specimen; obtained also at Station 149. The only other species of the genus (*Perknaster densus*) was also obtained at Station 149.

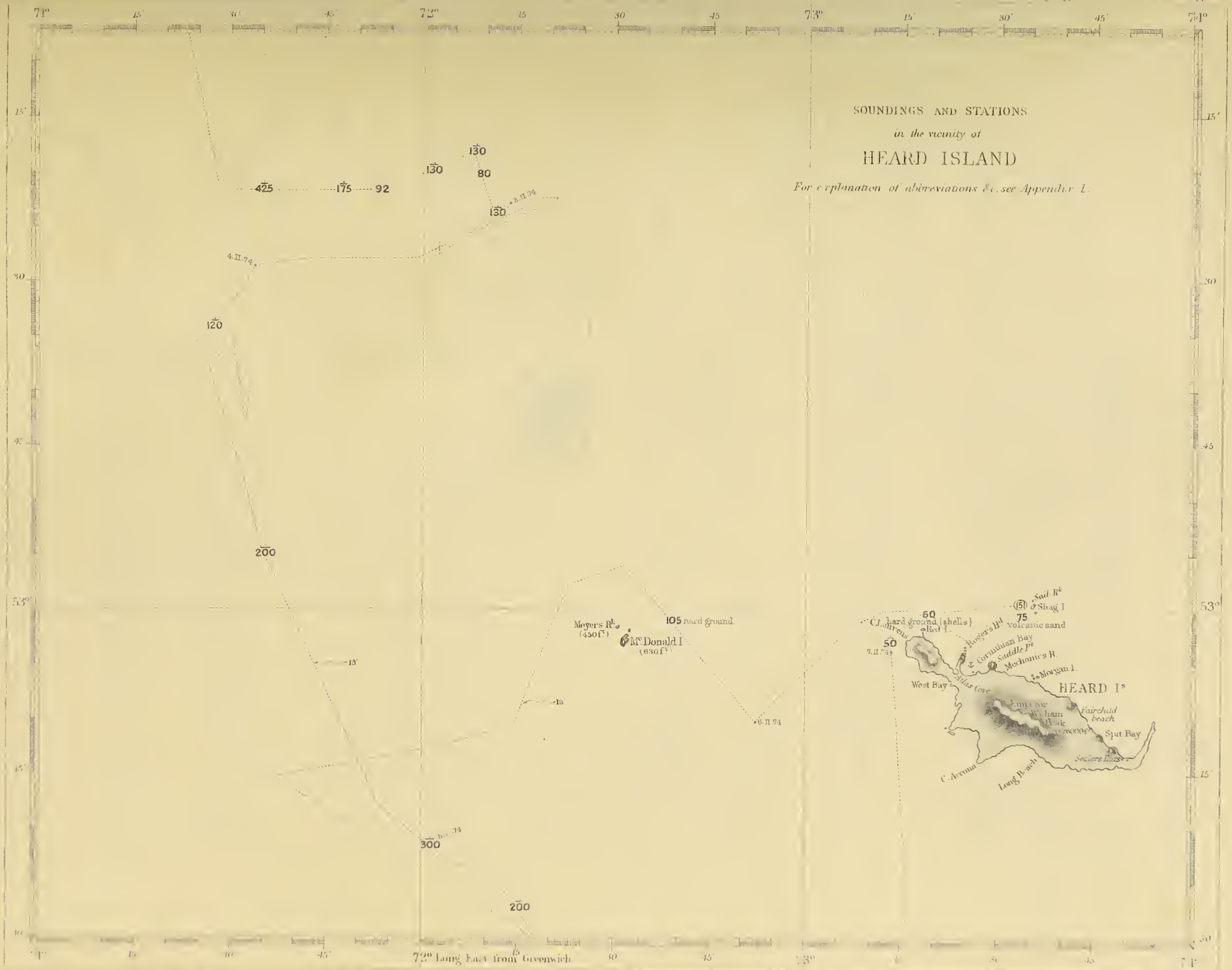
Asterias (*Smilasterias*) *scalprifera*, n.sp. Obtained also at Station 145.

Labidiaster annulatus, n.sp. Obtained also at Stations 149, 150, and 191.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophioglypha deshayesi, n.sp. Obtained also at Stations 149 and 150.

Amphiura studeri, Lyman. Obtained also at Stations 145 and 149.


