

- II. "Preliminary Reports to Professor WYVILLE THOMSON, F.R.S., Director of the Civilian Scientific Staff, on Work done on board the 'Challenger.'" By JOHN MURRAY, Esq., Naturalist to the Expedition. (Published by permission of the Lords of the Admiralty.) Received Feb. 14, 1876. Read March 16.

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# PREFACE TO PRELIMINARY REPORTS.

The Preliminary Reports have been prepared at the request of Professor Wyville Thomson. They have been compiled during the past three weeks from notes taken daily during the past three years. In only a few cases has it been possible to refer to the objects remarked upon, they having been sent home for greater safety, or packed away beyond reach. When specimens taken early in the cruise can be placed side by side and compared with the more recent revelations of the trawl, dredge, or sounding-tube, many of the statements herein made may require to be modified.

Reports on three years' work, prepared under the disadvantages above mentioned, must necessarily be very incomplete; and indulgence may be asked till the final Report can be issued.

To all my coadjutors, naval and civilian, I am indebted for much assistance, especially to Mr. Wild for his drawings, to Mr. Buchanan for much information concerning the chemical constituents of the bottoms, and to Professor Thomson for assistance and advice, not only in preparing these Reports, but also while carrying on the investigations of which they are intended to give some account.

JOHN MURRAY.

Valparaiso, Chili,  
9th December, 1875.

1. Preliminary Report on Specimens of the Sea-bottoms obtained in the Soundings, Dredgings, and Trawlings of H.M.S. 'Challenger,' in the years 1873-75, between England and Valparaiso.

*Method of Work.*—During the first six months of the expedition the sounding-apparatus in use on board was provided with a very narrow cylinder, which brought up only a very small quantity of the bottom.

In July 1873 Capt. Nares had a much larger cylinder fitted to the instrument, one with a 2-inch bore; and later on he caused the weights to be so arranged with respect to the cylinder that the latter projected some 18 inches beneath the former.

This arrangement, the cylinder of which is always provided with the common butterfly-valve, usually gives us a very large quantity of the

bottom in each sounding. Sometimes the tube has been forced fully 18 inches into the bottom, and has brought up frequently as much as a quart of the ooze, mud, or clay. When the tube arrives on board the contents are carefully removed, and the colour, extent, and arrangement of the section\* is noted. A portion is washed several times in distilled water and dried, a portion is submitted to a rough analysis, and the remainder, if any, is preserved in spirit.

The analysis consists in determining so far as possible :—

1. The kinds of organisms present, and their relative abundance, whether carbonate of lime or siliceous, and whether alive or dead.
2. The kind and quantity of amorphous and mineral matter, and its ratio to the remains of the above organisms.

This is accomplished by decanting the finer from the coarser particles, and examining each with the microscope. When carbonate of lime is present this is removed by weak acid, and the specimen is again examined. When manganese is present in great quantity this is removed by strong hydrochloric acid, and again an examination is made. Very frequently portions of the upper layers are placed in colouring solutions (as carmine, magenta, &c.), for the purpose of rendering more distinct any organized material, should any be present.

When the dredge or trawl brings up mud, a considerable quantity is preserved for future work, and what remains is carefully sifted. The siftings are examined and preserved.

Lately it has been the custom to send down tow-nets loosely attached to the trawl or dredge and at the weights in front of the trawl. These often bring up specimens of the bottom when the trawl fails to do so. As these nets do not probably sink deep into the ooze, they give us a surer idea of the nature of the surface-layers than previously obtained by the trawl alone.

*List of the Soundings and Dredgings, with an abstract of the nature of the bottom in each case where a sample has been procured.*

*Explanatory Note.*—The following remarks under each sounding or dredging have been abstracted from notes made daily during the cruise. In making the abstract the object in view has been to indicate so far as possible the relative abundance in each sample of—

- Remains of carbonate-of-lime organisms ;
- Remains of siliceous organisms ;
- Mineral particles, as quartz and mica ;
- Glauconite, pumice, manganese, &c. ; and
- Amorphous clayey and calcareous matter.

It has been thought that, however incomplete, such an abstract will in the mean time be useful to naturalists and geologists. It will give some

\* *i. e.* the vertical section, which is always greater the further the tube has been forced into the ooze or clay.

idea of the nature and distribution of the deposits which are taking place in the oceans and seas we have visited. It will also furnish some data and serve as the basis for speculations on the mode of origin of—

The deep-sea clays;

The formation of the manganese nodules ;

The presence of the remains of surface animals (consisting of siliceous and carbonate-of-lime organisms) in some deposits, and their absence in others, &c.

By pelagic Foraminifera are meant species of *Globigerina*, *Orbulina*, *Pulvinulina*, and of one or two other genera which are still undescribed, but which have been found abundantly in the surface-waters of the Pacific and South Atlantic oceans.

When the final Report is prepared, the genera or species of the organisms whose remains occur in each sample will be given. So also for the mineral particles, and the ratio of these to each other and to the amorphous, clayey, and calcareous matter will be more accurately stated. At the present moment such an undertaking is in no way possible. Those things which are most abundant in the sample are generally mentioned first.

#### ATLANTIC OCEAN.

##### *England to Gibraltar.*

30th December, 1872. Lat.  $41^{\circ} 37' N.$ , long.  $9^{\circ} 42' W.$  1125 fathoms.

A blue mud containing:—Amorphous blue clayey matter; many fine mineral particles; many pelagic Foraminifera and Coccoliths and Coccospheres.

Sounding 1. 13th January, 1873. Lat.  $38^{\circ} 10' N.$ , long.  $9^{\circ} 14' W.$

470 fathoms. A green mud containing:—Amorphous clayey matter; many sandy particles; pelagic and other Foraminifera; spicules of sponges; pieces of Corallites. Light green-coloured glauconitic casts of the Foraminifera remained after treatment with acid.

Sounding 3. 14th January, 1873. Lat.  $38^{\circ} 26' N.$ , long.  $9^{\circ} 38' W.$

560 fathoms. A dark green mud containing:—Amorphous matter and many dark green grains and other mineral particles; pelagic and other Foraminifera, *Echini*-spines, &c. Beautiful glauconitic casts of all the carbonate-of-lime organisms remained after treatment with acid.

Sounding 4. 14th January, 1873. Lat.  $38^{\circ} 22' N.$ , long.  $9^{\circ} 44' W.$

1290 fathoms. A blue mud containing:—Much amorphous matter; many black, green, and white mineral particles; many pelagic Foraminifera and few shells of Mollusca; a few casts of the Foraminifera in glauconite.

Sounding 5. 14th January, 1873. Lat.  $38^{\circ} 14' N.$ , long.  $9^{\circ} 49' W.$

1475 fathoms. A blue mud containing:—Amorphous matter; many fine and some coarse mineral particles of green, white, and black

colour; some pelagic Foraminifera and Coccoliths. One or two green casts of the Foraminifera remained after treatment with acid.

Sounding 6. 14th January, 1873. Lat.  $38^{\circ} 9' N.$ , long.  $9^{\circ} 43' W.$  1380 fathoms. A blue mud containing:—Amorphous matter; many fine mineral particles, white and green; a few pelagic Foraminifera and many Coccoliths; a few green casts of the Foraminifera.

Sounding 7. 14th January, 1873. Lat.  $37^{\circ} 56' N.$ , long.  $10^{\circ} 8' W.$  1800 fathoms. A blue mud containing:—Much amorphous clayey matter; many small mineral particles; a few pelagic Foraminifera, Coccoliths, and Rhabdoliths.

Sounding 8. 15th January, 1873. Lat.  $37^{\circ} 2' N.$ , long.  $9^{\circ} 23' W.$  1000 fathoms. A blue mud containing:—Much amorphous matter; many fine mineral particles, white and green; some pelagic and other Foraminifera and Coccoliths; many green casts (glauconitic) of the Foraminifera after treatment with acid.

Soundings 9, 10, & 11. Lat.  $36^{\circ} 58' N.$ , long.  $9^{\circ} 14' W.$ , and lat.  $37^{\circ} 2' N.$ , long.  $9^{\circ} 14' W.$  525, 900, and 600 fathoms respectively. Gave a blue mud, as in No. 3.

*Gibraltar to Madeira.*

Sounding 12. 28th January, 1873. Lat.  $35^{\circ} 47' N.$ , long.  $8^{\circ} 23' W.$  1090 fathoms. A *Globigerina*-ooze containing:—Very many pelagic Foraminifera, Coccoliths, and Rhabdoliths; a few white mineral particles; one or two Radiolarian remains; amorphous calcareous matter.

Sounding 14. 30th January, 1873. Lat.  $36^{\circ} 23' N.$ , long.  $11^{\circ} 18' W.$  1525 fathoms. A *Globigerina*-ooze containing:—Very many pelagic Foraminifera, Coccoliths, and Rhabdoliths; a few white, red, and black mineral particles; one or two Radiolaria; amorphous calcareous matter.

Sounding 16. 1st February, 1873. Lat.  $34^{\circ} 4' N.$ , long.  $14^{\circ} 18' W.$  2250 fathoms. A white *Globigerina*-ooze containing:—Many pelagic Foraminifera, Coccoliths, and Rhabdoliths; a few small white crystalline particles; one or two Radiolaria; some amorphous calcareous matter.

Sounding 17. 2nd February, 1873. Lat.  $32^{\circ} 43' N.$ , long.  $15^{\circ} 52' W.$  2225 fathoms. A yellow *Globigerina*-ooze containing:—Many pelagic Foraminifera, Coccoliths, and Rhabdoliths; a good many mineral particles (Olivinite); a few manganese grains; a few Radiolaria.

Sounding 18. 2nd February, 1873. Off Madeira Island. 670 fathoms. A sand composed of broken pieces of coral, *Lepas*-valves, *Echinispines*, pelagic and other Foraminifera (these were all dead, and had a slight coating of the black oxide of manganese); many olivine and other mineral particles.

Sounding 19. 2nd February, 1873. South of Bugro Island. 1150 fathoms. A grey mud containing:—Much volcanic sand, as olivinite; pelagic Foraminifera and Gasteropod, Pteropod, and Heteropod shells, Coccoliths; a few siliceous spines, but no Radiolaria were observed.

Sounding 20. 2nd February, 1873. 930 fathoms. A grey mud containing:—Much volcanic sand and many very fine mineral particles; a few pelagic Foraminifera, Pteropods, and surface Gasteropods, a few Coccoliths; no siliceous remains were observed.

Sounding 21. 2nd February, 1873. 1500 fathoms. A grey mud containing:—Much volcanic sand (red, white, and black particles and olivine); a good many pelagic Foraminifera; Pteropod, surface Gasteropod, and Heteropod shells; Coccoliths and Rhabdololiths; a few siliceous spines and Radiolaria.

*At Canaries.*

Sounding 25. 10th February, 1873. 278 fathoms. A dark grey mud or sand containing:—Many volcanic sandy particles; a few pelagic Foraminifera, Pteropods, Gasteropods, and Coccoliths; one or two siliceous spines.

Soundings 26 and 28. At 630 and 560 fathoms respectively. The same as No. 25.

Sounding 29. 10th February, 1873. 78 fathoms. A coarse sand formed of débris of volcanic rocks, with pieces of Echinoderms, Foraminifera, molluscous shells, &c.

Sounding 31. 10th February, 1873. 640 fathoms. Off Teneriffe. A grey mud containing:—Much volcanic sand, black, white, and red in colour, and olivine; some pelagic Foraminifera, Pteropods, pelagic Gasteropods, and Heteropod shells; a few Coccoliths; one or two Radiolaria.

Sounding 33. 11th February, 1873. 1750 fathoms. A grey mud containing:—Very many fine particles of volcanic sand of black, white, and red colour, and amorphous clayey matter; a good many pelagic Foraminifera and Coccoliths; one or two Radiolaria.

Sounding 36. 12th February, 1873. 620 fathoms. A grey mud containing:—Very many particles of volcanic sand and amorphous clayey matter; many pelagic Foraminifera, Pteropods, and other surface shells.

Sounding 37. 15th February, 1873. 1800 fathoms. Lat. 27° 24' N., long. 16° 55' W. A grey mud containing:—Many fine particles of volcanic sand of white, black, and red colour; pelagic Foraminifera, Coccoliths, and Rhabdololiths; a few Radiolaria.

Sounding 38. 17th February, 1873. 1945 fathoms. Lat. 25° 15' N., long. 19° 14' W. A *Globigerina*-ooze containing:—Very many

pelagic Foraminifera and Coccoliths and some Pteropod shells; a few mineral particles.

Soundings 39 & 40. 18th February, 1873. 1525 fathoms. Lat.  $25^{\circ} 45' N.$ , long.  $20^{\circ} 12' W.$  Nothing in the sounding-tube.

The dredge brought up a large quantity of dead coral, a branching gorgonoid. The axis of this coral was white; but the surface was black, with a thick coating of manganese. Some pelagic Foraminifera and Pteropod shells adhered to the base of the coral, and about a large siliceous sponge.

Sounding 42. 21st February, 1873. 2740 fathoms. Lat.  $24^{\circ} 20' N.$ , long.  $24^{\circ} 28' W.$  A red clay containing:—Much amorphous matter; very many exceedingly fine mineral particles; a few whole and a good many broken parts of pelagic Foraminifera; one or two Radiolaria.

Sounding 43. 23rd February, 1873. 2950 fathoms. Lat.  $23^{\circ} 22' N.$ , long.  $27^{\circ} 49' W.$  A red clay containing:—Amorphous matter and many very fine mineral particles; a good many pelagic Foraminifera and their broken parts.

Sounding 44. 24th February, 1873. 2750 fathoms. Lat.  $23^{\circ} 15' N.$ , long.  $30^{\circ} 56' W.$  A red clay containing:—Much amorphous matter; mineral particles, all exceedingly fine and in immense numbers; a few remains of broken pelagic Foraminifera; no siliceous remains observed.

Sounding 45. 25th February, 1873. 2800 fathoms. Lat.  $23^{\circ} 12' N.$ , long.  $32^{\circ} 56' W.$  A red clay containing:—Much amorphous matter and very many exceedingly fine mineral particles; a few broken remains of pelagic Foraminifera.

Sounding 46. 26th February, 1873. 3150 fathoms. Lat.  $23^{\circ} 23' N.$ , long.  $35^{\circ} 10' W.$  A red clay containing:—Much amorphous matter and many very small mineral particles; a few broken pieces of pelagic Foraminifera; a few manganese grains.

Sounding 47. 28th February, 1873. 2720 fathoms. Lat.  $23^{\circ} 10' N.$ , long.  $38^{\circ} 42' W.$  A red clay containing:—Much amorphous matter; very many small white and red mineral particles; a few pelagic Foraminifera.

Sounding 48. 1st March, 1873. 2575 fathoms. Lat.  $22^{\circ} 35' N.$ , long.  $40^{\circ} 37' W.$  A red clay containing:—Much amorphous matter; very many exceedingly fine mineral particles; a good many pelagic Foraminifera, Coccoliths, and Rhabdoliths.

Sounding 49. 3rd March, 1873. 2025 fathoms. Lat.  $21^{\circ} 57' N.$ , long.  $43^{\circ} 29' W.$  A *Globigerina*-ooze containing:—Very many pelagic Foraminifera, Coccoliths, and Rhabdoliths; a great many manganese particles, many of them rather large; many pieces of a cherty-

like mineral of a red colour (a silicate); a few white mineral particles.

Sounding 50. 4th March, 1873. 1900 fathoms. Lat.  $21^{\circ} 38' N.$ , long.  $44^{\circ} 39' W.$  A *Globigerina*-ooze containing:—Very many pelagic Foraminifera, Coccoliths, and Rhabdoliths; many red-coloured mineral particles, and a few manganese particles.

Sounding 51. 5th March, 1873. 1950 fathoms. Lat.  $21^{\circ} 1' N.$ , long.  $46^{\circ} 29' W.$  A *Globigerina*-ooze of a red colour containing:—Very many pelagic Foraminifera, Rhabdoliths, and Coccoliths; many very fine white-coloured mineral particles (sanidin); a good many small manganese particles, to which the colour of the sounding is to some extent due.

Sounding 52. 6th March, 1873. 2325 fathoms. Lat.  $20^{\circ} 49' N.$ , long.  $48^{\circ} 45' W.$  A *Globigerina*-ooze of rose-colour containing:—Very many pelagic Foraminifera, Coccoliths, and Rhabdoliths; much amorphous matter, and very many fine white mineral particles; a few Radiolarian remains.

Sounding 53. 7th March, 1873. 2435 fathoms. Lat.  $20^{\circ} 39' N.$ , long.  $50^{\circ} 33' W.$  A red clay containing:—Much amorphous clayey matter; many fine white and red mineral particles; a few manganese particles; a good many remains of pelagic Foraminifera, Coccoliths and Rhabdoliths; a few Radiolarians.

The dredge brought up some grey-coloured concretions covered with manganese, also a few sharks' teeth and valves of a *Scalpellum* covered with a thin coating of manganese.

Sounding 54. 8th March, 1875. 2385 fathoms. Lat.  $20^{\circ} 7' N.$ , long.  $52^{\circ} 32' W.$  A red clay containing:—Much amorphous matter; many exceedingly fine mineral particles; many pelagic Foraminifera, Coccoliths, and Rhabdoliths; a few manganese grains.

Sounding 55. 10th March, 1873. 2675 fathoms. Lat.  $19^{\circ} 41' N.$ , long.  $55^{\circ} 13' W.$  A red clay containing:—Much amorphous clayey matter; many very small crystalline particles; a few whole and some broken parts of pelagic Foraminifera.

Sounding 56. 11th March, 1873. 3000 fathoms. Lat.  $19^{\circ} 15' N.$ , long.  $57^{\circ} 47' W.$  A red or grey clay containing:—Amorphous matter and exceedingly fine mineral particles; a small piece of shell and a portion of a siliceous spine were the only traces of organisms; a few manganese particles.

Sounding 57. 12th March, 1873. 2975 fathoms. Lat.  $18^{\circ} 56' N.$ , long.  $59^{\circ} 35' W.$  A red clay containing:—Much amorphous matter and very many exceedingly fine mineral particles; a few remains of pelagic Foraminifera; one or two portions of a siliceous spine.

Sounding 58. 13th March, 1873. 3025 fathoms. Lat.  $18^{\circ} 54' N.$ , long.

61° 25' W. A red clay containing:—Much amorphous matter; many small white and yellow-coloured mineral particles; three small fragments of *Globigerina* and two pieces of a siliceous spine were the only traces of organisms noticed.

Sounding 59. 14th March, 1873. 1420 fathoms. Lat. 18° 40' N., long. 62° 56' W. A *Globigerina*-ooze containing:—Many pelagic Foraminifera; Pteropods, pelagic Gasteropods, Heteropods, Coccoliths, and Rhabdoliths; a few mineral particles of a white colour; a few Radiolaria and siliceous spines.

Sounding 60. 15th March, 1873. 460 and 390 fathoms. North of Calebra Island. A coral mud containing:—Many pelagic Foraminifera, Pteropods, Heteropods, small larval Gasteropods; *Echinispines*; a few Coccoliths; a good many rather coarse mineral particles of white and black colour; a good many siliceous spines and Radiolaria; amorphous calcareous matter; one cast of a Foraminifer of a red colour.

*St. Thomas's to Bermuda.*

Station 24. 25th March, 1873. 390 and 625 fathoms. North of Calebra Island. A coral mud containing:—Much amorphous calcareous matter; a good many remains of pelagic Foraminifera, Pteropods, surface Gasteropods, Coccoliths, and Rhabdoliths; a good many small white crystalline particles; one or two casts of Foraminifera in a dark red substance.

Sounding 61. 26th March, 1873. 3875 fathoms. Lat. 19° 41' N., long. 65° 7' W. A blue mud (red on the top, then a layer of blue or slate-colour, the lower layers of a grey colour) containing:—Much amorphous matter; many very small crystalline or mineral particles; a good many broken pieces of pelagic Foraminifera; Pteropods and Heteropods; a few Coccoliths and Rhabdoliths. The lower layers appeared to contain more carbonate of lime than the upper ones.

Sounding 62. 27th March, 1873. 2800 fathoms. Lat. 21° 26' N., long. 65° 16' W. A red clay containing:—Much amorphous matter; very many fine mineral particles; a few remains of pelagic Foraminifera, and one or two Coccoliths; one or two manganese grains.

Sounding 63. 28th March, 1873. 2960 fathoms. Lat. 22° 49' N., long. 65° 19' W. A red clay containing:—Much amorphous clayey matter; very many exceedingly fine mineral particles; a few broken remains of pelagic Foraminifera.

Sounding 64. 29th March, 1873. 2850 fathoms. Lat. 24° 39' N., long. 65° 25' W. A red clay containing:—Much amorphous clayey matter; many exceedingly fine white mineral particles; a few broken remains of pelagic Foraminifera; one or two manganese grains.

Sounding 65. 31st March, 1873. 2700 fathoms. Lat.  $27^{\circ} 49' N.$ , long.  $64^{\circ} 59' W.$  A red clay containing:—Much amorphous matter; many very fine mineral particles; a good many remains of pelagic Foraminifera and Coccoliths; no remains of siliceous organisms were observed.

The dredge brought up much mud; in the siftings were found:—a few manganese pellets; a few arenaceous Foraminifera, *Nodosarias*, &c.; *Biloculina*, *Rotalia*, and *Carpenteria* on a concretion; a few pieces of red cherty-like mineral; a few concretions of the bottom; a small piece of pumice(?); one *Echinus*-spine; a small shark's tooth.

The tests of the arenaceous Foraminifera were chiefly small, white, mineral particles; and these, I think, are from broken-down pieces of pumice.

Sounding 66. 1st April, 1873. 2600 fathoms. Lat.  $29^{\circ} 5' N.$ , long.  $65^{\circ} 1' W.$  A red clay containing:—Much amorphous matter; many very fine mineral particles; a good many pelagic Foraminifera, with Coccoliths and Rhabdoliths.

Sounding 67. 3rd April, 1873. 2475 fathoms. Lat.  $31^{\circ} 24' N.$ , long.  $65^{\circ} 00' W.$  A red clay containing:—Much amorphous clayey matter; many fine crystalline and mineral particles; a good many pelagic Foraminifera, Coccoliths, and Rhabdoliths, and some amorphous calcareous matter; one siliceous spine, but no Radiolaria observed.

Sounding 68. 3rd April, 1873. 2250 fathoms. Lat.  $31^{\circ} 49' N.$ , long.  $64^{\circ} 55' W.$  A coral-mud containing:—Many pelagic Foraminifera, Coccoliths, Rhabdoliths, and broken pieces of dead coral; amorphous calcareous matter; a few mineral particles (some green); a few siliceous spines and Radiolaria.

Sounding 69. 3rd April, 1873. 1820 fathoms. Lat.  $32^{\circ} 1' N.$ , long.  $64^{\circ} 50' W.$  A coral-mud containing:—Many pelagic Foraminifera, Pteropods, and other surface shells, Coccoliths, and Rhabdoliths; broken pieces of Coral, Polyzoa, and *Echini*-spines; amorphous calcareous matter.

Sounding 70. 30th April, 1873. 950 fathoms. A coral-mud containing:—Pelagic Foraminifera, Pteropods, and surface Gasteropods; broken pieces of Coral, Polyzoa, &c.; much amorphous calcareous matter; a few siliceous spines and Radiolaria.

Sounding 70 A. 4th April, 1873. 435 fathoms. Off Bermuda. A coral-mud containing:—Much amorphous calcareous matter; pelagic and other Foraminifera, Pteropods, &c.; broken pieces of Coral, Polyzoa, &c.; a few siliceous spines.

Soundings off the reef at Bermuda, about a mile from the edge of the reef, in the gun-boat, gave always a coral-sand containing:—Broken

pieces of coral; Polyzoa, *Serpula*, large Foraminifera, *Textularia*, *Nodosaria*, Crystellarias, &c.; broken pieces of Echinoderm shells &c.

Sounding 71. 21st April, 1873. 1375 fathoms. A coral-mud, same as No. 69. Specimen not preserved.

Sounding 72. 22nd April, 1873. 2450 fathoms. Lat.  $32^{\circ} 39' N.$ , long.  $65^{\circ} 6' W.$  A coral-mud containing:—Much amorphous calcareous and a little clayey matter; many pelagic Foraminifera and Coccoliths; a few siliceous spines; a few mineral particles, some green, some of an olive-colour (serpentine and olivine?).

Sounding 73. 22nd April, 1873. 2100 fathoms. Lat.  $32^{\circ} 26' N.$ , long.  $65^{\circ} 9' W.$  A coral-mud containing:—Many pelagic Foraminifera, Pteropods, other surface shells, Coccoliths, and Rhabdololiths; broken pieces of Coral, Polyzoa, and shore forms of Foraminifera; a few siliceous spines and Radiolaria.

Sounding 74. 22nd April, 1873. 1950 fathoms. Lat.  $32^{\circ} 15' N.$ , long.  $65^{\circ} 8' W.$  Same as last, with more pelagic shells and larger pieces of broken coral.

23rd April, 1873. 32 fathoms. About 13 miles S.W. of Bermuda. A hard bottom composed chiefly of large pieces of broken *Serpula* reefs, on which were *Crystellaria* and other large Foraminifera, Alcyonarians, &c.

Sounding 75. 24th April, 1873. 2650 fathoms. Lat.  $32^{\circ} 19' N.$ , long.  $65^{\circ} 39' W.$  A coral-mud containing:—Many pelagic and other Foraminifera and their broken parts; many Coccoliths and Rhabdololiths; amorphous, calcareous, and some clayey matter; a few mineral particles, white and yellow (mica); a few siliceous spines and Radiolaria.

Sounding 76. 25th April, 1873. 2600 fathoms. Lat.  $33^{\circ} 3' N.$ , long.  $66^{\circ} 32' W.$  A grey clay containing:—Much amorphous clayey matter; many fine mineral particles, some of a yellow colour, others white; a good many pelagic Foraminifera, Coccoliths, and Rhabdololiths; a few manganese grains.

Sounding 77. 27th April, 1873. 2850 fathoms. Lat.  $34^{\circ} 3' N.$ , long.  $67^{\circ} 32' W.$  A red clay containing:—Much amorphous clayey matter; many very fine and some rather coarse mineral particles—mica, quartz, olivine (?), &c.; a good many pelagic Foraminifera and some Coccoliths.

Sounding 78. 28th April, 1873. 2675 fathoms. Lat.  $34^{\circ} 51' N.$ , long.  $68^{\circ} 30' W.$  A small quantity of mud came up in the dredge which indicated a bottom same as the last.

Sounding 79. 30th April, 1873. 2425 fathoms. Lat.  $35^{\circ} 58' N.$ , long.  $70^{\circ} 39' W.$  A blue mud with reddish upper layer containing:—Much amorphous clayey matter; many fine and coarse mineral par-

ticles, as quartz, mica, &c., and a green and red mineral; a good many pelagic Foraminifera and Coccoliths; a few Radiolaria and Diatoms (*Coccinodiscus* &c.).