SOUNDINGS AND STATIONS
in the vicinity of
HEARD ISLAND
For explanation of abbreviations &c. see Appendix I.
HEARD Is
Mc Donald I
(630 ft)
Meyers Rk
(450 ft)
105 hard ground
hard ground (shells)
volcanic sand
West Bay
Long Beach
Spit Bay
Fairchild beach
Rogers Hd
Corinthian Bay
Saddle Pt
Mechanics R.
Morgan I.
Shag I
Sail Rk
C. Arcona
72° Long East from Greenwich
Engraved by Malby & Sons

Ophiacantha vivipara, Ljungman. Obtained also at Stations 145, 149, 313, 314, and 320. STATION 151.

,, *imago*, n.sp. Obtained also at Stations 149 and 150.

Gorgonocephalus pourtalesii, Lyman. Obtained also at Stations 149, 150, 307, 308, and 313.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Goniocidaris canaliculata, Agassiz. For distribution see Station 147.

Echinus margaritaceus, Lamarck. Obtained also at Stations 149, 150, 308, and 311.

Hemiaster cavernosus (Phil.). Obtained also at Stations 149 and 310.

HOLOTHURIOIDEA (Théel, Zool. pt. 39).

Cucumaria lævigata, Verrill. One specimen; obtained also at Station 149.

,, *serrata*, n.sp., var. *intermedia*, nov. Several specimens; obtained also at Stations 145, 148, and 150.

Psolus incertus, n.sp. One specimen; obtained also at Stations 149 and 150.

,, *ephippifer*, Wyville Thomson, n.sp. Forty specimens; obtained also at Stations 145, 149, and 150.

NEMERTEA (Hubrecht, Zool. pt. 54).

Cerebratulus corrugatus (M'Intosh). Several specimens; obtained also at Station 149.

ANNELIDA (M'Intosh, Zool. pt. 34).

Lætmonice producta, Grube. Two specimens; obtained also at Station 149.

Nephthys trissophyllus, Grube. Two specimens; obtained also at Station 149.

Phyllocomus crocea, Grube. One fragmentary specimen; obtained at no other locality by the Challenger. Recorded from Antarctic.

Neottis antarctica, M'Intosh. Two fragmentary specimens; obtained also at Stations 145, 149, 150, and 313.

Serpula narconensis, Baird. Several specimens; obtained also at Stations 145, 149, and 308.

OSTRACODA (Brady, Zool. pt. 3).

Bairdia simplex, n.sp. One or two specimens; obtained at no other locality.

Cythere kerguelenensis, n.sp. Obtained also at Stations 145, 149, 162, and Port Jackson.

,, *foveolata*, n.sp. Obtained also at Station 149.

,, *wyville-thomsoni*, n.sp. Obtained also at Stations 149, 150, and 185.

Xestoleberis setigera, n.sp. Obtained also at Stations 145 and 149.

Cytheropteron assimile, n.sp. Obtained also at Station 149.

Station 151. *Cytherideis lævata*, n.sp. Obtained at no other locality.

Sclerochilus contortus (Norman). Obtained also at Station 149 and Wellington Harbour, N.Z.

Amphipoda (Stebbing, Zool. pt. 67).

Iphimedia pulchridentata, n.sp. One specimen; obtained at no other locality.

Eusiroides pompeii, n.g., n.sp. One specimen; obtained at no other locality.

Liljeborgia consanguinea, n.sp. One specimen; obtained also at Station 149.

Isopoda (Beddard, Zool. pt. 48).

Arcturus furcatus, Studer. Several specimens; obtained also at Stations 149 and 153.

One specimen, genus and species undetermined.

Gasteropoda (Watson, Zool. pt. 42).

Patella kerguelensis, Smith. (Heard Island, shore); obtained also at Station 149.

Trochus (*Margarita*) *charopus*, n.sp., var. *cæruleus*, nov. Obtained also at Station 149.

Trophon geversianus (Pallas). One specimen; obtained also at Station 315, 12 fathoms. Recorded from Magellan Strait and Falkland Islands.

Neobuccinum eatoni, Smith. Obtained also at Station 149.

,, *vestitum* (Martens). Obtained also at Station 149.

Cancellaria (*Admete*) *specularis*, n.sp. Obtained also at Station 149.

Pleurotoma (*Typhlomangelia*) *fluctuosa*, n.sp. Obtained also at Station 149 (var. *cariosa*).

Struthiolaria mirabilis, Smith. Obtained also at Station 149.