Sounding 81. 2nd May, 1873. 1700 fathoms. Lat.  $37^{\circ} 25' N.$ , long.  $71^{\circ} 40' W.$  A blue mud containing:—Much amorphous clayey matter; many fine and coarse mineral particles, as quartz, mica, &c.; a good many pelagic Foraminifera and Coccoliths; a good many Diatom remains and a few Radiolaria.

Sounding 82. 3rd May, 1873. 1240 fathoms. Lat.  $38^{\circ} 34' N.$ , long.  $72^{\circ} 10' W.$  A blue mud containing:—Amorphous clayey matter; many coarse mineral particles as quartz, mica, granitic pebbles, &c.; a few pelagic and other Foraminifera, Coccoliths; a good many Diatom remains.

Sounding 83. 6th May, 1873. 1350 fathoms. Lat.  $40^{\circ} 17' N.$ , long.  $66^{\circ} 48' W.$  A blue mud, same as the last.

Sounding 84. 7th May, 1873. 1340 fathoms. Lat.  $41^{\circ} 15' N.$ , long.  $65^{\circ} 45' W.$  A blue mud comprised of:—Amorphous matter; an immense number of mineral particles and pebbles; pelagic Foraminifera and Coccoliths; a few Diatoms; a few glauconitic casts of the Foraminifera were noticed after treatment with acid; a block of cyanite (5 cwt.) came up in the dredge.

8th and 20th May, 1873. 75 and 83 fathoms. Lat.  $43^{\circ} 2' N.$ , long.  $64^{\circ} 2' W.$ , and lat.  $43^{\circ} 3' N.$ , long.  $63^{\circ} 39' W.$  Le Havebank. The bottom was composed of sand and gravel. Two or three Foraminifera and glauconitic casts.

Sounding 85. 21st May, 1873. 1250 fathoms. Lat.  $42^{\circ} 8' N.$ , long.  $63^{\circ} 31' W.$  A blue mud containing:—Amorphous matter; very many sandy particles (quartz, mica, &c.); a good many pelagic and other Foraminifera; Coccoliths and Rhabdoliths; a few Diatoms and Radiolarian remains.

Sounding 86. 22nd May, 1873. 2020 fathoms. Lat.  $41^{\circ} 19' N.$ , long.  $63^{\circ} 12' W.$  A blue mud, with red upper layer, containing:—Amorphous clayey matter; a great many mineral particles, as mica, quartz, &c.; many pelagic Foraminifera and Coccoliths; a few Radiolaria and Diatoms.

Sounding 87. 23rd May, 1873. 2800 fathoms. Lat.  $39^{\circ} 44' N.$ , long.  $63^{\circ} 22' W.$  A red or grey clay containing:—Much amorphous clayey matter; very many fine mineral particles, and a few rather coarse ones of mica, quartz, and a green mineral; a good many pelagic Foraminifera and Coccoliths.

Sounding 88. 26th May, 1873. 2650 fathoms. Lat.  $36^{\circ} 30' N.$ , long.  $63^{\circ} 40' W.$  A red or grey clay containing:—Much amorphous clayey matter; very many fine and a few rather coarse mineral par-

ticles—quartz, mica, and a green mineral (serpentine?); a good many pelagic Foraminifera, Coccoliths, and Rhabdoliths.

Sounding 89. 27th May, 1873. 2650 fathoms. Lat.  $34^{\circ} 50' N.$ , long.  $63^{\circ} 59' W.$  A red clay containing:—Much amorphous clayey matter; many very fine mineral particles; a good many pelagic Foraminifera and their broken parts; Coccoliths and Rhabdoliths.

Sounding 90. 27th May, 1873. 2500 fathoms. Lat.  $33^{\circ} 20' N.$ , long.  $64^{\circ} 37' W.$  A red clay, much the same as the last, but containing perhaps rather more carbonate-of-lime organisms.

Sounding 92. 29th May, 1873. 1325 fathoms. A coral-mud containing:—Much amorphous calcareous matter; pelagic Foraminifera, Pteropod and Heteropod shells; Coccoliths and Rhabdoliths; broken pieces of coral, Polyzoa, &c.; a few siliceous spines and Radiolaria.

Sounding 93. 29th May, 1873. 1075 fathoms. A coral-mud, much the same as the above, but having a few white and green mineral particles.

Sounding 94. 30th May, 1873. 1250 fathoms. A coral-mud containing:—Much amorphous calcareous matter; many pelagic Foraminifera, Pteropods, Heteropods, Coccoliths, and Rhabdoliths; a few siliceous spines and Radiolaria; some white and green mineral particles (mica).

Sounding 95. 30th May, 1873. 1575 fathoms. A coral-mud containing:—Many pelagic and other Foraminifera, Pteropods, Heteropods, and surface Gasteropods, Coccoliths, and Rhabdoliths; amorphous calcareous matter; a few siliceous spines; a few quartz and other mineral particles.

Sounding 96. 13th June, 1873. 1500 fathoms. Lat.  $32^{\circ} 37' N.$ , long.  $64^{\circ} 21' W.$  A coral-mud containing:—Many pelagic and other Foraminifera, Pteropods, and Heteropods; Coccoliths and Rhabdoliths; much amorphous calcareous matter; a few Radiolaria and siliceous spines; a few green mineral particles.

Sounding 97. 14th June, 1873. 2360 fathoms. Lat.  $32^{\circ} 54' N.$ , long.  $63^{\circ} 22' W.$  A grey clay containing:—Much amorphous clayey and calcareous matter; a good many exceedingly fine mineral particles; a good many pelagic Foraminifera and Coccoliths; one or two Radiolarians.

Sounding 98. 16th June, 1873. 2575 fathoms. Lat.  $34^{\circ} 28' N.$ , long.  $58^{\circ} 56' W.$  A red clay containing:—Much amorphous clayey matter; many fine mineral particles, and a few rather coarse ones; a good many pelagic Foraminifera and their broken-down parts; one or two grains of manganese.

Sounding 99. 17th June, 1873. 2850 fathoms. Lat.  $34^{\circ} 54' N.$ , long.  $56^{\circ} 33' W.$  A red clay containing:—Amorphous clayey matter;

very many sandy particles, as quartz, mica, red and green minerals; the green mineral (glauconite) appears the same as those particles in the bottoms where the green casts of the Foraminifera occur; a good many pelagic Foraminifera and a few Coccoliths; one or two manganese grains.

The dredge brought up several concretions, coated on the outside with the black oxide of manganese. To one of these a *Scalpellum* was attached.

Sounding 100. 18th June, 1873. 2875 fathoms. Lat.  $35^{\circ} 7' N.$ , long.  $52^{\circ} 32' W.$  A red clay containing:—Amorphous matter; very many fine and a few rather coarse mineral particles, as mica, quartz, pieces of a green and a red mineral, all much smaller than yesterday; a few pelagic Foraminifera and their broken parts; a few Coccoliths.

Sounding 101. 19th June, 1873. 2750 fathoms. Lat.  $35^{\circ} 29' N.$ , long.  $50^{\circ} 53' W.$  A grey clay containing:—Much amorphous clayey matter; many very fine mineral particles; many pelagic Foraminifera and their broken parts, and Coccoliths; one or two Radiolaria.

Is lighter in colour and contains more carbonate of lime than yesterday.

Station 64. 20th June. 2750 fathoms. Lat.  $35^{\circ} 35' N.$ , long.  $50^{\circ} 27' W.$

Sounding 102. 21st June. 2700 fathoms. Lat.  $36^{\circ} 33' N.$ , long.  $47^{\circ} 58' W.$

Sounding 103. 22nd June. 2750 fathoms. Lat.  $37^{\circ} 24' N.$ , long.  $44^{\circ} 14' W.$

Sounding 104. 23rd June. 2700 fathoms. Lat.  $37^{\circ} 54' N.$ , long.  $41^{\circ} 44' W.$

All a grey clay, same as No. 101.

In the dredge on the 20th there were a few manganese pellets.

Sounding 105. 24th June, 1873. 2175 fathoms. Lat.  $38^{\circ} 3' N.$ , long.  $39^{\circ} 19' W.$  A *Globigerina*-ooze of reddish colour containing:—Great numbers of pelagic Foraminifera, Coccoliths, and Rhabdoliths; some amorphous clayey matter of a red colour; a few Radiolarians.

Sounding 106. 25th June, 1873. 2200 fathoms. Lat.  $38^{\circ} 23' N.$ , long.  $37^{\circ} 21' W.$  A small quantity came up which indicated a *Globigerina*-ooze of a rather lighter colour than yesterday.

Sounding 107. 26th June, 1873. 1675 fathoms. Lat.  $38^{\circ} 25' N.$ , long.  $35^{\circ} 50' W.$  A *Globigerina*-ooze containing:—Great numbers of pelagic Foraminifera, Coccoliths, and Rhabdoliths; *Cypridina*-valves; a few Radiolaria (many more than usually); a few fine and coarse mineral particles.

Sounding 108. 27th June, 1873. 1675 fathoms. Lat.  $38^{\circ} 18' N.$ , long.

34° 48' W. A *Globigerina*-ooze (same as yesterday); a few grey-coloured concretions in the trawl.

Sounding 109. 28th June, 1873. 1240 fathoms. Lat. 38° 34' N., long. 32° 47' W. A *Globigerina*-ooze containing:—Great numbers of pelagic Foraminifera, Coccoliths, and Rhabdoliths; otoliths of fish; *Cypridina*-valves; *Echini*-spines; *Biloculina* and other Foraminifera; a few Radiolaria; many mineral particles, red, white, and black; volcanic sand.

Sounding 110. 30th June, 1873. 1000 fathoms. Lat. 38° 30' N., long. 31° 14' W. A *Globigerina*-ooze containing:—Many pelagic Foraminifera; Pteropods, Heteropods, and other surface shells; otoliths of fish, *Cypridina*-valves, *Echini*-spines, &c.; a few Radiolaria; a good many mineral particles, chiefly volcanic sand and pumice.

Sounding 111. 1st July, 1873. 1350 fathoms. Lat. 38° 22' N., long. 29° 37' W. A *Globigerina*-ooze containing:—Very many pelagic Foraminifera; Coccoliths and Rhabdoliths; amorphous calcareous matter; a good many Radiolarian and siliceous spines; many fine mineral particles, chiefly pumice and grains of volcanic sand.

Sounding between Fayal and Pico. 450 fathoms. 8 miles N.E. of Aorta. A grey mud containing:—Many mineral particles, as pumice, volcanic sandy particles (mica); many pelagic and other Foraminifera; Pteropods, Heteropods, surface Gasteropods, and small laval Lamellibranchs; a few siliceous spines.

Sounding 112. 3rd July, 1873. 900 fathoms. Lat. 38° 11' N., long. 27° 9' W. A white *Globigerina*-ooze containing:—Many pelagic Foraminifera; broken Pteropod shells, Coccoliths, and Rhabdoliths, &c.; a great deal of volcanic sand and disintegrating pumice; a few Radiolarians and siliceous spines.

Sounding 114. 10th July, 1873. 1000 fathoms. Off San Miguel Island. A grey mud containing:—Many fine and large particles of pumice, and black, red, and white particles of volcanic sand; some pelagic Foraminifera, Pteropods, and other surface shells.

Sounding 115. 11th July, 1873. 2025 fathoms. Lat. 36° 21' N., long. 23° 31' W. A white *Globigerina*-ooze containing:—Very many pelagic Foraminifera, Coccoliths and Rhabdoliths; a good deal of pumice and volcanic sand (mica); a few Radiolarians.

Sounding 116. 12th July, 1873. 2660 fathoms. Lat. 35° 3' N., long. 21° 25' W. A white *Globigerina*-ooze containing:—Many pelagic Foraminifera and their broken parts; a few Coccoliths and Rhabdoliths; a good deal of amorphous calcareous matter; a good many mineral particles, pumice, quartz, mica, &c.; a few Radiolarians.

Sounding 117. 13th July, 1873. 2675 fathoms. Lat. 34° 11' N., long. 19° 52' W. A white *Globigerina*-ooze containing:—Much amor-

phous calcareous matter; many pelagic Foraminifera and their broken parts; Coccoliths and Rhabdoliths; a good many mineral particles, coarse and fine pumice, quartz, mica; a few Radiolarians.

Sounding 118. 14th July, 1873. 2400 fathoms. Lat.  $33^{\circ} 46'$  N., long.  $19^{\circ} 17'$  W. A white *Globigerina*-ooze containing:—Many pelagic Foraminifera and their broken parts; Coccoliths and Rhabdoliths; amorphous calcareous matter; some fine and coarse black and white mineral particles; a few Radiolaria.

Sounding 119. 15th July, 1873. 1650 fathoms. Lat.  $33^{\circ} 13'$  N., long.  $18^{\circ} 13'$  W. A white *Globigerina*-ooze containing:—Very many pelagic Foraminifera; Coccoliths and Rhabdoliths; a good deal of fine volcanic sandy particles of a white, red, and black colour; a few Radiolaria.

Sounding 120. 19th July, 1873. 1125 fathoms. Lat.  $28^{\circ} 42'$  N., long.  $18^{\circ} 6'$  W. A brown or grey mud containing:—A large quantity of volcanic sand, the majority of the particles being black and brown; a few pelagic Foraminifera, Pteropods, Coccoliths, and Rhabdoliths; one or two Radiolaria. The dredge brought up some pieces of a dead Gorgonoid, with a coating of manganese.

Sounding 121. 21st July, 1873. 2300 fathoms. Lat.  $25^{\circ} 46'$  N., long.  $20^{\circ} 34'$  W. A *Globigerina*-ooze with a red tinge containing:—Many pelagic Foraminifera; Coccoliths and Rhabdoliths, and amorphous calcareous matter; a good deal of mineral matter of a white, red, and yellow colour, and a few grains of manganese.

Sounding 122. 21st July, 1873. 1675 fathoms. Lat.  $25^{\circ} 49'$  N., long.  $20^{\circ} 12'$  W. Four miles to the north of sounding No. 39. Three small pieces of a dead Gorgonoid covered with manganese came up.

Sounding 123. 22nd July, 1873. 2300 fathoms. Lat.  $23^{\circ} 58'$  N., long.  $21^{\circ} 18'$  W. A *Globigerina*-ooze with a red tinge containing:—Many pelagic Foraminifera; Coccoliths and Rhabdoliths; a good many red, white, and yellow mineral particles; a few manganese grains; one or two Radiolaria.

Sounding 124. 23rd July. 2400 fathoms. Lat.  $22^{\circ} 18'$  N., long.  $22^{\circ} 2' W.$

Sounding 125. 24th July. 2400 fathoms. Lat.  $20^{\circ} 58'$  N., long.  $22^{\circ} 57' W.$

Sounding 126. 25th July. 2075 fathoms. Lat.  $19^{\circ} 4'$  N., long.  $24^{\circ} 6' W.$

Sounding 127. 26th July. 1975 fathoms. Lat.  $17^{\circ} 54'$  N., long.  $24^{\circ} 41' W.$

All gave a *Globigerina*-ooze with a red tinge, and in other respects the same as No. 123.

- Sounding 128. 27th July, 1873. 1070 fathoms. Off San Antonio. A dark brown or grey mud containing:—Very many particles of volcanic sand of a red, white, yellow, and black colour.
- Sounding 129. 27th July, 1873. 1000 fathoms. Off St. Vincent. A bark brown or grey mud containing:—Much volcanic sand; pelagic Foraminifera and broken pieces of Pteropod; Coccoliths and Rhabdoliths; a few siliceous spines.
- Sounding 130. 27th July, 1873. 465 fathoms. Off St. Vincent. A dark brown or grey mud containing:—Much coarse volcanic sand; a few pelagic and other Foraminifera; a few Coccoliths; broken pieces of coral, Polyzoa, &c.
- Sounding 130 A. 27th July, 1873. 52 fathoms. Off St. Vincent. A coarse coral-sand, composed of:—Broken pieces of corallines, corals, Polyzoa, large Nummulinas and other Foraminifera, and a few pelagic Foraminifera, and Pteropods.
- 5th August, 1873. Off St. Vincent. 260 fathoms. A green sand, composed chiefly of:—Green, red, and black mineral particles; pelagic and other Foraminifera; broken pieces of Pteropods, Heteropods, Polyzoa, Coralline, &c.; one or two pale imperfect casts of the Pteropods.
- 5th August, 1873. Off St. Vincent. 675 fathoms. A grey mud containing:—Much volcanic sand; pelagic Foraminifera, Heteropods, Pteropods, and other surface shells; Coccoliths and Rhabdoliths.
- Sounding 131. 5th August, 1873. 1150 fathoms. Off St. Vincent. A grey *Globigerina*-ooze containing:—Very many pelagic Foraminifera; shells of Pteropods, Heteropods, larval Gasteropods, and Lamelli-branches; a good many particles of volcanic sand, of a red, white, and green colour; a few siliceous spines.

*St. Vincent to Bahia.*

- Sounding 132. 10th August, 1873. 2300 fathoms. Lat. 13° 36' N., long. 22° 49' W. A *Globigerina*-ooze of reddish tinge containing:—Very many pelagic Foraminifera; Coccoliths and Rhabdoliths; some amorphous clayey matter, and many fine mineral particles; a few Radiolarians.
- Sounding 133. 13th August, 1873. 2575 fathoms. Lat. 10° 25' N., long. 20° 30' W. A *Globigerina*-ooze containing:—Very many pelagic Foraminifera and a few Coccoliths; a good deal of amorphous clayey matter, and many very fine mineral particles; a few Radiolarians.
- Sounding 134. 14th August, 1873. 1750 fathoms. Lat. 9° 21' N., long. 18° 28' W. A blue mud containing:—Much amorphous

clayey matter; a good many fine mineral particles; a good many pelagic Foraminifera and Coccoliths; a few Radiolaria.

Sounding 136. 19th August, 1873. 2500 fathoms. Lat.  $5^{\circ} 48' N.$ , long.  $14^{\circ} 20' W.$  A dark blue mud containing:—Much amorphous clayey matter; many fine mineral particles; a few pelagic Foraminifera and their broken parts.

Sounding 137. 21st August, 1873. 2450 fathoms. Lat.  $3^{\circ} 8' N.$ , long.  $14^{\circ} 49' W.$  A grey *Globigerina*-ooze containing:—Very many pelagic Foraminifera and Coccoliths; much amorphous clayey matter and fine mineral particles; a good many Radiolaria.

Sounding 138. 22nd August, 1873. 2475 fathoms. Lat.  $2^{\circ} 49' N.$ , long.  $17^{\circ} 13' W.$  Some patches of a grey ooze came up on the outside of the tube.

Sounding 139. 23rd August, 1873. 2500 fathoms. Lat.  $2^{\circ} 25' N.$ , long.  $20^{\circ} 1' W.$  A grey *Globigerina*-ooze containing:—Many pelagic Foraminifera and a few Coccoliths; much amorphous clayey matter, and many fine white and red mineral particles; a few manganese grains.

Sounding 140. 24th August, 1873. 2275 fathoms. Lat.  $2^{\circ} 6' N.$ , long.  $22^{\circ} 53' W.$  Some traces of a grey ooze came up on the outside of the sounding-tube.

Sounding 141. 25th August, 1873. 1850 fathoms. Lat.  $1^{\circ} 47' N.$ , long.  $24^{\circ} 26' W.$  A grey *Globigerina*-ooze containing:—Many pelagic Foraminifera; many Coccoliths and Rhabdoliths; a little amorphous clayey and calcareous matter; a few white and red mineral particles; small manganese grains attached to many of the Foraminifera.

Sounding 142. 26th August, 1873. 1500 fathoms. Lat.  $1^{\circ} 22' N.$ , long.  $26^{\circ} 36' W.$  A grey *Globigerina*-ooze containing:—Many pelagic Foraminifera, Coccoliths, and Rhabdoliths; a few broken pieces of Pteropod shells; a little amorphous clayey matter and some fine mineral particles; one small piece of pumicestone.

Sounding 143. 27th August, 1873. 1900 fathoms. Lat.  $1^{\circ} 10' N.$ , long.  $28^{\circ} 23'.$  A grey *Globigerina*-ooze containing:—Many pelagic Foraminifera; Coccoliths; a good many Radiolarians; a little amorphous clayey matter, and a few white mineral particles.

Sounding 144. 29th August, 1873. 1425 fathoms. Off St. Paul's Rocks. A grey *Globigerina*-ooze containing:—Many pelagic Foraminifera:—a few Pteropod shells; Coccoliths; a good many mineral particles, mica, serpentine, &c.; one or two Radiolarians.

Off St. Paul's Rocks. 29th August, 1873. 780 fathoms. A grey *Globigerina*-ooze containing:—Many pelagic Foraminifera and Cocco-

liths ; a few Pteropod, Heteropod, and pelagic Gasteropod shells ; many rough crystalline particles, of a green, black, red, and white colour.

Sounding 145. 30th August, 1873. 2275 fathoms. Lat.  $0^{\circ} 9' N.$ , long.  $30^{\circ} 18' W.$  A *Globigerina*-ooze with reddish tinge containing :—Many pelagic Foraminifera ; Coccoliths ; some amorphous calcareous and clayey matter ; a good many Radiolarians ; a few fine crystalline particles.

Sounding 146. 31st August, 1873. 2475 fathoms. Lat.  $1^{\circ} 45' S.$ , long.  $30^{\circ} 58' W.$  A *Globigerina*-ooze of a red colour containing :—many pelagic Foraminifera and their broken parts ; a few Coccoliths ; much amorphous clayey matter ; many very fine mineral particles ; one or two Radiolaria.

About one half of this specimen was clayey, the other calcareous.

Sounding 147. 1st September, 1873. 2200 fathoms. Lat.  $3^{\circ} 33' S.$ , long.  $32^{\circ} 16' W.$  A white *Globigerina*-ooze containing :—Many pelagic Foraminifera ; Coccoliths and Rhabdoliths ; some red amorphous matter, and some red and white mineral particles.

Sounding 148. No bottom came up. 1010 fathoms. Off Fernando Noronha.

Sounding 149. No bottom came up. 820 fathoms. Lat.  $3^{\circ} 58' S.$ , long.  $32^{\circ} 42' W.$

Sounding 150. 3rd September, 1873. 2150 fathoms. Lat.  $4^{\circ} 2' S.$ , long.  $32^{\circ} 47' W.$  A white *Globigerina*-ooze containing :—Many pelagic Foraminifera ; Coccoliths and Rhabdoliths ; a few white and red mineral particles ; a few Radiolaria.

Sounding 151. 4th September, 1873. 2275 fathoms. Lat.  $5^{\circ} 1' S.$ , long.  $33^{\circ} 50' W.$  A *Globigerina*-ooze with a red tinge containing :—Many pelagic Foraminifera ; Coccoliths and Rhabdoliths ; amorphous matter and many fine white mineral particles ; one or two Radiolaria and siliceous spicules.

Sounding 152. 6th September, 1873. 1375 fathoms. Lat.  $5^{\circ} 56' S.$ , long.  $34^{\circ} 45' W.$  A red or yellow mud containing :—Much amorphous clayey matter ; many fine white and red mineral particles ; many pelagic Foraminifera, broken pieces of Pteropods and pelagic Gasteropods ; Coccoliths and Rhabdoliths.

Sounding 152A. 6th September, 1873. 500 fathoms. Off Brazilian coast. A red mud containing :—Much amorphous matter ; many mineral particles, quartz and mica ; a good many pelagic Foraminifera ; surface Gasteropods, Heteropods, and a few Coccoliths and Rhabdoliths.

Sounding 153. 8th September, 1873. 2050 fathoms. Lat.  $7^{\circ} 28' S.$ , long.  $34^{\circ} 2' W.$  A red or yellow mud containing :—Much amorphous clayey matter of a red colour ; many coarse and fine mineral particles, chiefly quartz and mica ; a good many pelagic Foraminifera ; Coccoliths and Rhabdoliths ; a few siliceous spicules, but no Radiolaria observed.

|               |                  | fathoms. |                           |                                 |  |
|---------------|------------------|----------|---------------------------|---------------------------------|--|
| Sounding 154. | 8th Sept., 1873. | 1650.    | Lat. $7^{\circ} 39' S.$ , | long. $34^{\circ} 12' W.$       |  |
| „ 155.        | 9th „            | 675.     | „ $8^{\circ} 37' S.$ ,    | „ $34^{\circ} 28' W.$           |  |
| „ 156.        | 9th „            | 500.     | „ $8^{\circ} 28' S.$ ,    | „ $34^{\circ} 31' W.$           |  |
| „ 157.        | 10th „           | 350.     | „ $9^{\circ} 5' S.$ ,     | „ $34^{\circ} 50' W.$           |  |
| „ A.          | 10th „           | 120.     | „ $9^{\circ} 10' S.$ ,    | „ $34^{\circ} 52' W.$           |  |
| „ B.          | 10th „           | 32.      | „ $9^{\circ} 9' S.$ ,     | „ $34^{\circ} 53' W.$           |  |
| „ c.          | 10th „           | 400.     | „ $9^{\circ} 10' S.$ ,    | „ $34^{\circ} 49' W.$           |  |
| „ 158.        | 11th „           | 1715.    | „ $10^{\circ} 9' S.$ ,    | „ $35^{\circ} 11' W.$           |  |
| „ 159.        | 11th „           | 1600.    | „ $10^{\circ} 11' S.$ ,   | „ $35^{\circ} 22' W.$           |  |
| „ 160.        | 12th „           | 1200.    | „ $10^{\circ} 46' S.$ ,   | „ $36^{\circ} 2' W.$            |  |
| „ 161.        | 12th „           | 700.     | „ $10^{\circ} 45' S.$ ,   | „ $36^{\circ} 9\frac{1}{2}' W.$ |  |
| „ 162.        | 13th „           | 1015.    | „ $11^{\circ} 42' S.$ ,   | „ $37^{\circ} 3' W.$            |  |
| „ 163.        | 14th „           | 1275.    | „ $13^{\circ} 6' S.$ ,    | „ $38^{\circ} 7' W.$            |  |

All these soundings along the coast of South America, from Cape San Roque to Bahia, gave a red or yellow mud as described under soundings 152 and 153. Those in the shallower depths were of a redder colour and contained larger mineral particles and fewer pelagic organisms than those in deeper water and further from the coast. Remains of siliceous organisms were almost entirely absent. In No. 157 A, 120 fathoms, there were a few red-coloured internal casts of Foraminifera.

*Bahia to Cape of Good Hope.*

Sounding 164. 30th September, 1873. 2150 fathoms. Lat.  $20^{\circ} 13' S.$ , long.  $35^{\circ} 19' W.$  A red mud containing :—Much amorphous clayey matter ; many fine mineral particles, mica, quartz, &c. ; many pelagic Foraminifera ; Coccoliths and Rhabdoliths ; a few manganese grains ; no siliceous things noticed.