Natica (*Lunatia*) *grönlandica*, Beck. One specimen; obtained at no other locality by the Challenger. Recorded from Arctic and North Atlantic. Fossil—English Crag, and glacial clays of Europe, Iceland, and North America.

Cephalopoda (Hoyle, Zool. pt. 44).

Octopus levis, n.sp. Four specimens; obtained at no other locality.

Polyzoa (Busk, Zool. pts. 30 and 50; Waters, pt. 79).

Hippothoa flagellum, Manzoni. Obtained at no other locality by the Challenger. A widely-distributed species. Fossil—Pliocene.

Catenaria attenuata, n.sp. Obtained at no other locality.

Cellularia quadrata, n.sp. Obtained also at Station 149.

Nellia oculata, Busk. Obtained also at Stations 148, 188, 190, 208, and Bahia. STATION 151.

Bicellaria pectogemma, Goldstein. Obtained also at Stations 145 and 150.

Bugula longissima, n.sp. Obtained also at Station 149.

Diachoris magellanica, Busk, var. *distans*, nov. Small fragment; the species obtained also at Station 315 and Port Jackson, 2 to 12 fathoms. Recorded from New Zealand, Australia, Kerguelen, Magellan Strait, and Mediterranean.

Membranipora crassimarginata (Hincks), var. *erecta*, nov. Obtained also at Stations 135 (var. *incrustans*) and 162.

Vincularia gothica, d'Orbigny, var. *granulata*, nov. Numerous specimens; the species obtained also at Station 145.

Salicornaria clavata, n.sp. Obtained also at Stations 145, 149, 162, 163, and 304. [Waters calls it *Cellaria australis*, MacGillivray].

Onchopora sinclairii, Busk. Obtained also at Stations 149, 150, and 157. [Waters calls it *Calwellia sinclairii* (Busk)].

Reteporella flabellata, n.g., n.sp. One specimen; obtained at no other locality. The only other species of the genus (*Reteporella myriozoides*) was obtained at Station 148.

Cribrilina philomela, n.sp., var. *adnata*, nov. Obtained also at Station 145.

Escharoides verruculata (Smitt). Obtained at no other locality by the Challenger. Recorded from Gulf of Mexico.

Schizoporella triangula, Hincks (?). Obtained also at Station 162, 38 fathoms. Recorded from Bass Strait.

Myriozoum marionense, n.sp. Obtained also at Stations 145 and 148.

Cellepora albirostris (Smitt). Obtained at no other locality by the Challenger.

" *bicornis*, n.sp. Obtained also at Stations 145, 150, 313, and 314.

Idmonea marionensis, Busk. Obtained also at Stations 145, 147, and 320.

" *milneana*, d'Orbigny. Obtained also at Stations 75 and 145.

Hornera violacea, Sars. Obtained at no other locality by the Challenger. Recorded from Arctic and North Atlantic.

Pustulopora proboscidea, M.-Edwards. Obtained also at Station 145.

" *deflexa* (Smitt). Obtained at no other locality by the Challenger. Recorded from European seas and Gulf of Florida.

Supercytis tubigera, n.sp. (?). One specimen; obtained at no other locality.

TUNICATA (Herdman, Zool. pt. 38).

Colella pedunculata (Quoy and Gaimard). One specimen; obtained also at Stations 149, 313, 314, and 315.

STATION 151.

In addition to the foregoing, the Station-book records also several Sponges.

Excluding Protozoa, over 200 specimens of invertebrates were obtained at this Station, belonging to about 79 species, of which 43 are new to science, including representatives of 6 new genera ; 13 of the new species were not obtained elsewhere.

Willemoes-Suhm writes : " Most of the animals taken by the dredge belong to the Kerguelen fauna, as was to be expected. It may be noted that *Serolis*, which has been recently taken in nearly every haul, was not present. There were a spiny Amphipod, *Sphæroma*, *Arcturus*, large specimen of *Phyllodoce*, fine specimens of *Serpula* in jointed tubes, *Terebella*, *Hermione*, and several species of Polyzoa."

ORGANISMS FROM THE DEPOSIT.

The following species of Foraminifera and Diatoms were observed in the deposit from this Station (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.) :—

FORAMINIFERA (Brady, Zool. pt. 22).—The only pelagic species is *Globigerina bulloides*.

Biloculina elongata, d'Orbigny.
,, *sphæra*, d'Orbigny.
Miliolina seminulum (Linné).
,, *subrotunda* (Montagu).
Articulina funalis, Brady.
Reophax scorpiurus, Montfort.
Haplophragmium canariense (d'Orbigny).
Bulimina aculeata, d'Orbigny.
Virgulina schreibersiana, Czjzek.
Bolivina punctata, d'Orbigny.
Cassidulina crassa, d'Orbigny.
Lagena acuta (Reuss).
,, *acuticosta*, Reuss.
,, *apiculata*, Reuss.
,, *clavata* (d'Orbigny).
,, *gracillima* (Seguenza).
,, *interrupta*, Williamson.
Lagena lævigata (Reuss).
,, *lævis* (Montagu).
,, *marginata* (Walker and Boys).
,, ,, var. *semimarginata*, Reuss.
,, *squamosa* (Montagu).
,, *staphyllearia* (Schwager).
,, *striata* (d'Orbigny).
,, *sulcata* (Walker and Jacob).
Uvigerina tenuistriata, Reuss.
× *Globigerina bulloides*, d'Orbigny.
Pullenia quinqueloba, Reuss.
Patellina corrugata, Williamson.
Discorbina parisiensis (d'Orbigny).
,, *rosacea* (d'Orbigny).
,, *vilardeboana* (d'Orbigny).
Truncatulina lobatula (Walker and Jacob).

DIATOMACEÆ.—The following species of Diatoms were observed by Mr. Comber :—

Navicula didyma, Ralfs.
Pleurosigma rigidum, Smith.
Cocconeis costata, Gregory, var. *kerguelensis*, Petit.
,, *arctica*, Grunow.
Nitzschia constricta, Gregory, var. *similis*, Grunow.
,, *marina*, Grunow.
Grammatophora marina, Kutzing.
Trachysphenia australis, Petit.
Thalassiothrix longissima, Grunow, var. *antarctica*, Cleve and Grunow.
Gephyria gigantea, Greville.
Isthmia enervis, Ehrenberg.
Biddulphia roperiana, Greville.
,, *weissflogii*, Grunow.
Hemiaulus antarcticus, Ehrenberg.

Triceratium arcticum, Brightwell, var. *kerguelensis*, Grunow.
Coscinodiscus lentiginosus, Janisch.
,, *atlanticus*, Castracane.
,, *africanus*, Janisch, var. *wallichiana*, Grunow.
,, *curvatulus*, Grunow.
,, ,, var. *subocellata*, Grunow.
,, *centralis*, Ehrenberg.
Coscinodiscus convexus, A. Schmidt.
,, *concinnus*, Smith.
Hyalodiscus radiatus, Petit.
Podosira hormoides, Kutzing.
Paralia sulcata, Cleve.
Actinocyclus oliverianus, O'Meara.
Asteromphalus hookerii, Ehrenberg.
Chætoceros dicladia, Castracane, and its sporangial form, *Dicladia capreolus*, Ehrenberg.

STATION 151.

Surface Organisms.—The following species are recorded from the surface in this locality:—

ORGANISMS FROM SURFACE-NETS.

SCHIZOPODA (Sars, Zool. pt. 37).
Thysanoëssa macrura, n.sp.

TUNICATA (Herdman, Zool. pt. 76).
Salpa cylindrica, Cuvier.
,, *runcinata-fusiformis*, Chamisso-Cuvier.

Station 152 (Sounding 256), near Antarctic Ice (see Chart 23 and Diagram 9).

STATION 152.

February 11, 1874; lat. 60° 52′ S., long. 80° 20′ E.
Temperature of air at noon, 36°·3; mean for the day, 34°·7.
Temperature [1] of water:—

	°		°
Surface,	34·5	80 fathoms,	32·5
10 fathoms,	34·0	90 ,,	32·8
20 ,,	33·5	100 ,,	32·0 32·0 32·0
25 ,,	31·2	150 ,,	31·8
30 ,,	30·0	200 ,,	35·2 35·0 35·8
40 ,,	30·2	300 ,,	35·5
50 ,,	30·5 32·0		
60 ,,	32·2		
70 ,,	32·2		

Density at 60° F. at surface, 1·02512; bottom, 1·02561.
Depth, 1260 fathoms; deposit, Diatom Ooze, containing 22·47 per cent. of carbonate of lime, and pebbles of granite and sandstone (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 2.50 A.M. observed a large iceberg bearing E.S.E., distant about 6 miles;

[1] At this and other Stations in the south the temperatures given are the actual readings of the thermometers, whereas in other cases the temperatures are taken from the curves (see Report on Deep-Sea Temperature Observations, *Phys. Chem. Chall. Exp.*, part iii.).