Sounding 165. 3rd October, 1873. 2350 fathoms. Lat.  $26^{\circ} 15' S.$ , long.  $32^{\circ} 56' W.$  A red or grey clay containing :—Much amorphous clayey matter ; a few rather large and many very small white mineral particles ; a good many remains of pelagic Foraminifera ; a few Coccoliths and Rhabdoliths ; a few small manganese pellets.

Sounding 166. 6th October, 1873. 2275 fathoms. Lat.  $29^{\circ} 35' S.$ , long.  $28^{\circ} 9' W.$  A grey clay containing :—Much amorphous clayey matter and some amorphous calcareous matter ; a few rather large and many very small mineral particles, quartz, pumice, &c. ; a good

many pelagic Foraminifera; Coccoliths and Rhabdoliths; one or two pieces of Diatoms; a few manganese grains.

The dredge brought up an ear-bone of a Cetacean and a piece of pumice, both coated with the peroxide of manganese.

Sounding 167. 10th October, 1873. 2050 fathoms. Lat.  $35^{\circ} 25' N.$ , long.  $23^{\circ} 40' W.$  A white *Globigerina*-ooze containing:—Very many pelagic Foraminifera; Coccoliths and Rhabdoliths; a little amorphous calcareous and clayey matter; a good many Radiolaria; a few yellow, red, and white mineral particles.

Sounding 168. 11th October, 1873. 1900 fathoms. Lat.  $35^{\circ} 41' S.$ , long.  $20^{\circ} 55' W.$  A white *Globigerina*-ooze containing:—Very many pelagic Foraminifera; Coccoliths and Rhabdoliths; a little amorphous calcareous and clayey matter; a few Radiolarians and siliceous spines; a few coarse and fine mineral particles.

Sounding 169. 14th October, 1873. 2025 fathoms. Lat.  $36^{\circ} 12' S.$ , long.  $12^{\circ} 16' W.$  A grey *Globigerina*-ooze containing:—Many pelagic Foraminifera; Coccoliths and Rhabdoliths; some amorphous clayey and calcareous matter; many sandy particles, of a red, white, and black colour; a good many Radiolaria.

Off Tristan d'Acunha. 15th October, 1873. 360 fathoms. A dark grey mud containing:—Much volcanic sand of a black and red colour (olivine &c.); a few pelagic Foraminifera, Pteropods, surface Gasteropods, &c.

Sounding 170. 18th October, 1873. 1100 fathoms. Off Tristan d'Acunha. A piece of shell came up in the tube. In the dredge were several lumps of pumice.

Sounding 172. 20th October, 1873. 2100 fathoms. Lat.  $36^{\circ} 43' S.$ , long.  $7^{\circ} 13' W.$  No bottom came up.

Sounding 173. 23rd October, 1873. 2550 fathoms. Lat.  $35^{\circ} 59' S.$ , long.  $1^{\circ} 34' E.$  A red clay containing:—Much amorphous clayey matter; a few rather coarse and many very fine mineral particles; a few broken remains of pelagic Foraminifera and a few Coccoliths; a few Radiolarians; a few manganese grains.

Sounding 174. 25th October, 1873. 2650 fathoms. Lat.  $36^{\circ} 22' S.$ , long.  $8^{\circ} 12' E.$  A red clay containing:—Much amorphous clayey matter; very many coarse and fine white mineral particles (quartz and pumice); a good many broken remains of pelagic Foraminifera; a few Radiolarians; a small tooth of shark; a few pellets of black manganese.

Sounding 175. 27th October, 1873. 2325 fathoms. Lat.  $35^{\circ} 35' S.$ , long.  $16^{\circ} 8' E.$  A blue mud containing:—Many pelagic Foraminifera, Coccoliths, and Rhabdoliths; very many mineral particles,

mostly of a white colour (quartz), but also many dark and light green coloured (glauconite); a few Radiolarians and siliceous spines; a few pellets of manganese.

Sounding 176. 28th October, 1873. 1250 fathoms. Lat.  $35^{\circ} 0' S.$ , long.  $17^{\circ} 57' E.$  A blue mud containing:—Much amorphous clayey matter; very many sandy particles, quartz and green glauconite grains; a good many pelagic Foraminifera, Cocoliths, and Rhabdoliths; a few Radiolaria and siliceous spines.

#### SOUTHERN OCEAN.

##### *Cape of Good Hope to Australia.*

Simon's Bay. 20 fathoms. Dredges gave a bottom composed of sandy particles, quartz and green and black particles, pieces of broken shells, Echinoderm shells, Foraminifera, &c.; mixed up with these was much amorphous matter, which gave a green colour to the bottom.

Sounding 177. 17th December, 1873. 100 fathoms. Lat.  $34^{\circ} 41' S.$ , long.  $18^{\circ} 36' E.$  A green mud containing:—Very many small light and dark green mineral particles, usually of a rounded form, and quartz, mica, &c.; a good many pelagic Foraminifera; other Foraminifera, as Textularias, Rotalias, Uvigerinas, Nummulinas, &c.; a few siliceous spines and Diatoms; green-coloured amorphous matter; many casts of the Foraminifera, *Echini*-spines, and other carbonate-of-lime organisms in pale green substance (glauconite).

18th December, 1873. 150 fathoms. Agulhas Bank. Lat.  $35^{\circ} 4' S.$ , long.  $18^{\circ} 37' E.$  Same kind of bottom as No. 177.

Sounding 178. 19th December, 1873. 1900 fathoms. Lat.  $36^{\circ} 48' S.$ , long.  $19^{\circ} 24' E.$  A white *Globigerina*-ooze containing:—Very many pelagic Foraminifera and Cocoliths; a great many mineral particles, quartz, and a red and green mineral; one or two parts of siliceous spines, but no Radiolarians: a few casts of the Foraminifera remained after treatment with acid; some of these were pure white, others had a greenish tinge.

The dredge brought up some stones of a black colour. These were very hard, and made up of *Globigerina* and small green and white particles imbedded in a grey flinty-like matrix. Internal casts of the Foraminifera in this flinty-like substance remained when portions of these concretions were treated with acid. The black colour was due to a thin coating of the peroxide of manganese.

Sounding 179. 24th December, 1873. 1570 fathoms. Lat.  $45^{\circ} 57' S.$ , long.  $34^{\circ} 39' E.$  A white *Globigerina*-ooze containing:—Very many pelagic Foraminifera and Cocoliths; a few Radiolarians and Dia-

toms ; a few white, red, and green mineral particles, some of them rather large.

26th and 27th December, 1873. 50 to 150 fathoms. Off Prince-Edward Island. The dredges in these depths gave a black or dark-grey sand containing :—Many black or brown mineral particles ; pieces of broken shells ; Polyzoa ; Echinoderms ; some pelagic and other Foraminifera.

Sounding 180. 29th December, 1873. 1375 fathoms. Lat.  $46^{\circ} 46' S.$ , long.  $45^{\circ} 31' E.$  A white *Globigerina*-ooze containing :—Many pelagic Foraminifera and a few Coccoliths ; many Radiolarian and Diatom remains ; a few mineral particles of a white and green colour.

The fine parts of the sounding were nearly all Diatom remains.

Sounding 181. 30th December, 1873. 1600 fathoms. Lat.  $46^{\circ} 16' S.$ , long.  $48^{\circ} 27' E.$  A grey *Globigerina*-ooze containing :—Many pelagic Foraminifera (Coccoliths and Pulvinulinas appeared wholly absent) ; many Diatoms and Radiolaria ; many white, black, and red mineral particles.

The finer portions appeared wholly made up of the broken frustules of Diatoms.

Sounding 182. 1st January, 1874. 600 fathoms. Off the Crozet Islands. A grey mud containing :—Many pelagic Foraminifera ; *Globigerinas* (*Orbulinas*, *Pulvinulinas*, and *Coccoliths* appeared to be quite absent) ; very many remains of Diatoms and Radiolaria ; many black, yellow, and red sandy particles.

Beautiful casts of the *Echini*-spines and Foraminifera remained after treatment with acid. These were of a pale straw-colour (green glauconitic particles were not observed in this sounding).

January 1874. 20 to 100 fathoms. During this month many soundings were taken off the east coast of Kerguelen Land in from 20 to 100 fathoms. The tube always brought up grey or blue mud containing :—Very many sandy particles of white, red, and black colour ; many Diatoms and spicules of sponges.

The soundings furthest from the coast were mostly a network of sponge-spicules and frustules of Diatoms.

2nd February, 1874. 150 fathoms. Between Kerguelen and Heard Islands. The bag of the trawl came up with many basaltic and other pebbles, to which many Brachiopods were attached and some frustules of Diatoms adhered.

7th February, 1874. 75 fathoms. Off Heard Island. The bottom was a grey sandy mud containing many black sandy particles, sponge-spicules, Diatoms, &c., as off Kerguelen.

Sounding 184. 11th February, 1874. 1260 fathoms. Lat.  $60^{\circ} 52' S.$ , long.  $80^{\circ} 20' E.$  A diatomaceous ooze of pure white colour containing:—Chiefly frustules of Diatoms and their broken-down parts; many Radiolaria; a few *Globigerina*; a few white, black, and red mineral particles (mica).

Sounding 185. 14th February, 1874. 1675 fathoms. Lat.  $65^{\circ} 42' S.$ , long.  $79^{\circ} 48' E.$  A blue mud (greenish tinge) containing:—Much amorphous clayey matter; a great many white, black, and yellow sandy particles (quartz &c.); some granitic pebbles; a good many frustules of Diatoms amongst the amorphous matter; a few Radiolaria; two small *Globigerina* were noticed in the portion examined. The mud did not effervesce with acid.

Sounding 186. 19th February, 1874. 1800 fathoms. Lat.  $64^{\circ} 37' S.$ , long.  $85^{\circ} 49' E.$  A blue mud containing:—Much amorphous clayey matter; some coarse and a very great number of very fine mineral particles, as quartz, mica, and black and yellow particles; a good many frustules of Diatoms and a few Radiolaria; one or two small *Globigerina*.

The above two soundings are in many respects like those we usually got when approaching a continent or large island, especially like those soundings off the coast of North America at 80 to 100 miles from the coast.

Sounding 187. 23rd February, 1874. 1300 fathoms. Lat.  $54^{\circ} 18' S.$ , long.  $94^{\circ} 47' E.$  A yellowish-blue mud containing:—Much amorphous matter; many coarse and fine mineral particles, quartz, mica, and red and yellow particles; many remains of Diatoms and Radiolaria; a good many pelagic Foraminifera (small *Globigerina* only); might be called a Diatom-ooze.

Sounding 188. 26th February, 1874. 1975 fathoms. Lat.  $62^{\circ} 36' S.$ , long.  $95^{\circ} 44' E.$  A diatomaceous ooze containing chiefly (of a yellow colour):—The frustules of Diatoms and their broken-down parts; many Radiolaria; no pelagic Foraminifera in the portion examined; a few quartz, mica, and other mineral particles; a few granitic pebbles came up in the trawl.

Sounding 189. 3rd March, 1874. 1950 fathoms. Lat.  $53^{\circ} 55' S.$ , long.  $108^{\circ} 35' E.$  A diatomaceous ooze of a straw-colour containing chiefly:—The frustules of Diatoms and their broken-down parts; many Radiolaria; a few small *Globigerina*; one or two quartz and mica particles.

Sounding 190. 7th March, 1874. 1800 fathoms. Lat.  $50^{\circ} 1' S.$ , long.  $123^{\circ} 4' E.$  A white *Globigerina*-ooze containing:—Very many pelagic Foraminifera (*Globigerina*, Pulvinulinas, and a few Orbulinas); Coccoliths; a good many Diatoms and Radiolaria; one or two quartz particles and one or two pieces of a cherty-like mineral.

Sounding 191. 10th March, 1874. 2150 fathoms. Lat.  $47^{\circ} 25' S.$ , long.  $130^{\circ} 32' E.$  A *Globigerina*-ooze, with a red tinge, containing:—Very fine pelagic Foraminifera, Coccoliths, and Rhabdoliths; a few Diatoms and Radiolaria; one or two small white mineral particles, and one or two red and black manganese grains.

Sounding 192. 13th March, 1874. 2600 fathoms. A red clay containing:—Much amorphous clayey matter; many very fine white mineral particles and a few black obsidian-like particles and manganese grains; a few whole and many broken pieces of pelagic Foraminifera and a few Coccoliths; two Radiolarians noticed; no Diatoms.

The trawl brought up many round manganese concretions or nodules, and one or two shark's teeth.

*Melbourne to Sydney.*

Sounding 193. 4th April, 1874. 2200 fathoms. Lat.  $36^{\circ} 56' S.$ , long.  $150^{\circ} 30' E.$  A green mud containing:—Amorphous clayey matter; many fine mineral particles, quartz, mica, and green glauconite particles, &c.; a good many pelagic Foraminifera and Coccoliths; a few broken pieces of Pteropod shells; a few remains of Diatoms and siliceous spines.

*Sydney to Wellington.*

12th June, 1874. Off Port Jackson. 120, 290, and 650 fathoms. Soundings at these depths gave a greenish mud containing:—Many coarse sandy particles; quartz, mica, and glauconite particles; many pelagic and other Foraminifera; broken pieces of Pteropod and other surface shells, Echinoderm spines, &c.

In the shallower soundings there were great numbers of green casts of the Foraminifera and other shells.

Sounding 194. 24th June, 1874. 950 fathoms. Lat.  $34^{\circ} 8' S.$ , long.  $152^{\circ} 0' E.$  A green mud containing:—Many fine and coarse mineral particles, quartz, mica, green and red minerals; many pelagic Foraminifera, Coccoliths, and Rhabdoliths; a few siliceous spines; many pale white casts of the Foraminifera remained after treatment with acid.

Sounding 195. 13th June, 1874. 1200 fathoms. Lat.  $34^{\circ} 9' S.$ , long.  $151^{\circ} 55' E.$  A greenish mud containing:—Very many fine and some coarse mineral particles, quartz, mica, green and red minerals; very many pelagic Foraminifera, Coccoliths, and Rhabdoliths; a few pieces of siliceous spines.

A few white casts of Foraminifera remained after treatment with acid.

Sounding 196. 13th June, 1874. 400 fathoms. Lat.  $34^{\circ} 19' S.$ , long.  $151^{\circ} 31' E.$  A green mud containing:—Very many sandy particles;

quartz, mica, glauconite, and red and black minerals; many pelagic and other Foraminifera, Coccoliths, and Rhabdoliths; a few siliceous spines.

Beautiful and wonderfully perfect casts of the carbonate-of-lime organisms remained after treatment with acid, as *Echini*-spines, Polyzoa, and Foraminifera, &c. Some of these were dark green, some pale green, and others a dirty white colour.

Compare 600 fathoms, off Crozets.

Soundings 197 and 198. Lines parted.

Sounding 199. 17th June, 1874. 2600 fathoms. Lat.  $34^{\circ} 50' S.$ , long.  $155^{\circ} 28' E.$  A red clay containing:—Amorphous clayey matter; many exceedingly fine mineral particles, quartz, mica, red and green particles (pumice?); a good many broken pieces of pelagic Foraminifera and a few Coccoliths; one or two pieces of siliceous spines; one or two manganese grains.

Sounding 200. 19th June, 1874. 2600 fathoms. Lat.  $36^{\circ} 41' S.$ , long.  $158^{\circ} 29' E.$  A red clay containing:—Amorphous clayey matter; many very fine mineral particles of a white and black colour; a few broken pieces of pelagic Foraminifera; a few broken parts of Radiolaria; a few manganese grains.

Sounding 201. 21st June, 1874. 1975 fathoms. Lat.  $37^{\circ} 53' S.$ , long.  $163^{\circ} 18' E.$  A white *Globigerina*-ooze containing:—Very many pelagic Foraminifera, Coccoliths, and Rhabdoliths; much amorphous calcareous and some clayey matter; a good many Radiolaria; one or two black and small white mineral particles (scoria and pumice?).

Sounding 202. 22nd June, 1874. 1100 fathoms. Lat.  $38^{\circ} 36' S.$ , long.  $166^{\circ} 39' E.$  A *Globigerina*-ooze containing:—Very many pelagic Foraminifera, Coccoliths, and Rhabdoliths; some amorphous calcareous matter; a good many Radiolarians and some Diatom remains; one or two small green and red mineral particles.

There were one or two nearly pure white casts of Foraminifera.

Sounding 203. 23rd June, 1874. 275 fathoms. Lat.  $38^{\circ} 50' S.$ , long.  $169^{\circ} 20' E.$  A small quantity which came up indicated *Globigerina*-ooze, containing:—Many pelagic and other Foraminifera; many Coccoliths, Rhabdoliths, and *Echini*-spines.

The trawl brought up many *Globigerinas*, *Pulvinulinas*, *Orbulinas*, and other Foraminifera, *Echini*-spines, surface-shells, &c. All the finer portions of the bottom had been washed out of the bag.

23rd June, 1874. 400 fathoms. A *Globigerina*-ooze containing:—Many pelagic Foraminifera, Coccoliths, and Rhabdoliths (the Coccoliths were very large and numerous, and made up perhaps 15 cwt. of the bottom); one or two Radiolarians and a few remains of Diatoms; a few white and small green mineral particles.

Many internal casts of the Foraminifera remained after treatment with acid. These were green and grey coloured. The smaller chambers were frequently green, while the larger ones were white or grey coloured.

24th June, 1874. 400 fathoms. A blue mud containing :—Very many small sandy particles, as quartz, mica, &c.; amorphous clayey matter; many pelagic Foraminifera and a few Cocoliths; no Radiolarians and no casts of the Foraminifera noticed.

24th June, 1874. 150 and 140 fathoms. The dredge contained a blue mud, containing :—Amorphous clayey matter; many small rounded green and black particles (glauconite), as on the Agulhas Bank; many pelagic Foraminifera, a few pale internal green casts of which remained after treatment with acid.

24th and 25th June, 1874. Off D'Urville Island, New Zealand, in 75, 49, 39, 40, and 32 fathoms. All gave a blue mud containing :—Many sandy particles; amorphous matter; portions of Echinoderms; shells; shore forms of Foraminifera &c.

*Wellington, New Zealand, to Fiji Islands.*

Sounding 204. 8th July, 1874. 1100 fathoms. Lat.  $40^{\circ} 28' S.$ , long.  $177^{\circ} 43' E.$  A blue mud, with a thin red top layer, containing :—Amorphous matter; many fine and coarse sandy particles, as quartz, pumice, mica, &c.; a few pelagic Foraminifera and Cocoliths; a few siliceous spines.

Sounding 205. 10th July, 1874. 700 fathoms. Lat.  $37^{\circ} 34' S.$ , long.  $179^{\circ} 22' E.$  A blue mud, with a thin red upper layer, containing :—Amorphous clayey matter; many fine and coarse sandy particles, as quartz, pumice, &c.; a few pelagic Foraminifera and Cocoliths.

Soundings 206 and 206A. 14th July, 1874. 520–600 fathoms. Off Kermadec Island. Traces of a grey mud came up on the sounding-tube. This contained a few pelagic Foraminifera and many sandy particles; the dredge brought up some very large pieces of pumice and some other pieces of volcanic rock.

Sounding 207. 15th July, 1874. 600 fathoms. Lat.  $28^{\circ} 33' S.$ , long.  $177^{\circ} 50' W.$  No bottom in the sounding-tube.

The dredge brought up many pieces of pumicestone.

Sounding 208. 17th July, 1874. 2900 fathoms. Lat.  $25^{\circ} 5' S.$ , long.  $172^{\circ} 56' E.$  A red clay containing :—Much amorphous clayey matter; many fine white mineral particles and a few larger pieces of pumice; one or two portions of Radiolaria; a few manganese grains.

No trace of carbonate of lime in this sounding. The fine mineral particles appeared to be broken-down pieces of pumice.

Sounding 208A. 22nd July, 1874. 18 fathoms. Inside the reef, Tonga-

tabu. A coral-mud containing:—Some amorphous calcareous matter; débris of coral reefs; immense numbers of Orbitolites, and a few other shore forms of Foraminifera, Pteropods, &c.

22nd July, 1874. 240 fathoms. Outside the reef, Tongatabu. A coral-mud containing:—Much amorphous calcareous matter; débris of coral reefs; pelagic and other Foraminifera, &c.

24th July, 1874. 315 fathoms. Off Matuka Island, Fiji Islands. A coral-mud containing:—Much amorphous calcareous matter; débris of coral; pelagic Foraminifera, Pteropods, Heteropods, and other surface shells and shore forms of Foraminifera; a few black mineral particles.

Off Kandavu, Fiji Islands. 3rd August, 1874. 140 fathoms. Inside the reef. A coral-mud containing:—Much amorphous calcareous matter; shore forms of Foraminifera, Pteropods, spicules of sponges, &c.; a few green and red mineral particles.

3rd August, 1874. 255 and 210 fathoms. Outside the reef, Kandavu. A coral-mud containing:—Much amorphous calcareous matter; débris of coral; Pteropods, Heteropods, and surface Gasteropods; pelagic and other Foraminifera, Coccoliths, and Rhabdoliths; a few sponge-spicules; a few green and red mineral particles.

A few internal casts of the Foraminifera and Pteropods remained after treatment with acid.

Sounding 209. 3rd August, 1874. 610 fathoms. A coral-mud containing:—Amorphous calcareous and some red clayey matter; many Pteropod, Heteropod, larval Gasteropod, and Lamellibranch shells; pelagic Foraminifera, Coccoliths, and Rhabdoliths; a few red and white mineral particles and rather large pieces of pumice.

Sounding 210. 12th August, 1874. 1350 fathoms. Lat.  $19^{\circ} 2' S.$ , long.  $177^{\circ} 10' E.$  A *Globigerina*-ooze of a red colour containing:—Some amorphous calcareous and clayey matter; very many pelagic Foraminifera, Coccoliths, and Rhabdoliths; very small mineral particles, as pumice; a black scoria-like mineral and manganese grains; one or two broken pieces of siliceous spines.

The trawl brought up many pieces of pumice, some having a slight coating of peroxide of manganese.

Sounding 211. 15th August, 1874. 1450 fathoms. Lat.  $18^{\circ} 30' S.$ , long.  $173^{\circ} 52' E.$  A *Globigerina*-ooze of a red colour containing:—Some amorphous calcareous and clayey matter; very many pelagic Foraminifera, Coccoliths, and Rhabdoliths; a good many small pieces of pumice and black and red mineral particles, and some manganese grains.

Many very complete casts of the Foraminifera, of a red colour, remained after treatment with acid. In many cases the red substance

had coated as well as filled the shell, so that we had both an external and internal cast, the two linings connected by pillars representing the foramina of the shell.

18th August, 1874. Off Api, New Hebrides. 67, 70, and 125 fathoms. The bottom in each case was a black volcanic sand, with which were mixed Foraminifera and Pteropod shells.

Sounding 212. 19th August, 1874. 2650 fathoms. Lat.  $16^{\circ} 47' S.$ , long.  $165^{\circ} 20' E.$  A red clay containing:—Much amorphous clayey matter; many fine mineral particles, pumice, and black and brown particles; a few manganese grains; one or two Radiolaria; no carbonate of lime.

Sounding 213. 21st August, 1874. 2325 fathoms. Lat.  $15^{\circ} 58' S.$ , long.  $160^{\circ} 48' E.$  A red clay containing:—Much amorphous clayey matter; many small mineral particles, as pumice, mica, red mineral, &c.; a few remains of pelagic Foraminifera and a few Coccoliths.

Sounding 214. 24th August, 1874. 2450 fathoms. Lat.  $14^{\circ} 7' S.$ , long.  $153^{\circ} 43' E.$  A red clay containing:—Much amorphous clayey matter; many very fine mineral particles, as pumice &c.; a few broken remains of pelagic Foraminifera; a few manganese grains.

Sounding 215. 25th August, 1874. 2440 fathoms. Lat.  $13^{\circ} 50' S.$ , long.  $151^{\circ} 49' E.$  A red clay containing, in the upper half of the tube:—Much amorphous clayey matter; many fine mineral particles, as pumice &c.; a few Radiolaria; no carbonate-of-lime organisms. In the lower half of the tube a much lighter-coloured clay containing:—Amorphous clayey matter; fine mineral particles; a few Radiolaria; a great many pelagic Foraminifera and Coccoliths, which appeared to be entirely absent in the upper layers.

The trawl brought up many pieces of pumice, varying from the size of a pea to that of an egg.

Sounding 216. 27th August, 1874. 2275 fathoms. Lat.  $13^{\circ} 6' S.$ , long.  $148^{\circ} 37' E.$  A small quantity of bottom came up, which indicated a grey clay containing:—Amorphous clayey matter; fine mineral particles; a few pelagic Foraminifera, Coccoliths, and Rhabdoliths.

Sounding 217. 28th August, 1874. 1700 fathoms. Lat.  $13^{\circ} 42' S.$ , long.  $146^{\circ} 46' E.$  A *Globigerina*-ooze of a light brown colour containing:—Many pelagic Foraminifera, Coccoliths, and Rhabdoliths; amorphous clayey matter; some fine mineral particles; one or two parts of Radiolaria.

Sounding 218. 29th August, 1874. 1400 fathoms. Lat.  $12^{\circ} 8' S.$ , long.  $145^{\circ} 10' E.$  A *Globigerina*-ooze of a light brown colour containing:—Many pelagic Foraminifera, Coccoliths, and Rhabdoliths;

a good deal of amorphous clayey and calcareous matter; fine mineral particles (pumice); a few siliceous spines.

The trawl contained several pieces of water-logged cocoanut wood and some pieces of pumice.

Soundings inside the Barrier reef gave:—A coral-mud, made up of much amorphous calcareous matter, débris of coral, Foraminifera, &c.

9th to 16th September, 1874. 10 to 70 fathoms. The soundings and dredgings between Cape York and the Arru Islands, across the Arafura Sea, were all shallow water, 10 to 70 fathoms. In each case the bottom was a green mud containing:—Many sandy particles, as quartz, mica, and rounded mineral particles of a green and black colour; much amorphous green-coloured clayey matter; broken pieces of shell; shore forms of Foraminifera, as *Textularias*, *Rotalias*, &c., and *Echini*-spines &c.; a few remains of Diatoms.

After treatment with acid there always remained internal casts of the Foraminifera. Pelagic Foraminifera, Coccoliths, Rhabdoliths, Pteropods, and Radiolaria appeared to be nearly or quite absent in the bottom and in the surface-waters.

#### *Cape York to Hongkong.*

Sounding 219. 23rd September, 1874. 800 fathoms. Lat.  $5^{\circ} 41' S.$ , long.  $134^{\circ} 4' E.$  A green mud containing:—Much green amorphous clayey matter; many small mineral particles of a white, black, and green colour; a few pelagic and other Foraminifera; a few Radiolarians and Diatoms.

Sounding 220. 24th September, 1874. 580 fathoms. Lat.  $5^{\circ} 26' S.$ , long.  $133^{\circ} 19' E.$  A green mud containing:—Green-coloured amorphous matter; very many pelagic Foraminifera, Pteropods, and Coccoliths; a great many small mineral particles; one or two Radiolaria and a few Diatoms.

Many pale-green casts of the Foraminifera remained after treatment with acid. A section of 2 feet 3 inches came up in the tube; the lower layers were of a blue rather than a green colour, and contained fewer Foraminifera than the upper layers.

26th September, 1874. 129 fathoms. A blue mud containing:—A great many pelagic Foraminifera and some Pteropod shells.

These were imbedded in a fine amorphous mud of a blue colour. In the dredge there came up some large pieces of rock, which required a sharp blow with a hammer to break. They contained many Foraminifera, and appeared to be merely hardened portions of the bottom.

Sounding 221. 28th September, 1874. 2800 fathoms. Banda Sea. Lat.  $5^{\circ} 24' S.$ , long.  $130^{\circ} 37' E.$  A blue mud with a red upper layer, containing:—Amorphous clayey matter; many fine and a few

rather coarse mineral particles of a white, green, and black colour ; a few Radiolarian remains ; no carbonate of lime.

29th September, 1874. 200 fathoms. Bottom composed of pebbles and sandy particles, and a few pelagic Foraminifera.

Sounding 222. 3rd October, 1874. 1425 fathoms. Lat.  $4^{\circ} 21' S.$ , long.  $129^{\circ} 7' E.$  A blue mud with reddish upper layer, containing:—Much amorphous clayey matter ; many sandy particles of a green and black colour and pumice ; many pelagic Foraminifera and Coccoliths ; a good many Radiolaria.

The trawl brought up soft mud of a brownish colour, in which were imbedded some large lumps of blue mud, also pieces of wood and fruits.

Molucca Passage. 13th October, 1874. 825 fathoms. Lat.  $0^{\circ} 48' S.$ , long.  $126^{\circ} 58' E.$  Sounding 223. No bottom came up.

Sounding 224. 14th October, 1874. 1200 fathoms. Lat.  $0^{\circ} 41' N.$ , long.  $126^{\circ} 37\frac{1}{2}' E.$  A small quantity of bottom came up, which indicated a grey mud, containing:—Very many particles of volcanic sand ; a few Foraminifera and Radiolaria.

#### *Celebes Sea.*

Sounding 225. 20th October, 1874. 2150 fathoms. Lat.  $2^{\circ} 55' N.$ , long.  $124^{\circ} 53' E.$  A grey or red mud, containing:—Amorphous clayey matter ; many fine mineral particles of black, green, and red colour (pumice) ; a good many Radiolaria ; no carbonate of lime.

Sounding 226. 22nd October, 1874. 2600 fathoms. Lat.  $5^{\circ} 44' N.$ , long.  $123^{\circ} 34' E.$  A grey or brown mud, containing:—Red amorphous clayey matter ; very many fine and coarse mineral particles, as quartz, mica, and green minerals ; a few Radiolaria ; no carbonate of lime.

23rd October, 1874. 255 fathoms. A small quantity of bottom came up, which indicated a green mud, containing:—Amorphous clayey matter ; many mineral particles ; pelagic Foraminifera ; Coccoliths ; *Acanthometra*-spines and Diatoms.

#### *Sulu Sea.*

26th October, 1874. 98 and 102 fathoms. Several basaltic pebbles came up in the sounding-tube. In the dredge there was a large pebble covered with *Carpenteria* (c. f.).

Sounding 227. 27th October, 1874. 2550 fathoms. Lat.  $8^{\circ} 32' N.$ , long.  $121^{\circ} 55' E.$  A blue mud with reddish upper layer, containing:—Very many fine particles of minerals—quartz, mica, and a green and a red mineral ; a few Radiolaria and Diatoms ; one or two *Globigerina* and Coccoliths ; a few manganese grains.

2nd November, 1874. 100 fathoms. A green mud containing:—Amorphous matter; many pelagic and other Foraminifera; Pteropods, Heteropods, surface Gasteropods, and larval Lamellibranch shells; many quartz, mica, and green and black mineral particles; a few siliceous spines.

Very complete casts of the carbonate-of-lime organisms in pale green remained after treatment with acid.

2nd November, 1874. 705 fathoms. Lat.  $12^{\circ} 24' N.$ , long.  $122^{\circ} 15' E.$  A green mud containing:—Much amorphous clayey matter; very many fine mineral particles of quartz, mica, and a green mineral; a few pelagic Foraminifera and a few broken pieces of Pteropods and other surface shells; a few Coccoliths.

*China Sea.*

Sounding 229. 13th November, 1874. 1050 fathoms. Lat.  $16^{\circ} 42' N.$ , long.  $119^{\circ} 22' E.$  A grey mud containing:—A great deal of amorphous clayey matter; many fine black, white, and green mineral particles; a good many pelagic Foraminifera; a few Coccoliths; one or two manganese grains.

*China and Sulu Seas.*

Sounding 230. 8th January, 1875. 2100 fathoms. Lat.  $17^{\circ} 54' N.$ , long.  $117^{\circ} 14' E.$  A blue mud with reddish upper layer, containing:—Much amorphous clayey matter; many fine white and a few large black mineral particles; a good many Radiolarian remains; one or two broken pieces of Radiolarians.

Sounding 231. 16th January, 1875. 700 fathoms. Lat.  $12^{\circ} 21' N.$ , long.  $122^{\circ} 15' E.$  A blue mud containing:—Amorphous clayey matter; many fine mineral particles; a few Globigerinas, Pulvinulinas, and Orbulinas; Pteropods and Coccoliths; a few Radiolarian remains and Diatoms.

22nd January, 1875. 90 to 150 fathoms. *Euplectella*-ground, Zebu. A soft blue mud containing:—Amorphous clayey matter; many fine sandy particles; a few pelagic and other Foraminifera; a few shells of larval Gasteropods and Lamellibranchs; a few siliceous spines.

25th January, 1875. 375 fathoms. Sounding 232. Lat.  $9^{\circ} 26' N.$ , long.  $123^{\circ} 45' E.$  A blue mud containing:—Amorphous clayey matter; very many fine mineral particles; a few pelagic and other Foraminifera; Pteropod and other surface shells; a few Radiolarian and Diatom remains.

26th January, 1875. 185 fathoms. Off Camiguin Island, New Volcano. A green mud containing:—Very many red, white, and black mineral particles; green amorphous clayey matter; a few pelagic Foraminifera.

fera ; Pteropod and other shells ; a few *Acanthometræ* and Diatom remains.

Sounding 233. 28th January, 1875. 2225 fathoms. Lat.  $8^{\circ} 0' N.$ , long.  $121^{\circ} 42' E.$  A blue mud with an upper red layer, containing :—Much amorphous clayey matter ; many fine mineral particles of a white, black, and green colour. A good many Diatoms and Radiolaria ; one or two small pieces of pelagic Foraminifera.

Sounding 234. 8th February, 1875. 2050 fathoms. Lat.  $5^{\circ} 47' N.$ , long.  $124^{\circ} 1' E.$  A blue mud with an upper reddish tinge, containing :—Amorphous clayey matter ; many fine and coarse minerals ; a great many Diatom and Radiolarian remains ; one or two broken portions of pelagic Foraminifera ; a few manganese grains.

Dredge brought up some hardened lumps of the bottom ; these were traversed by black streaks (manganese), and had imbedded in them some pieces of wood.

Sounding 235. 10th February, 1875. 500 fathoms. Lat.  $4^{\circ} 33' N.$ , long.  $127^{\circ} 6' E.$  A grey ooze containing :—Very many pelagic Foraminifera, Pteropods, and other surface shells ; many coarse and fine mineral particles of a white, black, and green colour ; a few pale white casts of the Foraminifera.

The dredge brought up some large, flat, hardened pieces of the bottom.

Sounding 236. 12th February, 1875. 2550 fathoms. Lat.  $4^{\circ} 19' N.$ , long.  $130^{\circ} 15' E.$  A red clay containing :—Much amorphous clayey matter ; many very fine white mineral particles ; a good many Radiolaria and Diatoms ; a few manganese grains.

The trawl brought up several pieces of pumice about the size of a hen's egg.

Sounding 237. 16th February, 1875. 1675 fathoms. Lat.  $2^{\circ} 46' N.$ , long.  $133^{\circ} 58' E.$  A *Globigerina*-ooze containing :—Very many pelagic Foraminifera, Coccoliths, and Rhabdoliths ; a great many Radiolaria and a few Diatom-remains ; amorphous clayey and calcareous matter and a few fine mineral particles.

Sounding 238. 16th February, 1875. 2000 fathoms. Lat.  $2^{\circ} 56' N.$ , long.  $134^{\circ} 11' E.$  A *Globigerina*-ooze of a red colour, containing :—Many pelagic Foraminifera, Coccoliths, and Rhabdoliths ; much clayey matter ; many fine mineral particles (pumice) ; a good many Radiolaria.

The trawl contained many small pieces of pumice from the size of a marble to that of a hen's egg. Some of these had a slight coating of manganese.

Sounding 239. 22nd February, 1875. 2000 fathoms. Lat.  $0^{\circ} 39' S.$ , long.  $138^{\circ} 55' E.$  A blue mud containing :—Much amorphous clayey matter ; many fine mineral particles (pumice &c.) ; a good many Radiolaria ; a few broken pieces of pelagic Foraminifera.

Humboldt Bay, New Guinea. 24th February, 1875. 37 fathoms. A green mud containing:—Many mineral particles and amorphous matter; many shore forms of Foraminifera; a few Globigerinas, Pteropods, and other surface shells; a few green internal casts of Foraminifera.

Sounding 240. 1st March, 1875. 1075 fathoms. Lat.  $2^{\circ} 33' S.$ , long.  $144^{\circ} 4' E.$  A blue mud with a red upper layer, containing:—Much amorphous clayey matter; fine black, white, and green mineral particles (pumice); a great many pelagic Foraminifera and Coccoliths; a great many Radiolaria.

In the trawl there were several large pieces of pumicestone, pieces of wood and fruits, and a few large Pteropod and *Ianthina*-shells.

Nares Harbour, Admiralty Islands. 7th March, 1875. 25 to 16 fathoms. Dredgings inside the harbour gave coral-muds and black sandy muds, or a mixture of these. In some places live coral.

*Admiralty Islands to Japan.*

10th March, 1875. Outside Nares Harbour, 152 fathoms. Some traces came up on the tube which indicated a green mud, containing:—Many mineral particles; débris of coral, Foraminifera, &c.

Sounding 241. 11th March, 1875. 1100 fathoms. Lat.  $0^{\circ} 43' S.$ , long.  $147^{\circ} 0' E.$  A *Globigerina*-ooze containing:—Many pelagic Foraminifera, Coccoliths, and Rhabdoliths; a good many Radiolarian remains; amorphous clayey and calcareous matter; some fine white and black mineral particles (pumice).

Several pumicestones came up in the dredge.

Sounding 242. 13th March, 1875. 2650 fathoms. Lat.  $0^{\circ} 40' N.$ , long.  $148^{\circ} 41' E.$  A red clay containing:—Much amorphous clayey matter; many very fine mineral particles; one small piece of pumice; a good many Radiolarians; a good many manganese grains.

Sounding 243. 16th March, 1875. 2450 fathoms. Lat.  $2^{\circ} 15' N.$ , long.  $146^{\circ} 16' E.$  A red clay containing:—Much amorphous clayey matter; very fine mineral particles; a great many Radiolaria; a few broken pieces of pelagic Foraminifera; some manganese grains.

Sounding 244. 19th March, 1875. 2325 fathoms. Lat.  $5^{\circ} 31' N.$ , long.  $145^{\circ} 13' E.$  A grey clay containing:—Much amorphous clayey and some calcareous matter; fine mineral particles (a red and yellow cherty-like mineral); a good many pelagic Foraminifera; a great many Radiolaria.

Several small pieces of pumice came up in the trawl.

Sounding 245. 21st March, 1875. 1850 fathoms. Lat.  $7^{\circ} 45' N.$ , long.  $144^{\circ} 20' E.$  A *Globigerina*-ooze with red tinge, containing:—Very many pelagic Foraminifera and Coccoliths; many Radiolaria;

some amorphous clayey and calcareous matter, and a few mineral particles.

In the trawl were one or two small pieces of pumice.

Sounding 246. 23rd March, 1875. 4575 fathoms. Lat.  $11^{\circ} 24' N.$ , long.  $143^{\circ} 16' E.$  A trace came up on the outside of the tube which indicated a Radiolarian ooze the same as described below, No. 247.

Sounding 247. 23rd March, 1875. 4475 fathoms. Lat.  $11^{\circ} 24' N.$ , long.  $143^{\circ} 16' E.$  A Radiolarian ooze (upper layers red, lower layers pale straw-colour), containing chiefly the remains of Radiolaria, Diatoms, Challengerias, and other deep-sea Rhizopods (see notes on Surface Animals, p. 535); one or two white mineral particles (pumice?); one or two pieces of a yellow and green mineral (flinty concretion?); a very small quantity of amorphous clayey matter; many small peroxide of manganese particles.

A section of about 3 inches came up in the tube; the upper 2 inches were of a red colour, and contained very many of the small manganese particles. These manganese grains apparently gave the colour to these layers. The lower inch of the section was of a pale yellow colour, and contained relatively many fewer manganese grains. In all other respects the two layers appeared the same. The lower layer was to the look and touch very much like the Diatomaceous ooze taken in the South Atlantic. It also caked in the same way.

Sounding 248. 25th March, 1875. 2300 fathoms. Lat.  $14^{\circ} 44' N.$ , long.  $142^{\circ} 13' E.$  A red or chocolate clay containing:—Much amorphous clayey matter; many very fine mineral particles; a great many Radiolaria and Challengerias; one or two broken pieces of pelagic Foraminifera; many manganese grains.

The trawl brought up several pumicestones coated with manganese, and some hardened pieces of the bottom.

Sounding 249. 27th March, 1875. 2475 fathoms. Lat.  $17^{\circ} 29' N.$ , long.  $141^{\circ} 21' E.$  A red or chocolate clay, containing:—Much amorphous clayey matter; many fine and some coarse mineral particles—quartz, mica, pumice, &c.; a few Radiolarians; one or two broken pieces of pelagic Foraminifera; many manganese grains.

Sounding 250. 9th March, 1875. 2450 fathoms. Lat.  $19^{\circ} 24' N.$ , long.  $141^{\circ} 13' E.$  A red clay containing:—Much amorphous clayey matter; many fine and some rather coarse mineral particles (some of these pieces of areolar pumice of a green colour, and containing white crystals); a few Radiolarians and other siliceous remains; a few manganese grains.

Sounding 251. 1st April, 1875. 2500 fathoms. Lat.  $22^{\circ} 1' N.$ , long.  $140^{\circ} 27' E.$  A red clay, same as No. 250.

Sounding 252. 5th April, 1875. 2425 fathoms. Lat.  $26^{\circ} 29' N.$ , long.

137° 57' E. A red clay containing:—Much amorphous clayey matter; many small mineral particles of a white and black colour; many Radiolarian, Diatom, and *Challengeria* remains; a few manganese remains.

Sounding 253. 9th April, 1875. 2250 fathoms. Lat. 31° 8' N., long. 137° 8' E. A blue mud with reddish upper layer, containing:—Much amorphous blue clayey matter; many fine and a few rather coarse mineral particles; many remains of *Challengeria*, Radiolaria, and Diatoms; two pieces of pelagic Foraminifera noticed.

*Japan.*

Sounding 254. 12th May, 1875. 345 fathoms. *Hyalonema*-ground. A green mud containing:—Much amorphous clayey matter; many mineral particles of a green, white, and black colour; a few pelagic and other Foraminifera; Coccoliths and broken pieces of Pteropods and other shells; a good many Diatom and Radiolarian remains; a few casts of Foraminifera of a pale green colour.

Inland Sea, Japan. 19th to 31st May, 1875. 8 to 20 fathoms. Soundings and dredgings in the Inland Sea, Japan, gave always a blue mud containing:—Amorphous clayey matter; many mineral particles—mica, quartz, red and green minerals; broken pieces of large Gasteropods and Lamellibranch shells; spines of *Echini*, valves of *Cypridina*, and shore forms of Foraminifera.

Shells or tests of pelagic Foraminifera, Pteropods, and Polycystina were apparently wanting in these bottoms.

Sounding 255. 3rd June, 1875. 2675 fathoms. Lat. 32° 31' N., long. 135° 39' E. A blue mud with red upper layer containing:—Much amorphous blue clayey matter; many fine mineral particles—mica, pumice, &c.; very many Diatom, *Challengeria*, and Radiolarian remains; two shore forms of Foraminifera noticed; no pelagic Foraminifera.

Sounding 256. 4th June, 1875. 565 fathoms. Lat. 34° 7' N., long. 138° 0' E. A small quantity came up which indicated a green mud containing:—Amorphous matter; many mineral particles; a good many pelagic Foraminifera; a few Diatoms.

A good many dark and light green coloured casts of the Foraminifera remained after treatment with acid. The trawl brought up some pumice-stones.

Sounding 257. 5th June, 1875. 775 fathoms. Lat. 34° 58' N., long. 139° 30' E. A green mud containing:—Many sandy particles of a white, green, and black colour; pelagic and other Foraminifera; Diatoms and Radiolaria.

A great many green internal casts of the Foraminifera; in the trawl were many hardened pieces of the bottom, volcanic pebbles, &c.

*Japan to Honolulu, Sandwich Islands.*

Sounding 258. 17th June, 1875. 1875 fathoms. Lat.  $34^{\circ} 37' N.$ , long.  $140^{\circ} 32' E.$  A blue mud containing:—Much amorphous blue clayey matter; many fine and some coarse mineral particles of a black, red, and green colour; many remains of Diatoms, Radiolaria, and Challengerias; one or two Foramanifera and Coccoliths.

In the trawl were several large pieces of pumicestone, hardened pieces of the bottom honeycombed by worm-tubes, a few large Pteropod shells, a Cephalopod's beak, and two vertebræ of fish; the surface of the pumicestones was in most cases black with peroxide of manganese; so also was the surface of the worm-tracks in the hardened pieces of the bottom.

|               |                  |          |                         |                            |                           |
|---------------|------------------|----------|-------------------------|----------------------------|---------------------------|
| Sounding 259. | 18th June, 1875. | fathoms. | 3900.                   | Lat. $35^{\circ} 18' N.$ , | long. $144^{\circ} 8' E.$ |
| „ 260.        | 19th „ „         | 3625.    | „ $35^{\circ} 18' N.$ , | „ $147^{\circ} 9' E.$      |                           |

Each a red clay containing:—Much amorphous clayey matter; many fine and some rather coarse mineral particles, black and white in colour, and pieces of pumice; very many remains of Radiolarians, Diatoms, and Challengerias.

Sounding 261. 21st June, 1875. 2900 fathoms. Lat.  $35^{\circ} 20' N.$ , long.  $153^{\circ} 39' E.$  A red clay, the lower layers lighter in colour than the top ones, containing:—Amorphous clayey matter; many fine mineral particles and a few rather large pieces of pumicestone; very many remains of Diatoms, Radiolarians, and Challengerias; a few manganese grains.

The remains of siliceous organisms made up nearly a half of this bottom in bulk.

Sounding 262. 23rd June, 1875. 2300 fathoms. Lat.  $35^{\circ} 41' N.$ , long.  $157^{\circ} 42' E.$  A red clay, the upper layers soft, the lower ones compact and of a lighter colour, containing:—Much amorphous clayey matter; many fine mineral particles, some of them black, but the majority apparently broken-down pieces of pumice; very many Radiolarians, Diatoms, and Challengerias; a few pelagic Foraminifera and Coccoliths.

The trawl brought up many large and some small pieces of pumice, most of them having a slight coating of peroxide of manganese.

|               |                  |          |                         |                            |                            |
|---------------|------------------|----------|-------------------------|----------------------------|----------------------------|
| Sounding 263. | 24th June, 1875. | fathoms. | 2575.                   | Lat. $35^{\circ} 29' N.$ , | long. $161^{\circ} 52' E.$ |
| „ 264.        | 26th „ „         | 2800.    | „ $35^{\circ} 24' N.$ , | „ $166^{\circ} 35' E.$     |                            |
| „ 265.        | 28th „ „         | 2900.    | „ $35^{\circ} 22' N.$ , | „ $169^{\circ} 53' E.$     |                            |
| „ 266.        | 30th „ „         | 2775.    | „ $36^{\circ} 23' N.$ , | „ $174^{\circ} 31' E.$     |                            |

In all these a red or chocolate clay containing:—Much amorphous clayey matter; very many fine mineral particles, being apparently broken-down pieces of pumice, also some rather large pieces of pumice (the size of a pea), which had frequently a coating of man-

ganese  $\frac{1}{8}$  inch in thickness; very many Diatom, Radiolarian, and *Challengeria* remains; very many manganese grains.

The trawl brought up many manganese nodules or concretions and two shark's teeth; these nodules had in most cases a nucleus of pumice.

Sounding 267. 2nd July, 1875. 205 fathoms. Lat.  $36^{\circ} 10' N.$ , long.  $178^{\circ} 0' E.$  A grey clay containing:—Much amorphous clayey matter; many fine white mineral particles; many Radiolarian and Diatom remains; a few pelagic Foraminifera and their broken parts and Coccoliths.

Several pumicestones came up in the trawl, the smaller ones having a coating of manganese.

Sounding 268. 3rd July, 1875. 2530 fathoms. Lat.  $35^{\circ} 49' N.$ , long.  $179^{\circ} 57' W.$  (a) Red clay, the upper layer in the tube 1 inch thick, containing:—Much amorphous clayey matter; many fine mineral particles; many Radiolarian and Diatom remains; some manganese grains; no carbonate-of-lime organisms.

(b) A grey clay, in lower part of the tube 4 inches thick, containing:—Same as in the upper layer, but, in addition, a good many pelagic Foraminifera and Coccoliths, and fewer manganese grains.

Sounding 269. 5th July, 1875. 2900 fathoms. Lat.  $37^{\circ} 41' N.$ , long.  $177^{\circ} 4' W.$  A red clay containing:—Much amorphous clayey matter; many fine mineral particles, pieces of pumice, and black and white crystals; many Radiolarian, Diatom, and *Challengeria* remains; two broken pieces of *Globigerina* were noticed.

The trawl brought up many manganese nodules, pieces of pumice and sharks' teeth; a few of these had a coating of peroxide of manganese  $\frac{1}{4}$  inch in thickness. Many of the nodules had a nucleus of pumice surrounded by  $\frac{1}{2}$  an inch of the black manganese; some were black manganese throughout excepting a small spot in the centre; one had a siliceous sponge (*Farrea*) imbedded in an inch of the black manganese.

|               |                 |       |   |  |  |
|---------------|-----------------|-------|---|--|--|
|               |                 |       | fathoms.  |  |  |
| Sounding 270. | 7th July, 1875. | 3000. | Lat. $37^{\circ} 59' N.$ , long. $171^{\circ} 68' W.$ |  |  |
| „ 271.        | 9th „ „         | 3050. | „ $37^{\circ} 49' N.$ , „ $166^{\circ} 47' W.$        |  |  |
| „ 272.        | 10th „ „        | 2900. | „ $37^{\circ} 37' N.$ , „ $163^{\circ} 26' W.$        |  |  |
| „ 273.        | 12th „ „        | 2740. | „ $37^{\circ} 52' N.$ , „ $160^{\circ} 17' W.$        |  |  |

In each case a red clay containing:—Much amorphous clayey matter; very many fine white mineral particles (pumice); very many Radiolarian, Diatom, and *Challengeria* remains; a good many manganese grains. In 270 and 271 the remains of siliceous organisms make up over one third of the bottom in bulk.

On the 12th July the trawl brought up fully a bushel of manganese nodules; these were chiefly of a rounded or kidney-shape, like a lot of potatoes, the largest being about the size of a cricket-ball; one of the

largest ( $2 \times 3 \times 3$  inches) contained in the centre a large shark's tooth with serrated edges; the tooth was well preserved and was about  $1\frac{1}{2}$  inch in length. Other nodules had smaller teeth, but the majority had a nucleus of pumice.

Sounding 274. 14th July, 1875. 3125 fathoms. Lat.  $38^{\circ} 9' N.$ , long.  $156^{\circ} 25' W.$  A red clay containing:—Much amorphous clayey matter; very many fine mineral particles (pumice); a great many Radiolaria and manganese grains.

The dredge brought up several nodules and pumicestones. One large nodule or concretion of manganese was  $12 \times 8 \times 2$  inches, and had a nucleus of clay and hard cherty-like mineral matter; its upper surface was smooth and had one *Nodosaria* and several small pieces of pumice cemented to it by layers of manganese. Attached to its surface and living were—reticulated Rhizopod tubes, *Serpula* and other worm-tubes, Polyzoa, &c. Its inner surface was rough and uneven, and had a worm-tube attached to one edge.

|               |                  |  | fathoms. |                            |                            |  |
|---------------|------------------|--|----------|----------------------------|----------------------------|--|
| Sounding 275. | 17th July, 1875. |  | 3025.    | Lat. $35^{\circ} 13' N.$ , | long. $154^{\circ} 43' W.$ |  |
| „ 276.        | 19th „ „         |  | 2850.    | „ $32^{\circ} 30' N.$ ,    | „ $154^{\circ} 38' W.$     |  |
| „ 277.        | 21st „ „         |  | 2950.    | „ $30^{\circ} 22' N.$ ,    | „ $154^{\circ} 56' W.$     |  |
| „ 278.        | 23rd „ „         |  | 2875.    | „ $27^{\circ} 33' N.$ ,    | „ $154^{\circ} 55' W.$     |  |
| „ 279.        | 24th „ „         |  | 2775.    | „ $26^{\circ} 5' N.$ ,     | „ $155^{\circ} 8' W.$      |  |

In each case a red clay containing:—Much amorphous clayey matter; many fine white mineral particles (pumice), and occasionally some small pieces of a red mineral; a few Radiolarian remains and manganese grains.

The dredge on the 21st July contained much mud, in which were a few manganese nodules, about a dozen sharks' teeth, some with a coating of manganese, and one or two pieces of pumicestone.

Sounding 280. 26th July, 1875. 2225 fathoms. Lat.  $23^{\circ} 3' N.$ , long.  $156^{\circ} 6' W.$  A red clay containing:—Much amorphous clayey matter; many fine and some rather coarse mineral particles (pumice and red, black, and yellow minerals); a few Radiolaria and *Challengeria* remains; a few manganese grains.

Sounding 281. 27th July, 1875. 310 fathoms. Off Oahu, Sandwich Islands. Some traces of volcanic sand and coral débris on the dredge.

#### *Honolulu to Tahiti.*

Honolulu, August 1875. 4 to 16 fathoms. Inside the reefs. A blue mud containing:—Much amorphous matter; many fine mineral particles, the débris of volcanic rocks; a few Foraminifera and débris of coral.

Outside the reefs. 20 to 40 fathoms. A coral-sand containing:—Débris of coral, Polyzoa and Foraminifera, surface shells, &c.; a few black sandy particles.