STATION 152. it was 219 feet high and 734 yards long according to angular measurements taken at 4 and 5.30 A.M. At 5 A.M. got up steam, and at 6 A.M. shortened and furled sails. At 6.30 A.M. proceeded under steam, and sounded in 1260 fathoms. At 9 A.M. put trawl over. Lowered cutter to try current. At noon observed another large iceberg bearing S.E. by S. At 1 P.M. commenced heaving in trawl, which came up twisted at 2.30 P.M., but containing a few animals. Obtained a series of temperatures down to 300 fathoms, and samples of water for analysis. The carbonic acid was determined in bottom water, and amounted to 67·9 milligrammes per litre. At 3.30 P.M. made all plain sail, and shaped course S.W. At 4 P.M. three icebergs in sight. At 6 P.M. one iceberg in sight. At 7.10 P.M. observed a piece of drift ice. At 8 P.M. no icebergs in sight, one piece of drift ice ahead. At 9 P.M. passed piece of drift ice. The usual birds accompanied the ship: *Diomedea exulans*, *Procellaria capensis* and *æquinoctialis*, and prion.

Distance at noon from Termination Land, 458 miles; from the South Pole, 1748 miles. Made good 103 miles. Amount of current 22 miles, direction N. 62° E.

ANIMALS FROM TRAWL. The following species are recorded in the Zoological Reports from the trawl at this Station:—

DEEP-SEA MEDUSÆ (Haeckel, Zool. pt. 12).

Pectis antarctica, n.g., n.sp. One specimen; obtained at no other locality.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophiocten amitinum, n.sp. Obtained also at Stations 145, 146, 149, and 157.

HOLOTHURIOIDEA (Théel, Zool. pt. 13).

Elpidia incerta, n.sp. Four injured specimens; obtained at no other locality.
Scotoplanes murrayi, n.g., n.sp. One specimen; obtained at no other locality.
Kolga nana, n.sp. One injured specimen; obtained also at Station 50.

ANNELIDA (M'Intosh, Zool. pt. 34).

Maldanella antarctica, n.g., n.sp. One specimen; obtained also at Stations 146 and 157.

ISOPODA (Beddard, Zool. pt. 48).

Eurycope fragilis, n.sp. One specimen; obtained also at Stations 147, 158, and 237.

MACRURA (Spence Bate, Zool. pt. 52).

Nematocarcinus lanceopes, n.sp. Three specimens; obtained at no other locality.

Station 152.

Gasteropoda (Watson, Zool. pt. 42).

Trochus (*Margarita*) *brychius*, n.sp. Obtained at no other locality.

Fishes (Günther, Zool. pt. 57).

Bathydraco antarcticus, n.g., n.sp. One specimen; obtained at no other locality. Only species of the genus.

In addition to the foregoing, the Station-book records :—Large specimen of *Clymenia* (?) with tube, and *Discina*.

Excluding Protozoa, about 20 specimens of invertebrates and fishes were obtained at this Station, belonging to about 12 species, of which 10 are new to science, including representatives of 4 new genera; 6 of the new species and 1 new genus were not obtained elsewhere.

Organisms from Surface-Nets.

Surface Organisms.—The following species are recorded from the surface at this Station :—

Schizopoda (Sars, Zool. pt. 37).

Euphausia antarctica, n.sp.

Tunicata (Herdman, Zool. pt. 76).

Salpa runcinata-fusiformis, Chamisso-Cuvier.

In addition, the following are recorded in the note-books:—Diatomaceæ, small *Globigerinæ*, Radiolaria (including very fine specimens of *Aulosphæra elegantissima*, as well as *Astrocapsa stellata*), Ctenophoræ, Medusæ, *Diphyes*, larva of *Chirodota* (?), *Alciopa*, *Tomopteris*, *Sagitta*, Copepods (Calanids), *Hyperia*, *Primno*, Pteropod, and *Appendicularia*.

Moseley writes : "I saw two whales about the ship about 6 A.M.; they were light brown on the back, and light on the belly. The dorsal fin was small, hooked backwards, and placed far back near the tail. They were probably the "sulphur bottoms" of the whalers. They often showed the heads well, and there seemed to be a hump at the forehead. The whole back was often shown, the fin appearing very late. I saw also the somewhat elongated oval snout and blow-holes plainly. The reflection of light from the bodies of the animals lighted up the water around them as they swam submerged. They followed the ship a while, but did not turn flukes."