Sounding 282. 12th August, 1875. 2050 fathoms. Lat.  $20^{\circ} 18' N.$ , long.  $157^{\circ} 13' W.$  A trace of bottom came up on the tube, which indicated a grey clay containing:—Amorphous clayey matter; many remains of Radiolaria and Diatoms; one or two pelagic Foraminifera and their broken parts.

Sounding 283. 20th August, 1875. 2875 fathoms. Lat.  $19^{\circ} 10' N.$ , long.  $154^{\circ} 12' W.$  A grey mud or sand containing chiefly:—Volcanic sand and pumice; these mineral particles were of a green colour, like the areolar lava and Pele's hair at Kilauea Hawaii, also some olivine and black particles; a great many Radiolaria, *Challengeria*, and Diatom remains; very little amorphous clayey matter.

Sounding 284. 21st August, 1875. 2650 fathoms. Lat.  $17^{\circ} 33' N.$ , long.  $153^{\circ} 36' W.$  A grey mud containing chiefly:—The debris of volcanic rock in a finer state of division than yesterday; a great many Radiolarian and Diatom remains; rather more amorphous clayey matter than yesterday.

Sounding 285. 23rd August, 1875. 3000 fathoms. Lat.  $14^{\circ} 19' N.$ , long.  $152^{\circ} 37' W.$  A red clay containing:—Much amorphous matter; very many fine mineral particles, red and yellow or green colour; a few Radiolarian and Diatom remains; a good many manganese particles.

Several manganese nodules came up in the trawl; these were more angular than usual and appear to have been formed on hardened portions of the bottom; some had a cherty-like nucleus with concentric coloured layers as in agate. There were some hardened pieces of bottom also in the trawl, some with just a slight coating of manganese, others perforated in various directions by worm-tracks.

Sounding 286. 25th August, 1875. 2900 fathoms. Lat.  $12^{\circ} 42' N.$ , long.  $152^{\circ} 1' W.$  A red clay containing:—Much amorphous clayey matter; many very fine white mineral particles; a great many remains of Radiolaria, Diatoms, and *Challengeria*; a few manganese grains.

The dredge brought up much mud. In the washings were several pieces of pumice about the size of peas. One manganese nodule the size of a marble; three or four large Pulvinulinas. Over a third of the bottom made up of siliceous remains.

Sounding 287. 26th August, 1875. 2750 fathoms. Lat.  $11^{\circ} 11' N.$ , long.  $152^{\circ} 2' W.$  A Radiolarian ooze of a brown colour containing:—Immense numbers of Radiolarians, Diatoms, and some *Challengeria* remains; some amorphous clayey matter; a few small white and some red-coloured mineral particles; a few manganese particles.

There were some yellow-coloured spots in the bottom, but it was

mostly of a brown colour. It was more compact than yesterday's and contained more Radiolarians and fewer pieces of the delicate large cylindrical Diatom (see notes on Diatoms, p. 533).

Sounding 288. 28th August, 1875. 2700 fathoms. Lat.  $9^{\circ} 28' N.$ , long.  $150^{\circ} 49' W.$  A small quantity came up, which indicated a Radiolarian ooze of a yellow colour containing:—Great numbers of Radiolarian and remains of other siliceous organisms; a few rounded, olive-coloured, and some small white mineral particles; some manganese grains.

The colour of this sounding was the same as the lower layer of our deepest sounding, 4475 fathoms, and as the yellow patches in the last sounding.

Sounding 289. 30th August, 1875. 2900 fathoms. Lat.  $7^{\circ} 35' N.$ , long.  $149^{\circ} 49' E.$  A Radiolarian ooze of a brown colour, with a thin upper layer of a pale straw-colour, containing:—Immense numbers of Radiolarians, Diatom, *Challengeria*, and remains of other siliceous organisms; a few small white and yellow mineral particles; some amorphous clayey matter; a good many manganese grains.

There appeared to be a thin surface-layer of a yellow colour. It differed from the mass of the bottom beneath only in the relatively less abundance of manganese grains.

Sounding 290. 2nd September, 1875. 2550 fathoms. Lat.  $5^{\circ} 54' N.$ , long.  $147^{\circ} 2' W.$  A Radiolarian ooze, upper layer yellow, lower layer brown-coloured, containing:—Immense numbers of Radiolarian, Diatom, and *Challengeria* remains; a few pelagic Foraminifera and their broken parts (Pulvinulinas, Orbulinas, Globigerinas) and some Cœcoliths; some amorphous clayey matter.

The Foraminifera appeared to be confined to the top layer chiefly. There were fewer manganese grains in this sounding than in the last, and in this sounding they were more abundant in the lower than upper layer.

Sounding 291. 4th September, 1875. 2925 fathoms. Lat.  $2^{\circ} 34' N.$ , long.  $149^{\circ} 9' W.$  A *Globigerina*-ooze, upper layers brown, lower layers cream-white colour, containing:—Very many pelagic Foraminifera and their broken-down parts, and Cœcoliths; many Radiolaria; remains of other siliceous organisms; a good deal of amorphous calcareous and some clayey matter; very few mineral particles of any kind other than manganese grains.

The carbonate-of-lime organisms were most abundant in the lower layers. The upper brown layer had carbonate-of-lime and siliceous organisms in nearly equal proportions, and this layer had more clayey matter and manganese grains than the one underneath.

Sounding 292. 6th September, 1875. 2425 fathoms. Lat.  $0^{\circ} 33' S.$ , long.  $151^{\circ} 34' W.$  A white *Globigerina*-ooze containing:—Great

numbers of pelagic Foraminifera, their broken-down parts, and Coccoliths; a good many Radiolarians and some broken Diatoms; some amorphous calcareous but very little clayey matter.

Few, if any, mineral particles other than manganese grains, of which there were a few. A good deal of the bottom came up in the tow-net attached to the trawl. In the washings there was one piece of pumice about the size of a hen's egg.

Sounding 293. 8th September, 1875. 2600 fathoms. Lat.  $3^{\circ} 48'$  S., long.  $152^{\circ} 56'$  W. A Radiolarian ooze of brown colour containing:—Immense numbers of Radiolaria, Diatoms, and *Challengeria*; a few broken pieces of large pelagic Foraminifera, and one or two perfect specimens; a little amorphous clayey matter.

Few, if any, mineral particles other than the manganese particles, which were abundant. One of these last (about the size of a pea), which I broke, appeared to be formed on a nucleus of pumice.

In the trawl were several manganese nodules; one, the size of a hen's egg, appeared to be formed on a nucleus of ordinary pumice. Also one areolar piece of pumice (or lava) of a green colour like that from the Sandwich Islands. Several yellow and red cherty-like pieces of mineral.

Sounding 294. 9th September, 1875. 2350 fathoms. Lat.  $5^{\circ} 0'$  S., long.  $152^{\circ} 26'$  W. A Radiolarian ooze of a chocolate-colour containing:—Great numbers of Radiolaria and the broken exuviae of these and other siliceous organisms; a few pelagic Foraminifera and their broken parts; a few Coccoliths; a few red and yellow mineral particles; manganese grains in great abundance.

Sounding 295. 11th September, 1875. 2750 fathoms. Lat.  $7^{\circ} 25'$  S., long.  $152^{\circ} 15'$  W. A Radiolarian ooze of a chocolate-colour containing:—Great numbers of Radiolaria and the exuviae of other siliceous organisms; many pieces of black manganese, some pieces of red and yellow minerals, these latter being perfect crystals, and some pieces of pumicestones; some amorphous clayey matter; a few broken pieces of pelagic Foraminifera.

The trawl brought up fully a peck of manganese nodules and some mud. Amongst the nodules were some with a nucleus of pumice, of sharks' teeth, and of the ear-bones of cetaceans; some of the sharks' teeth had a very light coating of manganese.

Sounding 296. 14th September, 1875. 2610 fathoms. Lat.  $11^{\circ} 11'$  S., long.  $150^{\circ} 30'$  W. A dark chocolate clay containing chiefly:—Small yellow crystals and rounded particles of a red mineral about the size of a pea; very many manganese particles and grains; a few pieces of Radiolarian tests; a few small sharks' teeth; amorphous clayey matter.

Sounding 297. 16th September, 1875. 2350 fathoms. Lat.  $13^{\circ} 28'$  S.,

long.  $149^{\circ} 30'$  W. In the top of the tube a *Globigerina*-ooze of a light brown colour containing:—Very many pelagic Foraminifera and Coccoliths; amorphous clayey matter and many small yellow crystals and particles of the peroxide of manganese. In the lower part of the tube a dark chocolate clay containing:—Very many small yellow crystals; pieces of a red and yellow mineral and pumice particles; many small sharks' teeth; amorphous clayey matter, and great numbers of manganese particles and grains.

The transitions from the dark chocolate clay at the bottom to the light brown *Globigerina*-ooze on the top was very gradual, the lighter colour and the carbonate of lime increasing *pari passu*. The yellow crystals and manganese particles were most abundant in the lower portions of the tube. Radiolaria and other siliceous remains were almost wanting in this bottom.

The trawl brought up about half a ton of manganese nodules, some small pieces of pumice, several sharks' teeth, one of which was 3 inches across the base. Some of these were deeply and others only slightly coated with manganese.

Sounding 298. 17th September, 1875. 2325 fathoms. Lat.  $15^{\circ} 7'$  S., long.  $149^{\circ} 41'$  W. This bottom nearly the same as described for yesterday. It had, however, more mineral particles and fewer of the small yellow crystals in all its parts; also few manganese particles.

Sounding 299. 18th September, 1875. 1525 fathoms. Lat.  $17^{\circ} 13'$  S., long.  $149^{\circ} 33'$  W. A grey mud containing:—Amorphous clayey matter; many fine and coarse mineral particles of a white, red, and yellow colour; many pelagic Foraminifera; Coccoliths and Rhabdoliths; one or two portions of Radiolaria.

#### *Off Tahiti, Society Islands.*

Sounding 300. 20th October, 1875. 420, 590, 620, and 680 fathoms. In each case a grey or blue mud containing:—Very many particles of volcanic sand and amorphous matter; débris of coral; pelagic and other Foraminifera; larval Gasteropods and Lamellibranchs; *Echinospines* &c. In the two deeper ones there was a red surface-layer.

Just outside the reefs at Tahiti there was a coral-mud containing a few mineral particles; inside the reefs there was a soft blue mud.

#### *Tahiti to Valparaiso.*

Sounding 301. 4th October, 1875. 1940 fathoms. Lat.  $18^{\circ} 40'$  S., long.  $149^{\circ} 52'$  W. A grey *Globigerina*-ooze containing:—Very many pelagic Foraminifera; Coccoliths and Rhabdoliths; some amorphous clayey and calcareous matter; some manganese grains; a good many rather coarse mineral particles of a brown and black colour; a good

many internal and external casts of the Foraminifera in a red substance, as on 15th August, 1874.

Two or three hardened pieces of the bottom, coated with manganese, were in the trawl.

Sounding 302. 6th October, 1875. 2385 fathoms. Lat.  $22^{\circ} 21' S.$ , long.  $150^{\circ} 17' W.$  No bottom came up in the sounding-tube. The trawl brought up some dark chocolate clay and many manganese nodules and sharks' teeth. Washing away the amorphous matter from some of the bottom there remained a large amount of sediment, consisting almost entirely of small rounded red mineral particles. Many of these had the form of both Foraminifera and Radiolaria; and it seemed as if some substance had been deposited in and on these organisms. There were also many manganese particles; one or two pelagic Foraminifera.

In the washing of the mud in the trawl were great numbers of sharks' teeth, the largest being 4 inches across the base. One piece of manganese concretion measured  $18 \times 12 \times 2$  inches, and had a mass of soft red or yellow clay in the centre. There were two or three pieces of pumice.

Sounding 303. 7th October, 1875. 2450 fathoms. Lat.  $23^{\circ} 35' S.$ , long.  $150^{\circ} 3' W.$  A dark brown clay, same as described yesterday, containing:—Amorphous clayey matter; rounded yellow minerals, many Radiolarian-shaped; pieces of pumice and other minerals; very many manganese particles; a few Radiolaria.

Sounding 304. 9th October, 1875. 2075 fathoms. Lat.  $26^{\circ} 9' S.$ , long.  $145^{\circ} 17' W.$  In the upper part of the tube a *Globigerina*-ooze of a light brown colour containing:—Very many pelagic and other Foraminifera; Coccoliths, Rhabdoliths, and *Echini*-spines; small yellow crystals and pieces of a red and yellow cherty-like mineral; some amorphous clayey matter. In the lower part of the tube a dark chocolate clay containing:—Much amorphous clayey matter; very many yellow crystals and pellets of peroxide of manganese; a few broken pelagic Foraminifera.

The transition from the one to the other deposit was quite gradual. This sounding was very like that on 16th September last.

Remains of Radiolaria and other siliceous organisms appeared to be entirely wanting in this sounding.

Sounding 305. 11th October, 1875. 1985 fathoms. Lat.  $28^{\circ} 22' S.$ , long.  $141^{\circ} 22' W.$  A *Globigerina*-ooze of light yellow colour containing:—Great numbers of pelagic Foraminifera; Coccoliths and Rhabdoliths; *Echini*-spines; a good many Radiolarian remains; amorphous clayey matter and manganese grains; a few pieces of vesicular lava, of a green colour, like that at the Hawaiian Islands.

Sounding 306. 14th October, 1875. 2375 fathoms. Lat.  $32^{\circ} 36' S.$ ,

long.  $137^{\circ} 43'$  W. A dark chocolate clay containing :—Amorphous clayey matter; many small yellow crystals and pumice; pieces of red cherty-like mineral; many manganese grains and pellets; a few remains of pelagic Foraminifera.

The trawl brought up some mud and over a bushel of manganese nodules and some pieces of pumice. Amongst the nodules were :—Many sharks' teeth, some deeply imbedded in manganese; eight tympanic bones of Cetaceans, some deeply imbedded in manganese. Some nodules had a nucleus of bone, some of pumice, some a cherty-like mineral with agate bands.

Sounding 307. 16th October, 1875. 2335 fathoms. Lat.  $33^{\circ} 29'$  S., long.  $133^{\circ} 22'$  W. In upper part of tube, 2 inches, a dark chocolate clay containing :—Much amorphous clayey matter; many small yellow crystals, pieces of a cherty-like mineral, and many manganese grains and pellets; a few remains of pelagic Foraminifera. In lower part of the tube, 5 inches, a light brown clay containing, besides the things in the upper layer :—Many more pelagic Foraminifera, and immense numbers of Coccoliths.

The lighter colour of the lower layers appeared to be due to the greater abundance of carbonate-of-lime organisms, and consequently less abundance of manganese particles.

This arrangement of the contents of the sounding-tube is the reverse of that on the 9th inst.

The trawl brought up over a bushel of nodules &c., as :—

|                                       |  |
|---------------------------------------|--|
| Over 100 sharks' teeth,               | } All these had a more or less coating of peroxide of manganese. |
| About 30 tympanic bones of Cetaceans, |  |
| Portions of other bones,              |  |
| One granitic pebble,                  |  |
| Grey concretions of the bottom.       |  |

Also some nodules with no apparent nucleus, and some with a hard cherty yellow mineral in the centre.

Sounding 308. 19th October, 1875. 2400 fathoms. Lat.  $36^{\circ} 33'$  S., long.  $132^{\circ} 55'$  W. A dark chocolate clay containing :—Amorphous clayey matter; many manganese grains; small yellow crystals, rounded pellets of a red-brown mineral; a few pieces of pelagic Foraminifera.

The remains of the Foraminifera appeared to be confined to the upper layer.

Sounding 309. 21st October, 1875. 2600 fathoms. Lat.  $40^{\circ} 8'$  S., long.  $132^{\circ} 56'$  W. A chocolate clay containing :—Amorphous clayey matter; many manganese grains and pellets; small crystals, same as in late soundings, but had not the yellow colour; angular pieces of a cherty-like mineral; small teeth of sharks.

There was a section of over a foot; it was of a chocolate-colour throughout, except two small yellow spots.

Sounding 310. 23rd October, 1875. 2550 fathoms. Lat.  $39^{\circ} 47'$  S., long.  $131^{\circ} 20'$  W. Two small pieces of manganese and three small pieces of a cherty-like mineral in the tube; a trace of brown mud on the outside of the tube indicating a bottom like the last.

In the trawl were many rounded manganese nodules to which some traces of mud adhered. The nodules had nuclei of sharks' teeth, tympanic bones of cetacea, agate-like minerals, pieces of bones; and in all cases these were deeply imbedded in manganese, in some cases a coating of over an inch in concentric layers. It is curious and significant that not much (other than a trace) clay came up in the sounding-tube, the bag of the trawl, or in the tow-nets attached to the trawl and weight. All this indicates that the manganese was in great abundance at this spot.

Sounding 311. 25th October, 1875. 2300 fathoms. Lat.  $39^{\circ} 16'$  S., long.  $124^{\circ} 7'$  W. A streak of black manganese on the outside of the tube, as if it had been rubbed against a nodule. A small portion of mud adhered to the water-bottle, which indicated a dark chocolate clay containing:—Amorphous clayey matter; much manganese; piece of a red mineral; a few remains of pelagic Foraminifera and some Coccoliths.

Sounding 312. 27th October, 1875. 2250 fathoms. Lat.  $39^{\circ} 13'$  S., long.  $118^{\circ} 49'$  W. On the outside of the tube a streak of manganese, as if it had struck a nodule. Inside the tube a little light brown clay containing:—Amorphous clayey matter; many particles of a black manganese and of a red mineral; a good many pelagic Foraminifera and Coccoliths.

The trawl brought up one small manganese nodule. The frame of the trawl had many streaks of manganese.

Sounding 313. 29th October, 1875. 1600 fathoms. Lat.  $38^{\circ} 44'$  S., long.  $112^{\circ} 34'$  W. A *Globigerina*-ooze containing:—Great numbers of pelagic and a few other Foraminifera; many Coccoliths and Rhabdoliths; many manganese grains and one or two particles of a red mineral.

There was very little amorphous matter in this sounding; the brown colour is due to the presence of the manganese grains.

Sounding 314. 1st November, 1875. 2025 fathoms. Lat.  $39^{\circ} 4'$  S., long.  $105^{\circ} 5'$  W. A *Globigerina*-ooze of a red colour containing:—Very many pelagic Foraminifera and others; Coccoliths and Rhabdoliths and *Cypridina*-valves; some amorphous clayey matter; many manganese particles, and some particles of red, yellow, and black minerals.

The lower layers were of a darker colour than the upper ones, and

contained less carbonate of lime. About a dozen manganese nodules and two shark's teeth came up in the trawl. Two nodules had a nucleus of obsidian (?), outside this several agate-like bands, and then many layers of the peroxide of manganese. Two other nodules, from the structure and presence of lime, appeared to be formed on a nucleus of bone. One of the shark's teeth was deeply imbedded, the other was not.

Sounding 315. 3rd November, 1875. 2270 fathoms. Lat.  $39^{\circ} 22'$  S., long.  $98^{\circ} 46'$  W. A dark chocolate clay containing:—Much amorphous clayey matter; many manganese particles, small yellow crystals, red, white, and black mineral particles (quartz and particles of volcanic sand?). In the upper layers there were a good many remains of pelagic Foraminifera and a few Coccoliths, but these were almost wanting in the deeper layers.

Sounding 316. 5th November, 1875. 1500 fathoms. Lat.  $38^{\circ} 7'$  S., long.  $94^{\circ} 4'$  W. A small quantity of bottom came up which indicated a *Globigerina*-ooze of a brown colour containing:—Many pelagic Foraminifera, *Cypridina*-valves, and *Echini*-spines; many manganese particles, and a good many rather coarse sandy particles of a green colour (serpentine?); a few Radiolaria.

Most of the finer portions of the bottom appeared to have been washed out of the tube on the way up.

The tow-nets at the trawl contained many particles of a green mineral and one pebble of the same nature (serpentine?), with a coating of manganese.

Sounding 317. 9th November, 1875. 1825 fathoms. Lat.  $38^{\circ} 6'$  S., long.  $88^{\circ} 2'$  W. A *Globigerina*-ooze of a brown colour containing:—Many pelagic Foraminifera, Coccoliths, and Rhabdoliths; a good many manganese particles and pieces of a red and yellow mineral; one Radiolarian noticed; some amorphous clayey matter.

In the lower end of the tube the bottom was of a much darker colour, and contained fewer Foraminifera and more manganese and amorphous matter.

In the trawl there was some mud, all of a brown colour, same as in the upper part of the sounding-tube. In the sifting were many pellets of manganese and pieces of a flinty-like mineral.

Sounding 318. 11th November, 1875. 1775 fathoms. Lat.  $37^{\circ} 29'$  S., long.  $83^{\circ} 7'$  W. A *Globigerina*-ooze of a brown colour. No bottom came up in the tube.

I here copy *in extenso* from my Journal notes so far as they relate to the bottom in the trawl:—

“The trawl came up in the afternoon fouled, but in it were three or four quarts of manganese nodules varying from the size of a hen's egg to that of a pea.

“The weights (300 fathoms from the trawl) were all scored and marked

with streaks of black, as if they had been dragged over lumps of manganese.

"The tow-net just behind these weights had in it very many *Globigerinae*, *Pulvinulinae*, and one or two *Orbulinae* (all dead), a good many manganese pellets and a very little mud.

"This net would seem to have caught the particles knocked up by the weights in front. One of the tow-nets at the trawl was full to the brim of a yellow or, rather, light-brown-coloured mud, in which were many manganese nodules. Being so full of mud, not much of the finer portions of the bottom could have been washed away; hence this tow-net of mud gives us information from which some idea may be formed of the ratio which the manganese nodules bear to the ooze. In a peck of the mud there was a little over a quart of manganese nodules. The nodules were all nearly round. Some of the smaller ones were composed of the black manganese to the centre, while some had just a small yellow spot in the centre. Some of the larger ones had a yellow or dark green nucleus of about half an inch in diameter, which was surrounded by concentric layers of peroxide of manganese of half an inch in thickness. The yellow or green nucleus was soft, and could be cut with the knife like new cheese. Under the microscope it presented a mottled appearance, with yellow and light- and dark-green spaces, many of these being partially surrounded with agate bands.

"Foraminifera could also be seen imbedded in the mass; but all the carbonate of lime had been removed, strong nitric acid having no effect on any part of this nucleus. Birds'-feet-like extensions of the black manganese ramified into the yellow nucleus; and it seemed as if the manganese was extending into the nucleus as well as being deposited in concentric layers around it, as in those instances where pumice forms the nucleus of a nodule. There were lumps of the bottom in the tow-net which seemed to show the beginning of this process of nodule-formation. These lumps, which were of a redder colour than the rest of the bottom, seemed to be cemented by a red substance (?).

"Examined a portion of the bottom in the same way as usual with the soundings. It contained:—many *Globigerinas*, *Pulvinulinas* (the pyramidal variety), and a few *Orbulinas*; one or two *Uvigerinas*, and some *Biloculinas* and others; two arenaceous forms of *Foraminifera*, the tests composed of particles of manganese and a red mineral; many *Coccoliths* and *Rhabdoliths*; only two portions of siliceous spines and three *Radiolaria* were observed.

"Removing the manganese from the washing there remained:—A good many mineral particles (these were almost all of a dark lead-colour and very areolar structure, reminding one of volcanic ash and scoria); one small yellow crystal, several pieces of a red cherty-like mineral, and one quartz-like particle were noticed; manganese grains were abundant."

Sounding 319. 17th November, 1875. 2225 fathoms. Lat. 34° 7' S.,

long.  $73^{\circ} 56'$  W. A blue mud with a red upper layer containing :—  
 Much amorphous blue clayey matter ; many very fine mineral particles of quartz, mica, and a few of the green glauconitic particles ; a good many Radiolaria and Diatoms.

The top layers contained no carbonate-of-lime organisms. In those in the lower part of the tube there were a pelagic Foraminifer and Coccoliths. The tow-nets at the trawl each contained a little red mud without any pelagic Foraminifera. On the framework of the trawl were several large patches of blue mud.

#### REMARKS ON THE FOREGOING LIST.

Several kinds of deposits have been indicated in the foregoing list. For the present these may be classed under the following heads:—

##### 1. *Shore-deposits.*

(a) Blue and green muds.—Met with near the shores of most of the great continents and islands.

(b) Grey muds and sands.—Met with chiefly near oceanic islands of volcanic origin.

(c) Red mud.—Met with on the eastern coast of South America.

(d) Coral-mud.—Met with near coral reefs.

##### 2. *Globigerina-ooze.*—An abundant oceanic deposit not met with south of latitude $50^{\circ}$ S.

##### 3. *Radiolarian ooze.*—An oceanic deposit met with only in the Western and Middle Pacific.

##### 4. *Diatomaceous ooze.*—An oceanic deposit met with only south of $50^{\circ}$ S. latitude.

##### 5. *Red and Grey Clays.*—The most abundant oceanic deposit.

The above names have been selected as indicating those elements which give the predominating character of the deposit. As a rule, when the debris of continents or islands, the dead shells of Foraminifera, the exuviae of Radiolarians &c., the frustules of Diatoms, or red or grey clayey matter—when any of these have appeared to make up considerably more than one half of the specimen under examination, it has been called a shore-deposit, a *Globigerina*, Radiolarian, or Diatom ooze, or red or grey clay.

Sometimes it has been doubtful whether a specimen should be placed under one of the above heads or another, on account of the nearly equal ratio of constituents, or where one deposit overlies another of a different kind. In these cases the specimen has been placed under that head with which, on a general view, it has seemed to have most in common, or to which the surface-layer belonged, and a detailed description has been added in the list. A sixth kind of deposit or formation might have been added, to embrace those bottoms in which a great quantity of the peroxide of manganese occurs. This substance, in the form of nodules or concretions, of incrustations or in grains, has been found in nearly all

sea-deposits and at all depths in more or less abundance. However, for the present, it has been considered best to treat of its occurrence separately, at the same time pointing out those regions where we have found it in greatest abundance.

A few remarks may now be made upon each of the kinds of deposits indicated.

1. *Shore-deposits*.—It has been found that the deposits taking place near continents and islands have received their chief characteristic from the presence of the débris of adjacent lands. In some cases these deposits extend to a distance of over 150 miles from the coast. Several varieties can be recognized amongst these shore-deposits.

(a) *Blue and Green Muds*.—In the great majority of cases the deposits near continents and large islands, containing the older and crystalline rocks, have been of a blue or green colour; the only exception appears to be the east coast of South America, where we have a red mud, to be presently referred to.

In from 100 to 700 fathoms these deposits are often of a green colour, due to the presence of green amorphous clayey matter, and dark and pale green glauconite particles.

Beyond 700 fathoms they are usually of a blue or dark slate-colour, having a thin upper layer of a red or brown. This red layer is a soft ooze, whilst the blue mud or clay beneath is very compact and tenacious.

Much amorphous clayey matter and fine particles of mica, quartz, and other minerals are found in all these deposits, the mineral particles increasing in size as we approach the land.