Station 153.

Station 153 (Sounding 257), near Antarctic Ice (see Chart 23 and Diagram 9).

February 14, 1874; lat. 65° 42′ S., long. 79° 49′ E.

Temperature of air at noon, 33°·0; mean for the day, 32°·5.

Station 153

Temperature [1] of water :—

Surface,	29°·5	300 fathoms,	32°·0 / 32·0
50 fathoms,	29·0 / 29·0	500 ,,	32·8 / 32·8
100 ,,	29·0 / 29·0	Bottom,	33·0 / 33·0
200 ,,	30·5 / 30·5		

Density at 60° F. at surface, 1·02413 ; bottom, 1·02567.

Depth, 1675 fathoms ; deposit, Blue Mud, containing 3·50 per cent. of carbonate of lime, and many rocks and pebbles (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

At 4 A.M. passed icebergs. At 5 A.M. fifteen icebergs in sight. At 6 A.M. observed open pack ice to S.E. Got up steam to sound and dredge. At 6.30 A.M. shortened and furled sail, and proceeded under steam. At 7 A.M. sounded in 1675 fathoms. Numerous icebergs and pack ice in sight to E. and S.E. At 10 A.M. put dredge over. At 11 A.M. took a series of temperatures at 50, 100, 200, 300, and 500 fathoms. At noon, numerous icebergs and pack ice in sight to E. and S. The carbonic acid was determined in bottom water, and amounted to 82·9 milligrammes per litre. Weather fine ; quantity of wash ice about the ship. At 1.15 P.M. commenced heaving in dredge, which came up at 3.15 P.M. with several specimens. At 3.30 P.M. made sail. At 4 P.M. pack ice extending from S. to E. At 6 P.M. 47 icebergs in sight. Pack ice to S.E.; apparently open sea to S.W. Observed several whales during the day, also Cape pigeons, snow-birds, black and white petrels, and penguins.

Distance at noon from Termination Land, 420 miles ; from South Pole, 1458 miles. Made good 64 miles. Amount of current 3 miles, direction S. 18° W.

Animals from Dredge.

The following species are recorded in the Zoological Reports from the dredge at this Station :—

Alcyonaria (Wright and Studer, Zool. pt. 64).

Callozostron mirabilis, n.g., n.sp. One specimen ; obtained at no other locality. Only species of the genus.

Actiniaria (Hertwig, Zool. pt. 73).

Actinian, genus and species indeterminable.

[1] Actual readings of the thermometers.

DEEP-SEA MEDUSÆ (Haeckel, Zool. pt. 12).

Thamnostylus dinema, n.g., n.sp. Obtained at no other locality. Only species of the genus. [Reported in error from 120 fathoms].

ASTEROIDEA (Sladen, Zool. pt. 51).

Pararchaster antarcticus, n.g., n.sp. Two specimens ; obtained at no other locality.

OPHIUROIDEA (Lyman, Zool. pt. 14).

Ophiacantha cosmica, n.sp. For distribution see Station 122.

ECHINOIDEA (Agassiz, Zool. pt. 9).

Goniocidaris canaliculata, Agassiz. For distribution see Station 147.

Cystechinus vesica, n.g., n.sp. Obtained also at Stations 298 and 299, 2225 and 2160 fathoms.

CIRRIPEDIA (Hoek, Zool. pt. 25).

Scalpellum antarcticum, n.sp. One specimen ; obtained at no other locality.

ISOPODA (Beddard, Zool. pt. 48).

Iolanthe acanthonotus, n.g., n.sp. One specimen ; obtained at no other locality. Only species of the genus.

Arcturus furcatus, Studer. One specimen ; obtained also at Stations 149 and 151.

,, *glacialis*, n.sp. One specimen ; obtained at no other locality.

SCHIZOPODA (Sars, Zool. pt. 37).

Pseudomma sarsii, Willemoes-Suhm, n.sp. One specimen ; obtained also at Station 149.

PYCNOGONIDA (Hoek, Zool. pt. 10).

Nymphon meridionale, n.sp. One specimen ; obtained at no other locality.

POLYZOA (Busk, Zool. pt. 30).

Farciminaria magna, n.sp. Obtained also at Stations 323 (var. *armata*) and 325, 1900 and 2650 fathoms.

In addition to the foregoing, the following are recorded in the Station-book :— Silicisponge, *Farrea fecunda*, Aphroditacean, and Ascidian.

Excluding Protozoa, over 20 specimens of invertebrates were obtained at this Station, belonging to about 18 species, of which 11 are new to science, including representatives of 5 new genera ; 7 of the new species and 3 new genera were not obtained elsewhere.

STATION 153.

Willemoes-Suhm writes: "The dredge brought up a long Sponge-like Alcyonarian, on which was an Aphroditacean Annelid. The Polyzoon had small Cirripedia on it. Among the Crustacea was a whitish, blind and very spinous, *Idothea*-like Isopod, and also a small *Mysis*, the eyes of which were Petalophthalmid, belonging to the same genus as the one found near Kerguelen and the Crozets."

ORGANISMS FROM THE DEPOSIT

FORAMINIFERA (Brady, Zool. pt. 22).—The following species of Foraminifera were observed in the deposit from this Station (see also Murray and Renard, Deep-Sea Deposits Chall. Exp.); the two pelagic species, which make up about 57 per cent. of the carbonate of lime present in the deposit, are marked thus × :—

Astrorhiza angulosa, Brady (?).
„ *granulosa*, Brady (?).
Pelosina cylindrica, Brady.
Psammosphæra fusca, Schulze.
Saccammina sphærica, Sars.
Hyperammina vagans, Brady.
Marsipella cylindrica, Brady.
Rhabdammina abyssorum, Sars.
Reophax difflugiformis, Brady.
„ *fusiformis* (Williamson).
„ *nodulosa*, Brady.
„ *pilulifera*, Brady (?).
„ *scorpiurus*, Montfort.
Haplophragmium agglutinans (d'Orbigny).
„ *globigeriniforme* (Parker and Jones).
„ *latidorsatum* (Bornemann).
„ *nanum*, Brady.
„ *rotulatum*, Brady.
„ *turbinatum*, Brady.
Placopsilina cenomana (d'Orbigny).
Trochammina pauciloculata, Brady.
„ *trullissata*, Brady.
Webbina clavata, Jones and Parker.
Cyclammina orbicularis, Brady.
„ *pusilla*, Brady.
Clavulina communis, d'Orbigny.
Cassidulina crassa, d'Orbigny.
„ *lævigata*, d'Orbigny.
Lagena lævigata (Reuss).
„ *lævis* (Montagu).
Cristellaria sp. (?).
Uvigerina angulosa, Williamson.
× *Globigerina dutertrei*, d'Orbigny.
× *Orbulina universa*, d'Orbigny.
Pullenia quinqueloba, Reuss.
Sphæroidina bulloides, d'Orbigny.
Truncatulina lobatula (Walker and Jacob).
„ *pygmæa*, Hantken.
Pulvinulina exigua, Brady.
Rotalia soldanii, d'Orbigny.

ORGANISMS FROM SURFACE NETS.

Surface Organisms.—The following species are recorded from the surface at this Station:—

COPEPODA (Brady, Zool. pt. 23).
Rhincalanus gigas, n.sp.
Pleuromma abdominale, Claus.
Saphirinella stylifera (Lubbock).

SCHIZOPODA (Sars, Zool. pt. 37).
Euphausia antarctica, n.sp.
Thysanoëssa macrura, n.sp.

PTEROPODA (Pelseneer, Zool. pt. 65).
Limacina antarctica, Woodward.

TUNICATA (Herdman, Zool. pt. 76).
Appendicularia sp. (?).

In addition, the following are recorded in the note-books:—*Globigerina*, Radiolaria, *Diphyes*, *Sagitta*, *Alciopa*, Annelid larvæ, *Cypridina*, *Primno*, *Cleodora* [= *Clio*], shell-less Pteropod, and the remains of a large Cephalopod. STATION 153.

Moseley writes: "Whales were seen constantly about the ship. I went away in a boat to shoot birds, and saw a whale blow close by. The spout looks very different from the level of the water in a boat than from the deck of a ship: it appears so much higher, and shoots up into the air like a fountain. In the evening a whale was close alongside, and the expiratory noise in blowing was of a loud, somewhat prolonged, deep bass tone."

February 15, 16, and 17, 1874. On the 16th the Challenger reached her most southerly point in lat. 66° 43′ S.

Moseley writes: "During the afternoon of the 16th whales were extremely abundant, both those with the small fin very far back, as well as shoals of a grampus-like Cetacean with high pointed fins projecting out of the water as they swim, and looking like sharks' fins; on the side, behind the head, they had a white blotch, and a large light transverse patch immediately behind the high dorsal fin, which was placed nearly in the middle of the body."