Down to 1500 fathoms, we have generally found that Pteropod, larval Gasteropod, and Lamellibranch shells were tolerably abundant, and that there were many of the shore forms of Foraminifera, as Textularias, Rotularias, Nodosarias, Uvigerinas, Lagenas, &c. Pelagic Foraminifera occur throughout the deposit, but not in such abundance as in a true ocean-deposit. The frustules of Diatoms and their broken parts are numerous. Manganese grains are found in many of the bottoms, usually in the deeper soundings. We have also found imbedded in these muds pieces of wood, fruits, portions of fruits, and leaves of trees. Large pieces of rock, as pumice and granite, and rounded pebbles also occur. Our soundings near the southern ice-barrier were muds of a blue colour, containing many granitic and other pebbles and blocks, mostly rounded, and many Diatoms, and resembled in most respects the deposits we found off the east coast of North America, Halifax to New York.

Beyond 1500 or 1700 fathoms, Pteropod and Heteropod shells are usually not found, and in 3000 fathoms hardly a Foraminiferous or other carbonate-of-lime organism remains.

Siliceous organisms occur at all depths, but at times their remains would seem to be completely removed.

These green and blue muds have been found to prevail in all the en-

closed seas we have visited, as Arafura, Banda, Celebes, and China Seas, Inland Sea of Japan; and in all these the carbonate-of-lime organisms would appear to be removed from the bottoms in depths less by some 400 or 500 fathoms than on open coasts.

In the green muds from 50 to 700 fathoms we have found those beautiful casts of Foraminifera, Pteropods, *Echini*-spines, and other carbonate-of-lime organisms frequently in great numbers. These are of a dark green, pale green, and dirty white colour. In all cases where these green internal casts occur we have many glauconite grains in the bottom. Beyond 700 fathoms these casts seldom occur, and when they do they are very sparingly distributed; and the same may be said of the glauconite grains which accompany them. River-muds, in which Pteropods, Radiolaria, and pelagic Foraminifera are usually wanting, are included in these deposits.

The following are the localities in which we have found the blue muds (an \* before the locality indicates that the glauconite casts and grains have been found there):—

- \* Off coast of Portugal.
- „ Virgin Islands (?).
- \* „ Coast of North America, Halifax to New York.
- „ Guinea, coast of Africa.
- \* „ Cape of Good Hope.
- „ Antarctic ice-barrier.
- \* „ Australia.
- \* „ New Zealand.
- \* „ New Guinea and Philippines, and throughout the seas of the East-Indian archipelago.
- \* „ Japan.
- „ East coast of South America.

The following are the depths of the soundings which have been placed under this head:—

*Blue Muds.*

| fms. | fms. | fms. | fms. | fms. |
|------|------|------|------|------|
| 1125 | 1700 | 1675 | 32   | 375  |
| 1290 | 1240 | 1800 | 1100 | 2225 |
| 1475 | 1350 | 1300 | 700  | 2050 |
| 1380 | 1340 | 2200 | 2800 | 2000 |
| 1800 | 1250 | 400  | 1425 | 1075 |
| 1000 | 2020 | 150  | 2550 | 2250 |
| 525  | 1750 | 140  | 2100 | 20   |
| 900  | 2500 | 75   | 700  | 2675 |
| 600  | 2325 | 39   | 90   | 1875 |
| 3875 | 1250 | 40   | 150  | 2225 |
| 2425 |      |      |      |      |

*Green Muds.*

| fms. | fms. | fms. | fms. | fms. |
|------|------|------|------|------|
| 470  | 2200 | 400  | 129  | 37   |
| 560  | 290  | 10   | 255  | 152  |
| 80   | 120  | 70   | 100  | 245  |
| 75   | 650  | 800  | 705  | 565  |
| 100  | 950  | 580  | 185  | 775  |
| 150  | 1200 |      |      |      |

(b) *Grey Muds and Sands*.—Near volcanic islands we have found that the deposits have a distinctive character, from the presence of the débris of volcanic rocks. The presence of pieces of pumice, scoria, &c. prevents this deposit having that clayey character so characteristic of the blue mud. The colour is generally grey, but occasionally is a black sand or a more or less slate-coloured mud. In some places the shells of oceanic organisms make up a large part of these muds.

Down to about 1500 fathoms we have Pteropod, Heteropod, and surface Gasteropod shells, and the shore forms of Foraminifera are common. Deeper than 1500 fathoms, Pteropod shells are rare or entirely removed. Pelagic Foraminifera are found at all depths; but occasionally they and the siliceous organisms are quite absent at a depth of little over 2000 fathoms, and then we have a clay or mud with many small particles of pumice, scoria, &c. Manganese appears to be intimately associated with some of these bottoms, especially where the débris of augitic lavas are present, as at Sandwich Islands, Canaries, and elsewhere. Off the Desertas, in 670 fathoms, all the dead shells, pieces of Polyzoa, &c. had a slight coating of this substance, and we have had indications of the same thing in even less depths. In 1100 fathoms off the Canaries some pieces of shell had rather a thick coating; and in 1575 fathoms, not far from this place, the dredge brought up a great quantity of a Gorgonoid axis deeply imbedded in or coated with this black oxide of manganese.

In some localities this deposit extends to a great distance from the islands, as at Hawaii, 200 miles or more.

The following are the depths of the soundings which we have classed as

*Grey Mud.*

| fms. | fms. | fms.     | fms.      | fms. |
|------|------|----------|-----------|------|
| 670  | 1750 | 1675 (?) | 20 to 100 | 500  |
| 1150 | 620  | 465      | 75        | 2050 |
| 930  | 1890 | 675      | 520       | 2875 |
| 1500 | 1525 | 260      | 630       | 2650 |
| 278  | 450  | 360      | 600       | 1525 |
| 630  | 1000 | 1100     | 1200      | 420  |
| 560  | 1125 | 50       | 2150      | 590  |
| 7    | 1070 | 150      | 2600      | 620  |
| 640  | 1000 | 600      | 1050      | 680  |

Occasionally a few casts of the Foraminifera have been observed of a

red colour. These were usually very rough, and had not the delicate hues of the green glauconite casts. One very remarkable exception occurs:—off the Crozets there were (in 600 fathoms) many beautiful casts of the carbonate-of-lime organisms of a pale straw-colour. None of the glauconite grains were noticed in the same sounding or locality.

(c) *Red Mud*.—It has already been stated that the deposit along the east coast of South America, from Cape San Roque to Bahia, differed from the deposits found along the shores of other continents and large islands in being of a red colour. There can be little doubt but that this red colour is due to the presence of the ochreous matter carried into the Atlantic by the South-American rivers. There are reasons for thinking that the red colour of some of the deep-sea clays in this region of the Atlantic may have a like origin.

The soundings near the shore and in shallow water have a deeper red colour and contain larger mineral particles and fewer organic remains than those further from land and in deeper water. The mineral particles are chiefly quartz and mica.

In all these soundings there are many pelagic and other Foraminifera, Heteropod, Pteropod, larval Gasteropod, and Lamellibranch shells, Coccoliths, and Rhabdoliths. Siliceous organic remains, as of Diatoms and Radiolaria, are almost quite absent in these bottoms. In some of the shallower depths a few red-coloured casts of Foraminifera were observed; but these were rare, rough, and more or less imperfect.

The following are the depths of the soundings along this coast:—

| fms. | fms. | fms. |
|------|------|------|
| 1375 | 120  | 1200 |
| 500  | 32   | 1700 |
| 2050 | 400  | 1015 |
| 1650 | 1715 | 1275 |
| 675  | 1600 | 2150 |

(d) *Coral-Mud*.—This is a deposit found in the neighbourhood of coral reefs. It is characterized by a large quantity of amorphous calcareous matter, by the debris of coral reefs, by many large calcareous forms of Foraminifera, and by broken pieces of Polyzoa, &c. All the deposits about Bermuda are of this nature, extending from the edge of the reef down to a depth of 2500 fathoms. At 1000 fathoms the mud assumes a rose tinge; this deepens into a red colour with greater depth and the accompanying decrease of carbonate of lime and increase of clayey matter, until the coral-mud merges into the red and grey clays of the surrounding ocean. About Bermuda very few mineral particles were found. In some of the soundings to the S.W. of the island there were some small pieces of a green rock like those at St. Paul's Rocks, and probably serpentine. One or two pieces of quartz, or sanidin, a piece of mica, and a small piece of pumice (?) were also noticed. Dissolving away carbonate of lime in

some of the shallower soundings only a trace of clayey matter remained with a perceptible rose tinge. No casts of the Foraminifera were noticed about Bermuda.

At the Virgin Islands, at Tongatabu, at Fiji Islands, at Cape York, Admiralty Islands, Honolulu, and Tahiti we also met with coral-muds. Except at Cape York, these muds appeared to exist as a narrow band around the land, and had usually a considerable admixture of clayey matter and mineral particles.

Where there was much clayey matter we found usually a few rough red casts of the Foraminifera.

The following is a list of the depths of the soundings included under coral-muds :—

| At Bermuda. |      |      | At other places. |      |      |
|-------------|------|------|------------------|------|------|
| fms.        | fms. | fms. | fms.             | fms. | fms. |
| 2250        | 2100 | 1250 | 460              | 140  | 25   |
| 1820        | 1950 | 1575 | 390              | 210  | 100  |
| 950         | 2650 | 1500 | 625              | 610  | 40   |
| 430         | 1325 | 200  | 18               | 70   | 90   |
| 1375        | 1075 | 37   | 240              | 25   | 100  |
| 2450        |      |      | 315              | 16   |      |
|             |      |      | 255              |      |      |

2. *Globigerina*-ooze.—After the deep-sea clays, this is the most abundant deep-sea deposit. It has occurred at all depths from 250 fathoms to 2900 fathoms. The *Globigerinae*, which give at once the name and the chief characteristic to this deposit, are really found all over the bottom of the ocean. Even in our deepest clays, if the surface-layers be selected and all the amorphous matter be washed away, one or two shells of some variety of pelagic Foraminifera can usually be detected. By pursuing this method I have only failed on one or two occasions. They appear to be quite absent in the Arafura Sea. It is, however, when they occur in vast numbers that they form the deposit known by this name; at least such is the sense in which it is here used.

We did not find a *Globigerina*-ooze in any of the enclosed seas, in the Southern Ocean south of lat. 50° S., nor in the North Pacific north of lat. 10° N.

In the Southern Ocean only one small species of *Globigerina* was found in the surface-waters; but in the North Pacific many varieties of pelagic Foraminifera abound near the surface of the ocean.

In other parts of the preceding oceans, and in the other oceans we have visited, it occurs in irregular patches, being always present in the open ocean when we have depths of less than 1800 fathoms. Its presence or absence at depths beyond 1800 fathoms is, however, determined by conditions at present unknown. A number of varieties occur both as to colour and composition. Some specimens are nearly pure white, others have a rose-colour, and others are red or dark brown. The red and brown colour arises from the presence of the oxides of iron and

manganese. In the white varieties the sediment, after dissolving away the carbonate of lime, is in some specimens abundant, in others not abundant, and is either of a red or slate-blue colour. We find the former colour to prevail in those soundings far from continents and large islands, and the sediment is not abundant except where pumice or scoria is present. The latter, or slate-blue colour, is found in those soundings more or less near continents and large islands; and it is suspected that this sediment has its source chiefly from the disintegration of these adjacent lands.

Mica, quartz, pumice, scoria, and other mineral particles are met with; but in those soundings furthest from land a little piece of pumice or scoria may be the only trace of mineral particles.

In some specimens there are very many remains of organisms with siliceous shells, as Radiolaria, Diatoms, and Challengerias; but in others these remains are almost entirely wanting. In three soundings in mid-Atlantic between the Canary and Virgin Islands, and in several soundings in the South Pacific, manganese in the forms of grains and nodular concretions is very abundant. As a rule, however, this substance occurs rather sparingly in *Globigerina*-ooze. In some instances we get little nodules of these bottoms, the shells as it were being run together by a siliceous cement. Many small pieces of cherty-like mineral also occur, which are angular and soft, and do not look as if they had been transported. Manganese nodules occurring in the *Globigerina*-ooze have often a nucleus of a yellow and green colour, in which *Globigerina*-shells can be seen; but their carbonate of lime has been entirely removed, and replaced by a silicate. There are reasons for thinking that these indications of flint (?) occur only in those samples where the siliceous shells of Radiolaria, Diatoms, &c. are wanting, and do not occur where these organisms are present. A reexamination of all the bottoms must be made before this statement can be definitely affirmed. Casts of Foraminifera occur very sparingly in *Globigerina*-ooze; in the purest samples not at all. In those with an admixture of clayey matter we have frequently one or two partial casts of a very rough character. In two soundings, Nos. 211 and 301, in the Pacific, we found the Foraminifera not only filled, but also coated with a red substance, so that we had both an internal and an external cast, the two being connected by little rods representing the foramina of the shell. In these soundings there was much clayey matter and disintegrating pumice and scoria.

In a few soundings in the Pacific, as No. 304, we have had a *Globigerina*-ooze on the surface of the bottom, and a foot beneath a nearly pure red or brown clay. Again, as in Nos. 268 and 307, we have the reverse arrangement, a clay occupying the surface, and the deeper layers having many *Globigerinae*. In all these cases the surface-layer has been normal with the other soundings in the same region as to depth. In the first case we might bring in elevation to account for the

*Globigerina*-ooze overlying the red clay, or we might suppose that chemical changes are going on in the deeper layers which remove the carbonate of lime. In the second case we may account for a red clay overlying a deposit with many *Globigerina* in it by supposing a depression of the bottom after the latter had been laid down; or we may believe that agencies are now removing carbonate of lime from the surface-layer, and that these were not active in some past time.

This deposit occurs, in one sounding, in the Pacific at a depth of 2925 fathoms in mid-ocean. In the eastern part of the Atlantic it occurs also at great depths.

The following is a list of the depths at which we have found a *Globigerina*-ooze:—

*Atlantic Ocean.*

| fms. | fms. | fms. | fms. | fms. | fms. |
|------|------|------|------|------|------|
| 1090 | 1900 | 2200 | 1350 | 1425 | 2275 |
| 1525 | 1950 | 1675 | 900  | 1650 | 2475 |
| 2250 | 2325 | 1675 | 2025 | 2300 | 2200 |
| 2225 | 1420 | 1240 | 2660 | 2300 | 2150 |
| 1945 | 2575 | 1000 | 2675 | 2400 | 2275 |
| 1975 | 2450 | 2500 | 2400 | 2400 | 2050 |
| 1150 | 2475 | 2275 | 1500 | 2075 | 1900 |
| 2300 | 2175 | 1850 | 1900 | 780  | 2025 |
| 2025 |      |      |      |      |      |

*Southern Ocean.*

| fms. | fms. | fms. | fms. | fms. | fms. |
|------|------|------|------|------|------|
| 1900 | 1570 | 1375 | 1600 | 1800 | 2150 |

*Pacific Ocean.*

| fms. | fms. | fms. | fms. | fms. | fms. |
|------|------|------|------|------|------|
| 1974 | 1350 | 1675 | 2925 | 1915 | 1500 |
| 1100 | 1450 | 2000 | 2425 | 1600 | 1825 |
| 275  | 1700 | 1100 | 1940 | 2025 | 1775 |
| 400  | 1400 | 1850 | 2075 |      |      |

3. *Radiolarian Ooze*.—Organisms with the siliceous skeletons abound in the surface-waters, and apparently also in the deepest waters, of all the oceans and seas we have visited\*. The skeletons of these organisms are found in all, or almost all, the sea-bottoms. Even in those cases where at first sight they would seem to be quite absent, a more careful examination (by dissolving away a large quantity of carbonate of lime where this exists, and examining the sediment by careful washing in the case of clays, &c.) will usually reveal a Radiolarian skeleton, a Diatom frustule, or broken portions of these.

It is, however, only in some limited areas that these exuviae rise into such prominence as to be characteristic of the deposit taking place. Such is the case in the Antarctic, where we have a Diatom-ooze, and in the Western and Middle Pacific, where we have the above deposit.

\* They are, however, much more numerous in the Pacific than in the Atlantic, especially in the equatorial waters.

Our deepest sounding (4475 fathoms or 4575, see p. 504) was a Radiolarian ooze; with the exception of a little amorphous matter, manganese particles, a few yellow cherty-like particles, and some pumice pieces, this bottom was entirely composed of the exuviae of organisms with siliceous skeletons—as Radiolaria, one or two Diatoms, and some organisms which seem to be undescribed (Challengerias), but which are numerous in the deeper waters of the Pacific (see notes on surface animals, p. 536).

A section of about 3 inches came up. The upper two were of a red colour, due to the presence of much manganese; the lower one was a pale straw-colour, and contained relatively few manganese grains.

In our trip from the Sandwich Islands to the Society Islands we again met with Radiolarian ooze. Between 7° and 12° north of the equator we came on a patch represented by four soundings, some of these containing not a single *Globigerina*; then just on the equator, in two soundings, one at a depth of 2925 fathoms, we got a *Globigerina*-ooze containing a good many Radiolaria. Between 2° and 10° south we again had a patch of Radiolarian ooze represented by three soundings, and containing only a few pelagic Foraminifera or their broken parts. The occurrence of this patch of *Globigerina*-ooze in the position indicated (see map, Plate 20), and the comparative or total absence of the *Globigerina*-shells in the deposits a little to the north and south of it, is sufficiently curious and significant. It will be well to note that, in the *Globigerina*-patch, manganese and other mineral particles are much less abundant than in the adjacent Radiolarian. Note also the presence of the south equatorial current and the dip of some isotherms over the *Globigerina*-patch. One or two soundings to the east of Japan might have been classed under this head; but in them the siliceous remains do not make up over one third of the sample in bulk. Generally it may be said that in the Western and Middle Pacific the siliceous remains of Radiolaria and Diatoms are abundant in the deposits, whereas in the South Pacific and Atlantic they are much less so, or absent in the bottoms.

The following are the depths of the soundings placed under the head of Radiolarian ooze:—

|   | fms. | fms. | fms. |
|---|------|------|------|
| { | 4575 | 2700 | 2600 |
| { | 4475 | 2900 | 2350 |
|   | 2750 | 2250 | 2750 |

4. *Diatomaceous Ooze*.—South of the latitude of the Crozets, on our southern trip, we found Diatoms abundant, both in the surface-waters and in the bottom.

About the Crozets, Kerguelen, M'Donald's Islands, and close to the ice-barrier, the frustules of these organisms were very abundant in the soundings, but were masked by much land-débris. Between the parallels of 53° and 63° S., *i. e.* between the north edge of the ice and the latitude of M'Donald's Islands, we got in three soundings a pale straw-coloured

deposit, composed principally of the frustules of Diatoms and their broken-down parts. In addition, they contained a good many Radiolarian remains, a few specimens of one small species of *Globigerina*, a few particles of mica, quartz, and granitic pebbles, also a little amorphous blue clayey matter. No manganese particles were noticed. The one of these soundings which is nearest to the ice contains much amorphous clayey matter and larger mineral particles than the other two. When dried this deposit is of a white colour, and is very light.

The following are the depths of the soundings referred to above :—

| fms. | fms. | fms. |
|------|------|------|
| 1260 | 1975 | 1950 |

5. *Red and Grey Clays*.—By far the most abundant oceanic deposits are the deep-sea clays. These are of a grey, red, or dark chocolate-colour, and are found at depths greater than 2000 fathoms. The red and chocolate-colours of many of these clays is due to the presence of the oxide of iron in the first and of oxide of manganese in the latter instance. Most of them contain some carbonate of lime in the form of *Globigerina*-shells ; in one or two instances, however, I have not been able to find a single shell, nor has acid caused the least bubble of effervescence. The remains of siliceous organisms occur also in great numbers in the clays of some regions—so much so that, as I have stated, some of those soundings in the North-west Pacific which have been classed as clays might have been called Radiolarian ooze. In most places, however, they are nearly or quite absent. These clays are not amorphous in the true sense of the word—not amorphous in the sense in which a chemical precipitate is amorphous. They all contain small white and other coloured mineral particles in great abundance—exceedingly small particles, so as to be recognized only under the high powers of the microscope. They contain amorphous matter, it is true ; but it is doubtful if this ever makes up so much as a half of any sample in bulk. They also contain larger mineral particles, as quartz, mica, pumice, scoria, peroxide of manganese, and other mineral particles. Quartz and mica particles appear to be present only in some localities, as the North Atlantic and elsewhere. Peroxide of manganese is perhaps always present in the form of grains or nodules, sparingly distributed in some regions, in others making up nearly a half of the deposit or formation.

Pumice (the common felspathic or the highly vesicular augitic variety) and scoria appear to be universally distributed over the bottom of the ocean, and to be abundant in most of the deep-sea clays and present in them all. In those clays furthest from continents and islands sharks' teeth, ear-bones of whales, other bones of whales, and bones of turtles (?) are very frequently found, all these having usually a more or less thick coating of peroxide of manganese. The following are the depths at which we have found these red and grey clays :—

*Atlantic.*

| fms. | fms. | fms. | fms. | fms. |
|------|------|------|------|------|
| 2740 | 2385 | 2700 | 2650 | 2700 |
| 2950 | 2675 | 2600 | 2500 | 2750 |
| 2750 | 3000 | 2475 | 2360 | 2700 |
| 2800 | 2975 | 2600 | 2575 | 2350 |
| 3150 | 3025 | 2850 | 2850 | 2275 |
| 2720 | 2800 | 2675 | 2875 | 2550 |
| 2575 | 2960 | 2800 | 2750 | 2650 |
| 2435 | 2850 | 2650 | 2750 |      |

*Southern and Pacific Oceans.*

| fms. | fms. | fms. | fms. | fms. |
|------|------|------|------|------|
| 2600 | 2450 | 2575 | 3125 | 2325 |
| 2600 | 2325 | 2800 | 2025 | 2385 |
| 2600 | 2300 | 2900 | 2850 | 2450 |
| 2900 | 2475 | 2775 | 2950 | 2375 |
| 2650 | 2450 | 2050 | 2875 | 2250 |
| 2325 | 2500 | 2530 | 2775 | 2335 |
| 2450 | 2425 | 2900 | 2225 | 2270 |
| 2440 | 3900 | 2300 | 3000 | 2400 |
| 2275 | 3600 | 2350 | 2900 | 2600 |
| 2550 | 2900 | 2900 | 2610 | 2550 |
| 2650 | 2300 | 2740 | 2350 | 2300 |

*The Manganese in Deposits.*

The peroxide of manganese, in the form of minute grains, concretions, nodules, aggregations, or incrustations, occurs widely distributed in ocean-deposits. It has been met with most frequently in the deep-sea clays; indeed it seems to be present in all of them, sparingly in some localities, abundantly in others.

It is, however, not confined to these clays; it has been found in most of the other deposits and at all depths greater than 500 fathoms. In the *Globigerina*- and Radiolarian ooze and in the clays it usually assumes the forms of minute grains, pellets, and nodules. In those bottoms to which it gives a chocolate-colour, the higher powers of the microscope show small, round, red-brown grains of manganese, often with a dark spot in the centre.

The nodules vary from little pellets to masses of a large size and of several pounds in weight. In some regions every thing at the bottom, even the bottom itself, would appear to be overlaid by and impregnated with this substance. In the foregoing list, as at No. 318 and elsewhere, some of the nodules have been described with a little detail. The varieties which are most commonly procured may be here mentioned:—

Nodules of a black-brown colour throughout, the manganese being laid down in concentric layers, which are evident from their enclosing lines of red clay.

Nodules having a nucleus of pumice which is surrounded by concen-

tric layers, the original nucleus being often very deeply impregnated by spider-like ramifications of the manganese, or nearly the whole pumice may be replaced by manganese. When pieces of bone have formed the nucleus we have much the same state of things. The compact bone of the tympanics of cetaceans does not, however, appear to alter so rapidly as other bone; and hence it may be that we get ear-bones in such great numbers.

Sharks' teeth of all sizes (one was 4 inches across the base) are frequent, and are sometimes surrounded by concentric layers of nearly an inch in thickness. A siliceous sponge (*Farrea*) was found imbedded in two inches.

A mass of red clay may occupy the centre of the nodule. The nucleus is occasionally a mottled yellow-and-green substance, with agate bands in some parts, and *Globigerina*, the carbonate of lime being replaced by silicate in these last. This nucleus can be cut with a knife, like new cheese, or it is hard and brittle, breaking with a conchoidal fracture.

Large flat aggregations occur which seem to have been formed on hardened flat portions of the bottom.

The *Globigerina*-shells and Radiolaria are at times covered by small specks of the manganese; and in the former these are deposited in the substance of the shell.

In several soundings and dredgings to the south-west of the Canaries we got very many large pieces of a branching Gorgonoid which were deeply coated and impregnated with manganese. This was in a depth of from 1100 to 1575 fathoms.

In 670 fathoms, off the Desertas, the dead shells, pieces of coral, Polyzoa, &c. were all coated with a thin film of the peroxide of manganese; and we have had indications of the same thing in still shallower water.

In some of the Radiolarian oozes, and in other deposits, we have found the manganese more abundant in the upper layers than in the lower, and *vice versa*.

The following are the localities where we have met the manganese in greatest quantities :—

Off the Canary Islands.

Mid-Atlantic, between Canary and Virgin Islands.

South-west of Australia.

North and south of the Sandwich Islands.

North of Tahiti.

Generally in the South Pacific in our course between Tahiti and Valparaiso (see Map, Plate 20).

Further observations may show that manganese abounds in those places where we have much of the débris of augitic lavas.

#### *Abyssal Rhizopods (Bathybius).*

The manganese nodules, sharks' teeth, &c. which we got in our

deepest trawlings have very frequently small branching tubes, composed of clay and sandy particles, running over their surfaces. These belong to a Rhizopodal organism. The sarcode which fills these tubes contains many large brown pigment-cells, and small bioplasts are collected in clumps at distances along the length of the tube, or are scattered throughout it.

Tubes of a similar nature, but composed of pieces of *Globigerina*, *Radiolaria*, &c., would appear to be rather abundant on some of the oozes, and to run irregularly over the bottom.

In the clays we always get some arenaceous forms of Foraminifera when there has been a successful haul with the trawl. Their shells are made up of pieces of manganese, clay, and small mineral particles, and they contain the same kind of sarcodic substance as the tubes above referred to.

An attached calcareous form (c. f. *Carpenteria*) has been found in rather deep water, and *Biloculinas*, *Nodosarias*, *Triloculinas*, and other forms have been frequently procured alive. These last have orange-coloured pigment-cells, in which respect they resemble surface Rhizopods. A living specimen of *Orbulina* or *Globigerina* undoubtedly from the bottom has not yet been met with.

In the early part of the cruise many attempts were made by all of the naturalists to detect the presence of free protoplasm in or on the bottoms from our soundings and dredgings, but with no definite result. It was undoubted, however, that some specimens of the sea-bottom preserved in spirit assumed a very mobile or jelly-like aspect, and also that flocculent matter was often present.

Mr. Buchanan determined that the flocculent matter was simply the amorphous sulphate of lime precipitated by spirit from the sea-water\*. Subsequently a number of experiments were made upon the behaviour of this amorphous precipitate when precipitated with different quantities of spirit and when treated with colouring-solutions. The precipitate was also examined alone and mixed up with some of the ooze. The ooze was examined at the same time, and in the same manner, but without having been treated with spirit. The results were shortly these:—

When sea-water is treated with twice its volume of spirit or less, nearly the whole of the amorphous precipitate assumes the crystalline form in a short time.

When treated with a great excess of spirit the precipitate remains amorphous, and assumes a gelatinous aspect.

This gelatinous-like sulphate of lime colours with the carmine and iodine solutions, and when mixed with the ooze has, under the microscope, the appearances so minutely described by Hæckel.

The ooze washed with distilled water, or taken just as it comes up, and treated in the same manner with colouring-solution, does not

\* See Mr. Buchanan's report.

show these appearances. The jelly-like aspect and the matter coloured with carmine can always be removed from the spirit-preserved specimens of the ooze by treating with distilled water.

In all cases the jelly-like or mobile aspect of the oozes is found to be due to the presence of the flocculent precipitate from the seawater associated with the ooze.

No free albuminous matter could be detected.†

When it is remembered that the original describers worked with spirit-preserved specimens of the bottom, the inference seems fair that *Bathybius* and the amorphous sulphate of lime are identical, and that in placing it amongst living things, the describers have committed an error.

#### ORIGIN OF DEEP-SEA CLAYS. RELATIVE RATE OF DEPOSITION OF DEPOSITS. CONCLUSION.

The very wide distribution of pumice, vesicular lava, or light scorix has been already alluded to. Some of the bottoms which have been classed under the head of clays, as 2900 fathoms south of Tongatabu, are largely made up of pumice in a fine state of division. Pumice or vesicular lavas have, in short, been found in all the kinds of deposits, most abundantly in the vicinity of volcanic islands and in the deep-sea clays. It appears to be universally present, and its disintegration is most probably the chief source of the clayey matter found in oceanic deposits. North of the Sandwich Islands we for several days got small pieces of pumice floating on the surface, most of the pieces being covered with a fungoid growth. In this connexion it may be well to remember that Mr. Bates states somewhere that he found pumice rather common, floating on the surface of the Amazons, over a thousand miles from the nearest volcanic region. Many instances are given by Sir Charles Lyell of volcanic ashes having been transported to great distances by the wind.

At Honolulu Mr. Green informed me that *Pele's hair* had been picked up in his garden there after an irruption of Kelauea in Hawaii, a distance of about 180 miles from the crater. If there be an ash after the carbonate of lime is removed by carbonic acid or other agent, this will be another source of the clay.

Mr. Buchanan has determined in the clays the presence of copper, cobalt, and nickel, in addition to iron and manganese. Remembering this, one is tempted to suggest the presence of meteoric or cosmic dust in these deposits.

When we have had a good haul from a red-clay bottom, when the bag comes up full of nodules, tympanic bones, and sharks' teeth, we cannot resist the idea that we are dealing with things of a vast antiquity, and that we have evidences of a very slowly accumulating deposit. When there has been no reason to suppose that the trawl has sunk more than one or two inches in the clay, we have had in the bag over a hundred sharks' teeth and between thirty and forty ear-bones of cetaceans; some

of these have been imbedded in over an inch of the manganese, arranged in concentric layers, while others have had just a trace of manganese on them, or none at all. We have every reason to suppose that the aggregation of the manganese around these relics is a very slow process, and that consequently the occurrence of these deeply imbedded and recent teeth and tympanics in the same surface-layers argues strongly in favour of an exceedingly slow rate of deposition. These vertebrate remains are most abundant where the manganese abounds, but occur also in the red and grey clays, especially in those the furthest from the land, and where we may suppose the rate of deposition to be reduced to a minimum.

In the *Globigerina*, Radiolarian, and Diatom oozes we have found during the whole cruise only one or two shark's teeth and perhaps one tympanic bone. In shore-deposits they were even more rare. These facts, taken with others that will at once suggest themselves, go to show, as might be expected, that the shore-deposits accumulate faster than the organic oozes, and these last faster than the deep-sea clay. The organisms in our Radiolarian ooze appear to resemble very closely and in their relative proportions those described from the Barbadoes earth. Those described from the Oran deposit in Algeria are very like those in the blue muds taken along the course of the Japan stream. The *Globigerina*-oozes which we get in shallow water resemble the chalk much more than those in deeper water, say over 1000 fathoms. It is possible that deposits similar to those taking place in deep water, far away from the great continental anticlines, may never have been elevated into dry land.

In conclusion, large quantities of the various bottoms have been stored with a view to future work, and a large amount of material bearing on the subjects treated of in this Preliminary Report have been accumulated. When these come to be carefully examined and compared, with the aid of appliances and conveniences not to be had on board ship, many of the statements herein made may require to be altered and amended, and other facts and relations, more curious and interesting than any hinted at, may be revealed.

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## 2. Preliminary Report on some Surface Organisms and their relation to Ocean Deposits.

Throughout the cruise of the 'Challenger,' and especially during the past two years, tow-nets have been dragged through the surface and deep waters of the sea on every possible occasion. The contents of the nets, so far as known, have been carefully noted, and many hundreds of preparations have been made with the view of illustrating the organisms occurring in different regions and at various depths. Many new animals have been discovered, and many curious relations brought to light. It is not now possible to give any descriptions or to report fully with any success or satisfaction on such an extended series of observations.

A few remarks on those organisms which have an interest in relation to the deposits taking place at the bottom of the sea is all that will be attempted. Soon after the arrival of the Expedition at home I hope to be able to give a more complete report on surface organisms.

*Diatoms*.—In the Southern Ocean, south of Kerguelen, in the Arafura Sea, off the coasts of Japan, New Guinea, North America, and in enclosed bays and river-deltas, in short, wherever the specific gravity of the sea is low from an admixture of fresh water, we have met with very many Diatoms on the surface. Taking the maps which Mr. Buchanan has prepared, showing areas of low specific gravity, and comparing these with the records of the occurrence of Diatoms in great abundance, it is significant how often these agree. Again, excepting the area of the Diatom-ooze, those places where Diatoms are abundant, and where the specific gravity of the water is low, coincide generally with the areas where the blue muds are found, *i. e.* along the continents and great islands. It may be stated generally that close to these shores we have in the surface-waters organisms more or less distinct from those occurring in the open sea. Besides many forms of Diatoms, the true *Noctiluca*, several *Peridinia*, larvæ of Annelids, and Mollusca, Hydroid Medusæ are more or less characteristic of these shore waters. In the Antarctic, in the Arafura Sea, at Hongkong, off Japan, and elsewhere the tow-nets were frequently filled with a yellow slime in a short time, which consisted chiefly of Diatoms. In the Southern Ocean, as has been stated, the Diatoms form a peculiar deposit. In other deposits they are at times also well preserved, but occasionally are either completely masked by shore-débris or removed from the bottom.

In the open ocean, in the region marked out by the north edge of the N.E. trade-wind and the south of the S.E. trade, small forms of Diatoms do not occur in any numbers. They are represented, however, by three large species, which are undescribed so far as is known. Mr. Wild has figured two of these in Plate 21. These organisms have an exceedingly thin coating of silica and are true Diatoms, though they have been confounded with *Noctiluca*. The nuclei of both these forms are highly phosphorescent, and to them the diffused phosphorescence of the ocean within the tropics is generally due. A third large Diatom has a cylindrical shape and a much thicker coat of silica, and is not phosphorescent. These three forms are highly characteristic of the presence of tropical oceanic waters. The provisional generic name of *Pyrocystis* is proposed for the organisms figured in this Plate.

*Coccospheres and Rhabdospheres*.—These minute organisms, which are regarded as algæ, have been found all over the ocean, except south of the latitude of Kerguelen and in some of the enclosed seas. Their remains, in the forms of Coccoliths and Rhabdololiths, make up a very considerable portion of the bottom in some of the *Globigerina*-oozes. They are always

associated with the pelagic Foraminifera ; and when these are absent from the bottom so also are the Coccoliths and Rhabdoliths.

*Pelagic Foraminifera*.—All the observations which have been or may yet be made upon these animals will be collected at the end of our cruise, and published with those which have been made by Professor Wyville Thomson. It is here proposed to record shortly those results which it is believed have already been attained.

Calcareous Foraminifera have been found in the surface-waters of all the oceans and seas we have visited, excepting the Arafura and Japan inland seas.

In the tropics they are most abundant, both as to species and numbers, and are more numerous in the open ocean than near land.

Our tow-nets have perhaps in no single instance been dragged down to 200 fathoms without yielding some forms. At times they occur in vast numbers on the surface, and with a bottle can be picked up from a boat. In one specimen thus procured the sarcode of the animal was found thrown out into bubble-like extensions between the spines of the shell, and over these expansions of the sarcode and along the spines the pseudopodia moved freely and rapidly. Mr. Wild has figured this specimen in Plates 22 and 23, and Professor Wyville Thomson proposes to describe it under the generic name of *Hastigerina*.

This is the only instance in which we have seen one of these creatures fully expanded ; however, those taken in the net can, when the ship is steady, be got to expand partially. Almost always when they come up in the net the sarcode is found to adhere to and surround closely the outside of the shell, so much so that the pigment-cells and oil-globules obscure the shell, especially in the Pulvinulinas.

Those species without spines apparently throw out bubble-like expansions of the sarcode in the same manner as *Hastigerina*. They have, however, been seen only partially extended.

The sarcode matter of these organisms includes very many orange-coloured pigment-cells and oil-globules, the shape and size of these varying with the species. The sarcode has also many small bioplasts scattered through it, which quickly colour with carmine. These are generally found congregated in the smaller chambers of the shell when the animal is at rest.

About a dozen species of these organisms have been found on the surface ; some are more or less tropical, others extend into the region of the westerly winds north and south, and one species is found in the Antarctic Ocean.

The shell of the species represented in the Plate has been observed only once from the bottom, and then only in a broken state. This is to be accounted for by the fact that the shell is exceedingly thin, delicate, and fragile.

The specimens of these Foraminifera taken in the surface-net are of

all sizes, from the smallest ones to those which have been described with an exogenous growth. Species only occur on the bottom in those places where they are found on the surface. These organisms are found in vast numbers on the surface over regions where there are only a few traces of them or their broken parts on the bottom.

No living specimen of a *Globigerina*, an *Orbulina*, a *Pulvinulina*, or of the new genera found on the surface, which undoubtedly came from the bottom, has yet been met with.

The foregoing observations appear to justify the opinion that these organisms live only in the surface and subsurface waters of the ocean. The most potent agent concerned in the removal of these shells from the majority of the deep-sea deposits is very likely that suggested by Professor Wyville Thomson, viz. carbonic acid; yet there may be others. Why these shells should be almost entirely absent in some places at a depth of 2000 fathoms, and be abundant in some other few places at a depth of 2900 fathoms, has still to be explained. The tow-net seemed to show that they were as numerous in the surface-waters of the one region as of the other.

Two varieties of large cells are occasionally noticed in the pelagic Foraminifera, not unlike the reproductive cells which have been described as occurring in some Infusoria.

*Radiolaria*.—Radiolaria polyzoa, Acanthometræ, or Polycystinæ occur almost universally in the surface-waters of the ocean. As has been stated, they (in a few places in the Western, Northern, and Middle Pacific) make up a large or principal part of the deposits at the bottom. In very many places they appear to be nearly or quite absent in the bottoms. In some *Globigerina*-oozes they are present in considerable numbers, in others they cannot be detected. What agents are concerned in the removal of these organisms is at this time a matter of conjecture.

*Deep-Sea Rhizopods*.—In April 1875 a plan of sending down tow-nets to a great depth was adopted. These were either attached to the dredge and trawl-lines, or sent down separately to a depth of 2000 fathoms or more. This method has been repeatedly practised since, and with these results.

On every occasion organisms were found in the deep nets which had not hitherto, nor have since, been observed in the nets used near the surface. These appear to have a wide distribution, as the same forms have been taken in the deep nets in the North, Middle, and South Pacific, whilst the surface organisms have varied in these regions to a considerable extent. These organisms are:—

Many small crustaceans, usually of a bright orange-colour—Copepods, Amphipods, and Cypridinas principally. Many large-sized Radiolaria, resembling in most respects those forms described by Hæckel under the generic name of *Calodendrum*.

Many other Rhizopods, with more or less flask-shaped or bivalved siliceous shells, which are undescribed, so far as is known.

Mr. Wild has figured six of these last in Plate 24; for the sake of convenience we have been accustomed to call the organisms Challengeridæ. This provisional name will be retained if it be found that these organisms are new to science and universally distributed in deep water.

The shells of all have an exceedingly beautiful tracery, a fenestrated appearance often, which was at first supposed to be due to perforations of the shell, but which a closer examination shows to be caused by pit-like depressions. Some have only one, others have several openings through which the sarcode flows. The sarcode of all these deep-sea Rhizopods has many large black-brown pigment-cells. Small bioplasts are scattered through the sarcode. These collect into capsular-like clumps when the animal is at rest, and are quickly coloured by carmine. At times these Challengeridæ come up with a good deal of the sarcode outside of the shell; and two specimens have been seen to throw out elongated pseudopodia.

I should think that not less than fifty species of these organisms have been taken in the deep nets already. They all resemble more or less those forms drawn by Mr. Wild. It will be interesting to learn if future investigations will show these organisms to be present in the deep waters of the Atlantic as well as the Pacific. In the Radiolarian oozes the remains of these Challengeridæ make up a considerable portion of the deposit, and in some other deposits of the North-west Pacific they are well preserved. In the majority of bottoms, however, they appear to be quite absent.

*Pteropods, Heteropods, Pelagic Gasteropods.*—Species of these orders occur everywhere in the surface-waters of the ocean. Their shells make up a large portion of some deposits in shallow water, where there is relatively little land-débris.

In depths less than 1500 fathoms they abound; deeper than this they become more and more rare. At 2000 fathoms and deeper the only trace of these shells in the deposits is an occasional *Diacria* or *Ianthina* of a large size.

Those shells which are thin and delicate, as *Atlanta*, *Carinaria*, and *Styliola*, disappear first from the bottoms.

#### GENERAL REMARKS.

Everywhere we have found life abundant in the surface and subsurface waters of the ocean. If living creatures are small in number on the surface, the tow-net will usually yield many forms if dragged at a depth of 100 fathoms or more. We have not met with any really barren regions. Our observations appear to show that there are several regions of the surface of the ocean, each of which is characterized by a number of peculiar organisms :—

1. A region roughly marked out by the northern edge of the N.E. trade-wind and the southern edge of the S.E. trade-wind.
2. A region lying along the coasts of great islands and continents, where we have usually a mixture of fresh and salt water.
3. A region in the Southern and Antarctic Oceans south of the latitude of 50° S.

In all depths less than 1500 fathoms there would seem to be a direct relation between the organisms occurring on the surface and the deposits taking place on the bottom. Where we have Diatoms on the surface, there we have their frustules on the bottom. Where we have *Globigerina* and Pteropods &c. on the surface, there also we get their dead shells or broken parts of them; and so also for the Radiolaria, Coccospheres, and other organisms. In some areas within the depths referred to we occasionally do not find the remains of some of the surface organisms so numerous as we should expect. In these cases, however, I suspect they are rather masked or obscured by an abundance of shore débris than removed from the deposit.

When we consider the specimens of the bottom from depths greater than 1500 fathoms, the relation is by no means so constant. It still holds good that when pelagic Foraminifera, Pteropods, Diatoms, Radiolaria, or Coccoliths are found on these bottoms, the same varieties of each of these are found on the surface; but perhaps in the majority of bottoms, in depths greater than 1500 fathoms, the exuviae of some or all of the organisms found on the surface are partially or wholly absent. When these have been carefully reexamined, the results tabulated and compared with other observations recorded at the same place, it is likely some light will be thrown upon the subject.

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### 3. Preliminary Report on Vertebrates.

Of the Vertebrate animals collected during the cruise, the chief interest is very naturally attached to those fishes on which our special investigations might be expected to give some information. Many specimens have been taken in our trawlings and dredgings. Other than the British Museum Catalogue, we have with us no literature on this subject. Many of the specimens which we regard as new may be described, and some of those which are believed to be identical with described species may turn out to be distinct; therefore for the present it is considered best to give a list of the fishes, with the determinations which were made at the time of their occurrence, and not to cumber this Report with descriptions.

Besides the fishes taken in the trawl and dredge, many small larval and adult forms have been obtained in the tow-nets. These last have chiefly been preserved as microscopic preparations. In every case notes have been taken at the time the specimens were procured, and all have been labelled and preserved with great care.

In the following List the depths to which the trawl had been down are given. Of course it is not asserted that the specimens came from these depths; indeed we know that many of the Sternoptychidæ and Scopelidæ are surface creatures.

It will be seen from the list that all the fishes taken in the trawl or dredge have been relegated to known families. The definitions of some families will require to be altered in order to admit some of the new forms; but it is not thought that a new family will require to be established.

There are many new genera and species. The list includes the dredgings in all the depths greater than 100 fathoms. If we had given only the trawlings in depths greater than 500 fathoms, all the shore forms which appear in the list would have been eliminated. Our dredgings and trawlings in less than 100 fathoms do not once give a specimen of the species so characteristic of the hauls in deep water.

The deep-sea and oceanic forms belong to very few families.

#### *Sternoptychidæ.*

These occur at 40 stations, and over a hundred specimens have been taken. Besides those from the trawl, small species have continually been taken in the nets in warm regions. South of the latitude of 50° S. we did not get a single species of this family.

Many of the pelagic species occur both in the Atlantic and Pacific Oceans, *i. e.* identical species.

#### *Macruridæ*

occur at 24 stations, and about one hundred specimens have been taken. They have been met with in all latitudes, and most frequently in depths between 200 and 1000 fathoms.

In this family we have many species which cannot be referred to existing genera. These fishes were almost always blown out and at times even burst when taken from the bag of the trawl. Some of the species appear to be universally distributed.

#### *Ophidiidæ*

occur at 18 stations, and 20 specimens have been taken. These fishes would seem to inhabit deeper water than the Macrurids, as they have in most cases been present in the trawl when it has been down to depths greater than 1000 fathoms. All of them appear to be undescribed, excepting *Bythites fuscus* (?). One specimen is quite blind; in another, which is semitransparent, the eyes are represented by small black dots. These fishes are apparently universally distributed.

#### *Scopelidæ*

occur 24 times, and 41 specimens have been taken. Many of these are truly pelagic fishes, while others have characters which mark them

out as deep-sea. The majority of the forms cannot be referred to existing genera or species. Perhaps the most curious fish which we have obtained belong to this family. Two or three species have the upper rays of the pectoral fins greatly elongated, these rays being much longer than the fish in some cases. These rays arch over the head, and when erected simulate in a wonderful way Umbellularias, Virgularias, or Crinoids. Another species has a large white (phosphorescent?) organ situated on the head between the eyes.

These fishes have occurred in all regions, and when the trawl has been down to depths varying from 255 to 2385 fathoms.

#### *Stomiatiidæ*

occur at 13 stations, and 15 specimens have been taken. These have been present only when the trawl has been down in deep water, and all have more or less deep-sea characters. There are two or three new generic forms, and new specimens of *Malacosteus* and *Echiostoma* have been secured.

#### *Pediculati*

occur at 7 stations, and 7 specimens have been taken. A *Chaunax* from 360 fathoms at the Fijis appears to be identical with that described from the sea off Madeira as *Chaunax pictus*. The other fishes of this family all belong to the same little group with *Melanocetus*, *Oneiroides*, and *Ceratiæ*. One, which I propose to describe under the name of *Ceratiæ uranoscopæ*, came up from 2400 fathoms in the North Atlantic, the only living thing in the dredge on this occasion.

#### *Halosauridæ*.

*Halosaurus Owenii* occurs at 5 stations, and 5 specimens have been taken. These seem all to be referable to the described species, and occur both in the Atlantic and Pacific.

#### *Notocanthi*.

One specimen was taken off the coast of Japan. It is a new species.

#### *Muraenidæ*

occur at 10 stations, and 20 specimens have been taken. This family in our deep-water hauls is represented by *Nemichthys* and *Synaphobranchus*. The *Nemichthys* in the Atlantic is identical with the one described (*scolopacea*). One taken in the Pacific is generically distinct.

All the specimens of *Synaphobranchus* can, I think, be referred to the species described (*pinnatus*). They have occurred widely both in the Atlantic and Pacific, and generally with the Macrurids.

#### *Trachinidæ*.

A species referable to the genus *Chaenichthys*, but with deep-sea characters, occurred in one of the deep hauls in the Southern Ocean.

Only one small specimen of the Sphyrænidæ and one of the Trichuridæ have been taken during the cruise.

We have while at sea captured only two species of sharks. One occurs widely distributed in the Atlantic and Pacific; the other was taken off the coast of Japan.

Whenever the ship has been at anchor, and wherever possible, collections have been made of Fishes, Amphibians, Reptiles, Birds, and Mammals. Collectively these now form a large collection. They have been preserved as skins, spirit specimens, and skeletons, and all with a view to future work. In the former three classes we have met with a good many new species. In Birds we may have some new species. In Mammals it is not likely we have any new species except amongst the Cheiroptera.

Of the Petrels and Penguins we have very extensive collections, both as skins and spirit, chromic acid, and other preparations.

Two or three skeletons of very large specimens of the Sea-Elephant have been preserved, and many specimens of the Southern Seals.

*List of the Fishes obtained in Trawlings and Dredgings by H.M.S.  
'Challenger' in the years 1873, 1874, and 1875.*

Atlantic Ocean.

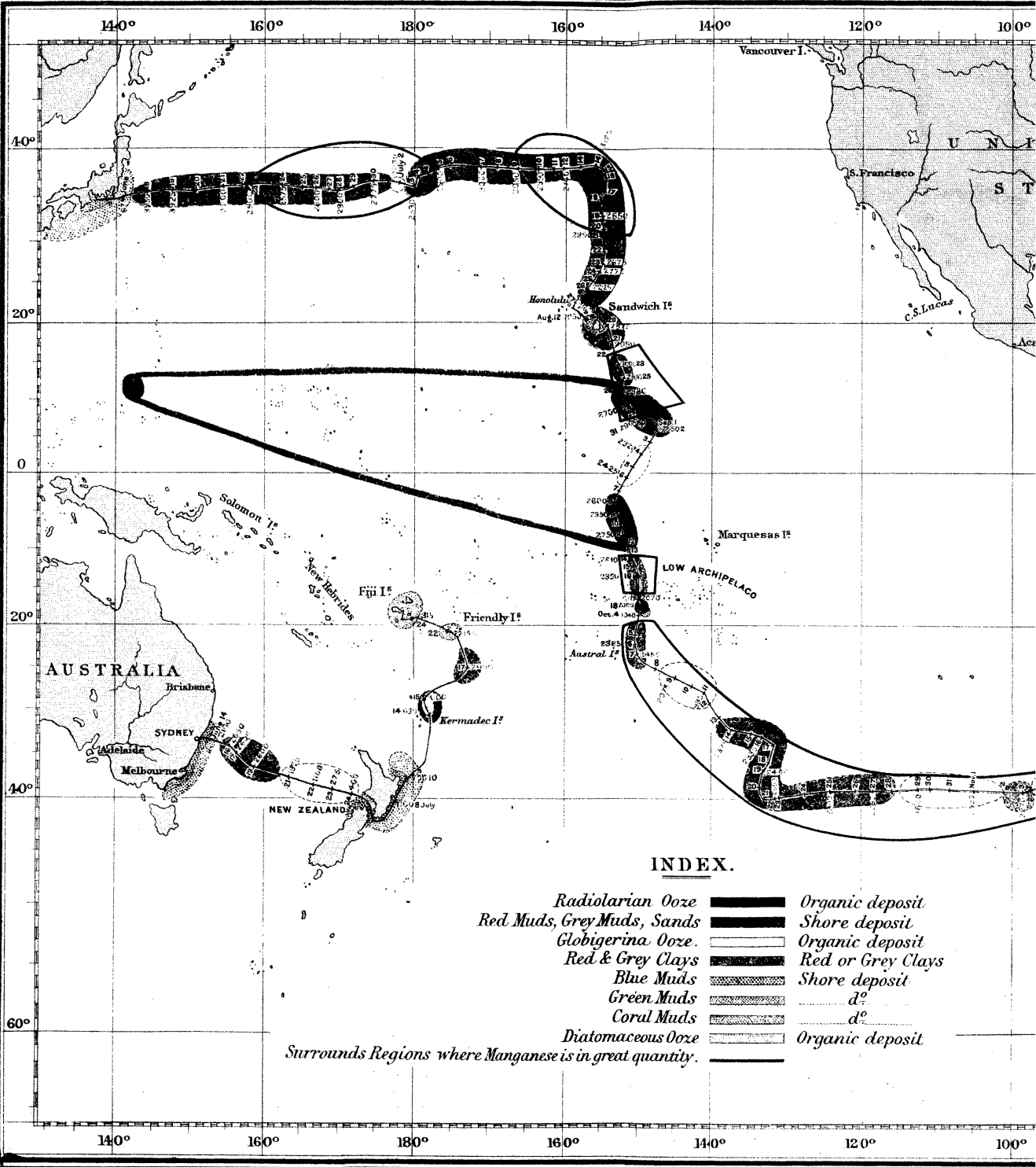
| Station. | Specimen.                                  | Num-<br>ber. | Depth.           | Locality.  |           |
|----------|--|--------------|------------------|------------|-----------|
|          |  |              |                  | Lat.       | Long.     |
| 1.       | <i>Sternoptyx diaphana</i> .....           | 1            | fathoms.<br>1127 | 41° 57' N. | 9° 42' W. |
| 4.       | <i>Mora mediterranea</i> .....             | 1            | 600              | 36 25 N.   | 8 12 W.   |
|          | <i>Coryphænoides</i> .....                 | 2            |                  |            |           |
|          | <i>Coryphænoides</i> .....                 | 1            | 1090             | 35 47 N.   | 8 23 W.   |
| 5.       | <i>Halosaurus Owenii</i> .....             | 1            |                  |            |           |
|          | Black Scopelid .....                       | 1            | 1420             | 18 40 N.   | 62 56 W.  |
| 22.      | Small black Sternoptychid .....            | 1            |                  |            |           |
|          | <i>Stomias boa</i> .....                   | 1            | 450              | Sombbrero  | Island.   |
| 23.      | Small black Sternoptychid .....            | 1            |                  |            |           |
| 40.      | <i>Sphyræna</i> probably (mutilated) ..... | 1            | 2675             | 34 51 N.   | 68 30 W.  |
|          | <i>Stomias boa</i> .....                   | 1            | 2575             | 34 27 N.   | 58 56 W.  |
| 60.      | <i>Maurolicus</i> .....                    | 1            |                  |            |           |
|          | Sternoptychids .....                       | 3            | 2850             | 34 54 N.   | 56 28 W.  |
| 61.      | <i>Halosaurus</i> .....                    | 1            |                  |            |           |
|          | <i>Stomias</i> , n. sp. ....               | 1            | 2750             | 35 29 N.   | 50 53 W.  |
| 63.      | Small Sternoptychids .....                 | 2            |                  |            |           |
|          | <i>Maurolicus</i> .....                    | 1            | 2175             | 38 3 N.    | 39 19 W.  |
| 68.      | <i>Ceratias uranoscopus</i> , n. sp. ....  | 1            | 2400             | 22 18 N.   | 22 2 W.   |
| 89.      | Small Sternoptychid .....                  | 1            | 1975             | 17 54 N.   | 24 41 W.  |
| 92.      | <i>Scolopacia</i> .....                    | 1            |                  |            |           |
|          | Stomiatics .....                           | 2            | 2500             | 5 48 N.    | 14 2 W.   |
| 101.     | <i>Maurolicus</i> .....                    | 1            |                  |            |           |
|          | <i>Argyrolepecus</i> .....                 | 1            | 2500             | 2 25 N.    | 20 1 W.   |
| 104.     | <i>Chauliodus Sloani</i> .....             | 1            |                  |            |           |
|          | <i>Eythites fuscus</i> , c. f. ....        | 2            |                  |            |           |