In the afternoon of the 17th the sea was of a greenish colour, and the water was found to be filled with many little spherical transparent masses, which were identical with those Mr. Murray had observed in the Arctic Ocean.[1] These minute Algæ can be seen in the water with the naked eye, when the vessel is held towards the light; they have the surface covered with little dots of a greenish or yellowish tinge, which when examined under high powers were seen to be arranged in groups of four. A few hours later the sea was blue, and these Algæ could not be observed in the water. Similar banks of these Algæ were passed through on other days when in the neighbourhood of the Antarctic ice.

Station 154 (Sounding 258), near Antarctic Ice (see Chart 23 and Diagram 9). STATION 154.

February 19, 1874; lat. 64° 37′ S., long. 85° 49′ E.

Temperature of air at noon, 31°·0; mean for the day, 28°·9.

Temperature[2] of water:—

Surface,	32·0°	300 fathoms,	33·8°
50 fathoms,	29·2	Bottom,	{ 32·9 / 33·0
100 „	29·0		

Density at 60° F.:—

Surface,	1·02458	300 fathoms,	1·02558
50 fathoms	1·02534	400 „	1·02562
140 „	1·02547	Bottom,	1·02529

Depth, 1800 fathoms; deposit, Blue Mud, containing 1·00 per cent. of carbonate of lime (see Murray and Renard, Deep-Sea Deposits Chall. Exp.).

[1] This Alga has since been described by G. Pouchet as *Tetraspora poucheti*, Hariot (*Comptes rendus des séances de la Société de Biologie*, 1892).

[2] Actual readings of the thermometers.

Station 154.

At 2 A.M. observed two icebergs to N. and W. At 8 A.M. shortened sail, and got up steam to sound. Numerous icebergs in sight. At 9.10 A.M. proceeded under steam, and at 10 A.M. sounded in 1800 fathoms. Obtained a series of temperatures. The carbonic acid was determined in bottom water, and amounted to 57·6 milligrammes per litre. At 11.30 A.M. completed temperature observations, and at 11.40 A.M. made all plain sail. At noon 28 icebergs in sight. At 4 P.M. 12 icebergs in sight; no pack ice. At 6 P.M. 40 icebergs in sight; no pack ice. At 8 P.M. 37 icebergs in sight. At 10.20 P.M. hove to. During the day observed several Cape pigeons, petrels, sooty albatrosses, prions, Mother Carey's chickens, and terns. Several snow-showers after 10 P.M.

Distance at noon from Termination Land, 260 miles. Made good 61 miles. Amount of current 18 miles, direction N. 51° E.

Organisms from Surface Net.

Surface Organisms.—The following species are recorded from the surface and down to 100 fathoms in this locality (February 19 to 21):—

RADIOLARIA (Haeckel, Zool. pt. 40).

Thalassopila cladococcus, Haeckel.
Haliomma antarcticum, Haeckel.
Amphibrachium spongurioides, Haeckel.
Larnacostupa dendrophora, Haeckel.
Acanthonia prismatica, Haeckel.
Porocapsa poronodon, Haeckel.
Lychnaspis minima, Haeckel.
Sagosphaera penicilla, Haeckel.
Auloscena spectabilis, Haeckel.

ANNELIDA (M'Intosh, Zool. pt. 34).

Alciopa antarctica, n.sp.

COPEPODA (Brady, Zool. pt. 23).

Calanus propinquus, n.sp.
Rhincalanus gigas, n.sp.
Pleuromma abdominale (Lubbock).
Candace truncata, Dana.

AMPHIPODA (Stebbing, Zool. pt. 67).

Hyperiella dilatata, n.sp.
Primno antarctica, n.sp.

SCHIZOPODA (Sars, Zool. pt. 37).

Euphausia murrayi, n.sp.
,, *superba*, Dana.
Thysanoëssa macrura, n.sp.

PTEROPODA (Pelseneer, Zool. pt. 65).

Limacina australis (Eydoux and Souleyet).
Clio sulcata (Pfeffer).

In addition, the following are recorded in the note-books:—Diatoms, *Globigerina*, Radiolaria, *Diphyes*, larvæ of *Chirodota* (?) with twelve divided wheels, *Sagitta*, and *Cypridina*.

The above surface organisms were collected by Mr. Murray in a boat, *Euphausia superba* being especially abundant (the supplementary eyes of which were in the evening observed to be phosphorescent).