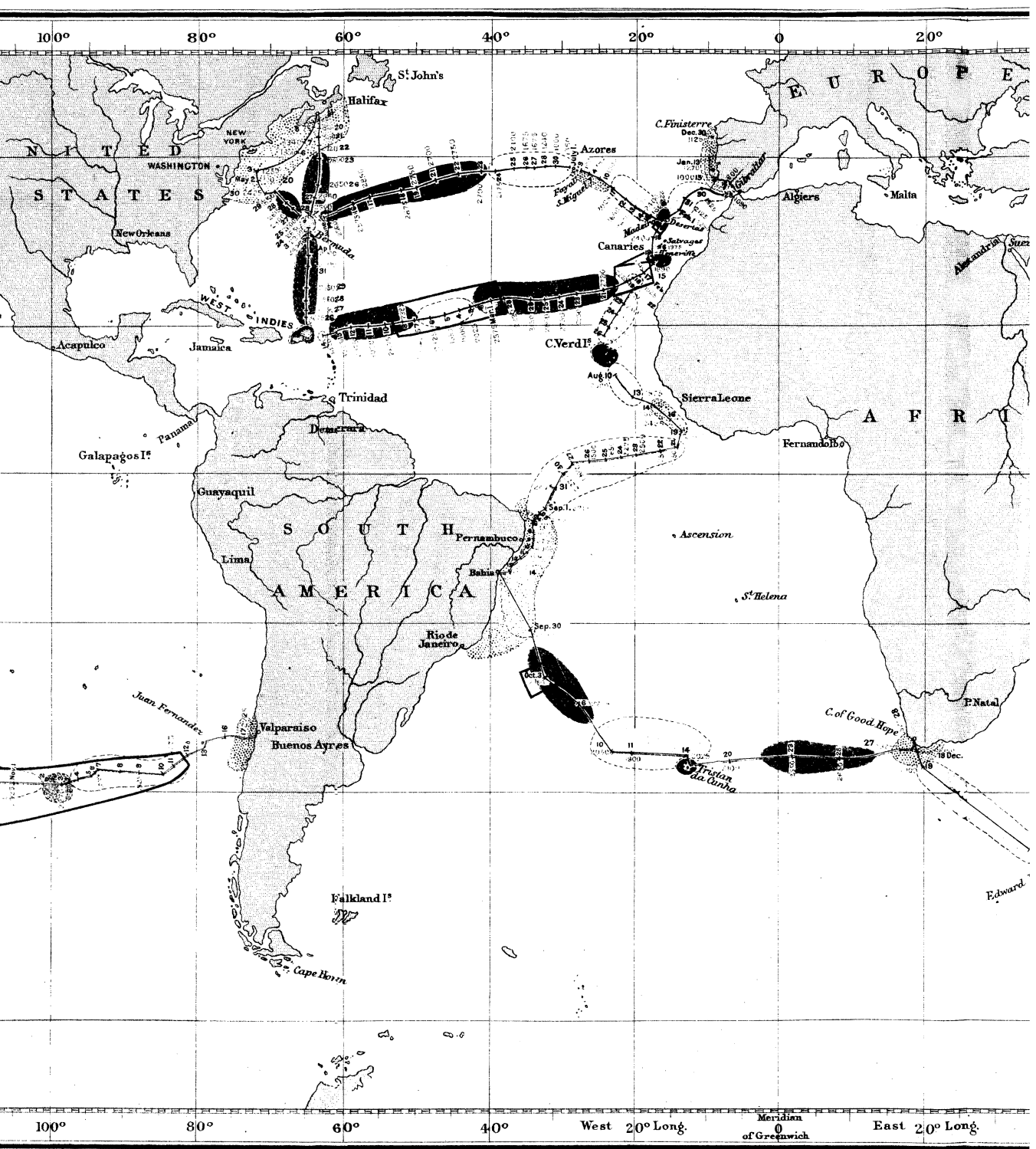
Atlantic Ocean (*continued*).

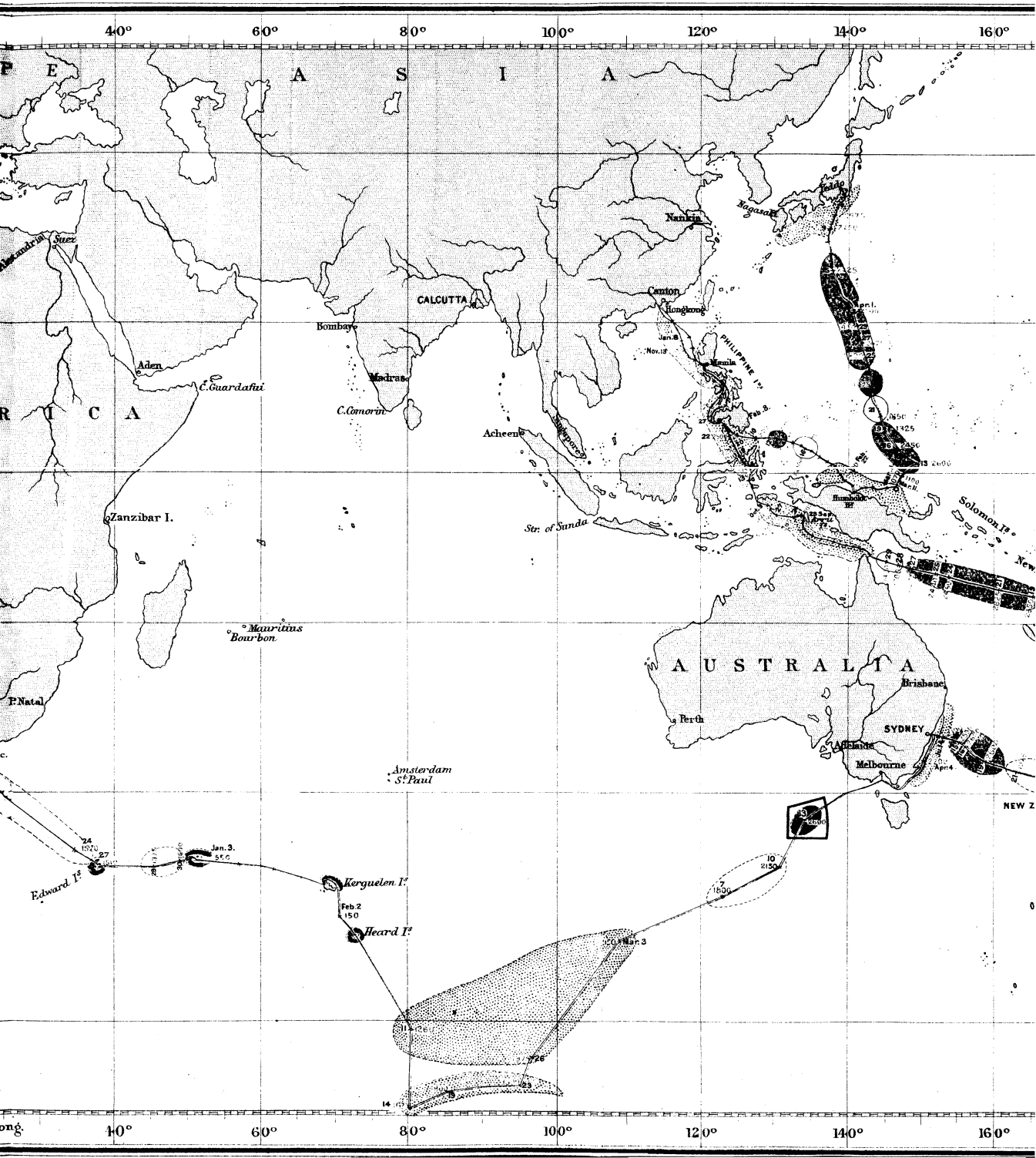
| Station.                       | Specimen.  | Number. | Depth.   | Locality. |           |
|--------------------------------|--|---------|----------|-----------|-----------|
|                                |  |         |          | Lat.      | Long.     |
|                                |  |         | fathoms. | o         | o         |
| 106.                           | <i>Maurolicus</i> .....  | 1       | 1850     | 1 47 N.   | 24 26 W.  |
|                                | <i>Sternoptyx diaphana</i> .....   | 1       |          |           |           |
|                                | <i>Melanocetus Johnsoni</i> .....  | 1       |          |           |           |
|                                | Small Scopelid .....   | 1       |          |           |           |
| 107.                           | <i>Bythites</i> .....  | 1       | 1500     | 1 22 N.   | 26 36 W.  |
|                                | <i>Sternoptyx</i> .....  | 1       |          |           |           |
|                                | Other fish .....   | 3       |          |           |           |
| 120.                           | Scopelid, with elongated pectoral rays   | 1       | 675      | 8 37 S.   | 34 28 W.  |
|                                | <i>Nemichthys</i> .....  |         |          |           |           |
| 121.                           | <i>Muraena</i> , with tube-like eyes.....  | 2       | ...      | 8 28 S.   | 34 31 W.  |
|                                | Scopelid, small black.....   | 1       |          |           |           |
|                                | Other fish .....   | 3       |          |           |           |
|                                | Macrurid .....   | 1       | 350      | 9 10 S.   | 34 50 W   |
| 122.                           | <i>Peristidium</i> and other fishes.....   |         |          |           |           |
|                                | <i>Balistes</i> , Pleuronectids, <i>Hippocampus</i> ,<br><i>Ostracion mathe</i> &c. .... |         |          |           |           |
| 124.                           | Scopelid, with white organ on the head.....  | 1       | 1600     | 10 11 S.  | 35 22 W.  |
| 125.                           | <i>Synaphobranchus</i> .....   | 1       | 1200     | 10 46 S.  | 36 2 W.   |
| 126.                           | Scopelid, with long pectorals .....  | 2       | 770      | 10 46 S.  | 36 8 W.   |
|                                | Small Scopelid .....   | 1       |          |           |           |
|                                | Scopelid, with white phosphorescent organ on the head .....                              | 2       | 1900     | 35 40 S.  | 20 55 W.  |
| 133.                           | Macrurids, 3 species .....   | 5       |          |           |           |
| 137.                           | Scopelid, small .....  | 1       | 2550     | 35 59 S.  | 1 26 E.   |
| Southern and Antarctic Oceans. |  |         |          |           |           |
| 145.                           | Large Macrurid .....   | 1       | 310      | P. Edward | Island.   |
|                                | Small Pleuronectid .....   | 1       |          |           |           |
|                                | Macrurids .....  | 14      | 1375     | 46 46 S.  | 45 31 E.  |
|                                | Macrurid (?) .....   | 1       |          |           |           |
| 146.                           | <i>Halosaurus</i> .....  | 4       |          |           |           |
|                                | <i>Muraena</i> .....   | 1       |          |           |           |
|                                | Scopelids, with mucif. canals .....  | 2       | 1600     | 46 16 S.  | 48 27 E.  |
| 147.                           | Macrurids, 1 large, 2 small .....  | 3       |          |           |           |
| 152.                           | <i>Chaenichthys</i> , deep-sea species .....   | 1       | 1260     | 60 52 S.  | 80 20 E.  |
|                                | Ophidiids .....  | 2       | 1975     | 62 26 S.  | 95 44 E.  |
| 156.                           | Stomiatis .....  | 2       |          |           |           |
|                                | <i>Leptocephalus</i> -like fish .....  | 1       | 1950     | 53 55 S.  | 108 35 E. |
| 157.                           | Macrurids .....  | 3       |          |           |           |
|                                | Scopelids.....   | 2       |          |           |           |
|                                | <i>Chauliodus</i> .....  | 1       | 1800     | 50 1 S.   | 123 4 E.  |
| 158.                           | <i>Nemichthys</i> .....  | 1       |          |           |           |
|                                | Macrurids .....  | 12      | 2150     | 47 25 S.  | 130 32 E. |
|                                | Small Sternoptychids .....   | many.   |          |           |           |
| 159.                           | Stomiatis, 1½ ft. in length .....  |         |          |           |           |
|                                | <i>Sternoptyx diaphana</i> .....   |         |          |           |           |

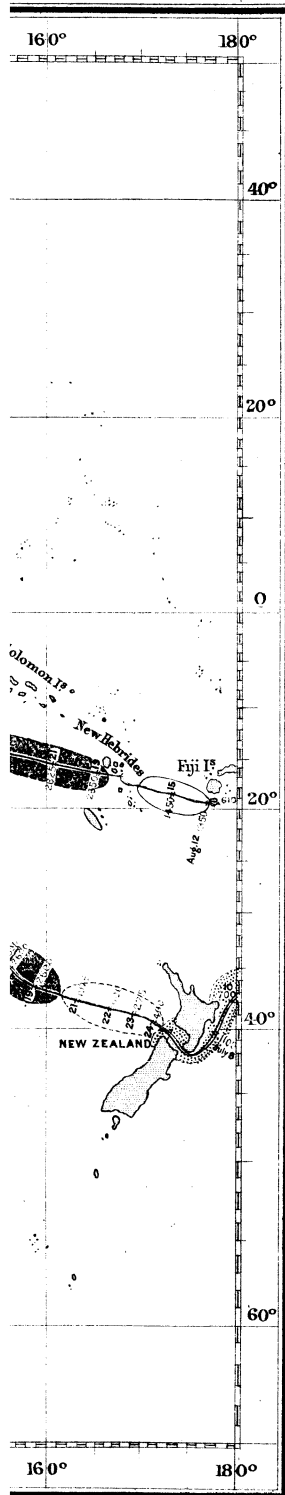
## Pacific Ocean.

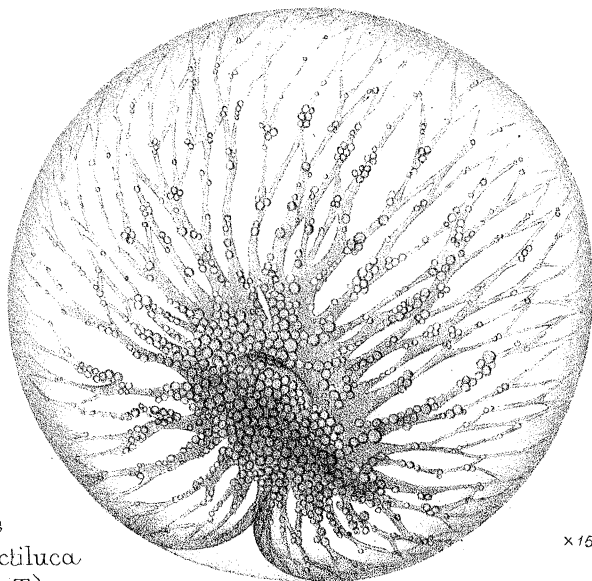
| Station. | Specimen.                                  | Number. | Depth.   | Locality.                        |           |
|----------|--|---------|----------|----------------------------------|-----------|
|          |  |         |          | Lat.                             | Long.     |
|          |  |         | fathoms. | o                                | o         |
| 163.     | <i>Hippocampus</i> .....                   | 1       | 120      | Off Two fold Bay,<br>N. C. Howe. |           |
|          | Dogfish .....                              | 1       |          |                                  |           |
|          | <i>Torpedo</i> .....                       | 2       |          |                                  |           |
|          | <i>Raja</i> .....                          | 2       |          |                                  |           |
|          | <i>Pagrus</i> .....                        | many    |          |                                  |           |
| 164.     | Lophioid.....                              | 1       | 410      | South-east,<br>P. Jackson.       |           |
|          | Young Macrurid .....                       | 1       |          |                                  |           |
| 166.     | <i>Trachichthys intermedius</i> .....      | 2       | 275      | 38 52 S.                         | 169 20 E. |
|          | <i>Macrurus armatus</i> .....              | 2       |          |                                  |           |
|          | <i>Platystethus abbreviatus</i> .....      | 2       |          |                                  |           |
| 167.     | <i>Scorpena Barathii</i> .....             | 2       | 150      | 39 32 S.                         | 171 48 E. |
|          | <i>Pseudorhombus</i> .....                 | 2       |          |                                  |           |
|          | <i>Solea</i> .....                         | 3       |          |                                  |           |
| 168.     | Large Macrurid .....                       | 1       | 1100     | 40 28 S.                         | 177 43 E. |
|          | Small Macrurid .....                       | 3       |          |                                  |           |
|          | Large Scopelid, 2 ft. long .....           | 1       |          |                                  |           |
| 169.     | Small Scopelid .....                       | 1       | 700      | 37 36 S.                         | 179 24 E. |
|          | Macrurids, 4 species .....                 | 8       |          |                                  |           |
|          | <i>Maurolicus</i> , Scopelid .....         | 2       |          |                                  |           |
| 170.     | Small <i>Maurolicus</i> .....              | 1       | 520      | 29 55 S.                         | 178 14 W. |
|          | Macrurids, 3 species .....                 | several |          |                                  |           |
|          | Scopelids .....                            | 5       |          |                                  |           |
| 171.     | Scopelid, with long pectorals .....        | 2       | 630      | 29 45 S.                         | 178 11 W. |
|          | Macrurid, over 2 ft. ....                  | 1       |          |                                  |           |
|          | Several small species.....                 | 6       |          |                                  |           |
| 173.     | <i>Maurolicus</i> .....                    | 1       | 315      | 19 10 S.                         | 179 40 E. |
|          | <i>Argyropelecus</i> .....                 | 1       |          |                                  |           |
|          | <i>Chaunax pictus</i> .....                | 1       |          |                                  |           |
| 174.     | <i>Bythites</i> .....                      | 1       | 310      | 19 10 S.                         | 178 10 E. |
|          | Muraenid .....                             | 1       |          |                                  |           |
|          | Scopelids, 2 species .....                 | 3       |          |                                  |           |
| 177.     | <i>Scorpena</i> .....                      | 2       | 610      | 16 45 S.                         | 168 5 E.  |
|          | Small Macrurids .....                      | 3       |          |                                  |           |
|          | <i>Maurolicus</i> .....                    | 1       |          |                                  |           |
| 181.     | <i>Maurolicus</i> .....                    | 2       | 125      | 13 50 S.                         | 151 55 E. |
|          | Ophidiid, blind .....                      | 1       |          |                                  |           |
|          | <i>Echiostoma barbatum</i> .....           | 1       |          |                                  |           |
| 184.     | Large Ophidiid .....                       | 1       | 1400     | 12 8 S.                          | 145 10 E. |
|          | Transparent Ophidiid .....                 | 1       |          |                                  |           |
|          | Small Ophidiid .....                       | 2       |          |                                  |           |
| 191.     | Scopelid ( <i>Paralepis</i> , c. f.) ..... | 1       | 800      | 5 37 S.                          | 134 4 E.  |
|          | Stomiatiid .....                           | 2       |          |                                  |           |
|          | Scopelid .....                             | 1       |          |                                  |           |
| 192.     | <i>Peristethus</i> .....                   | 2       | 129      | 5 42 S.                          | 132 25 E. |
|          | <i>Raja</i> .....                          | 1       |          |                                  |           |
|          | <i>Solea</i> .....                         | 1       |          |                                  |           |
| 194.     | <i>Uranoscopus</i> .....                   | 2       | 200      | 4 33 S.                          | 129 58 E. |
|          | Scopelid .....                             | 1       |          |                                  |           |
|          | <i>Peristethus</i> .....                   | 1       |          |                                  |           |
| 196.     | Stomiatiid .....                           |         | 360      | 0 43 S.                          | 126 59 E. |
|          | Macrurid .....                             |         |          |                                  |           |
| 196.     | Lophioid ( <i>Ceratias</i> ) .....         |         | 825      | 0 43 S.                          | 126 59 E. |
|          | <i>Maurolicus</i> .....                    |         |          |                                  |           |











nat. size  
0.5 mm.

× 150

*Pyrocistis*  
*pseudonociluca*  
(Wy. T.)

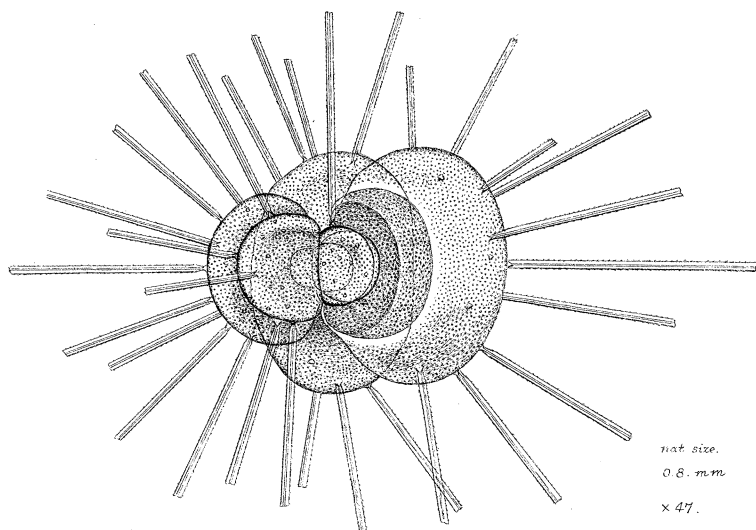
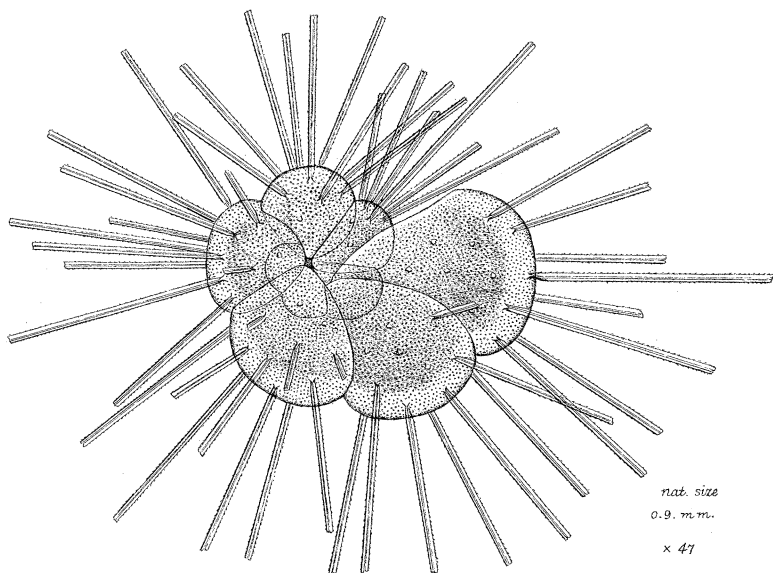


nat. size. 1 mm.

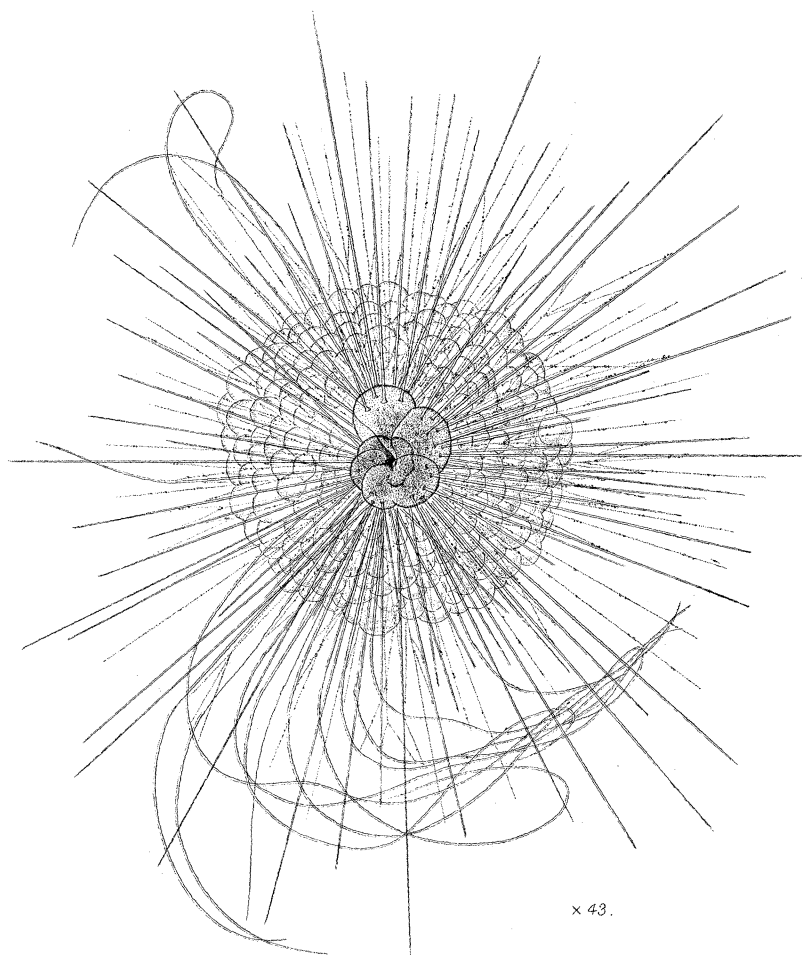


× 86

*Pyrocistis*  
*fusiformis*.  
(Wy. T.)

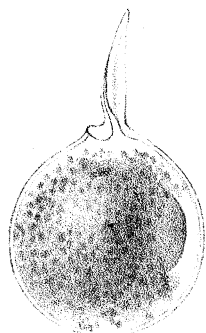


Hastigerina Murrayi (Wy. T.)

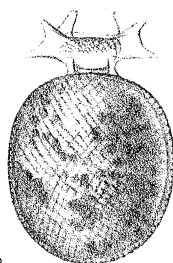


x 43.

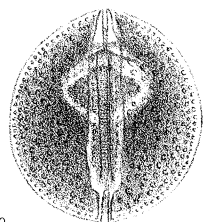
Hastigerina Murrayi (Wy. T.)



× 40



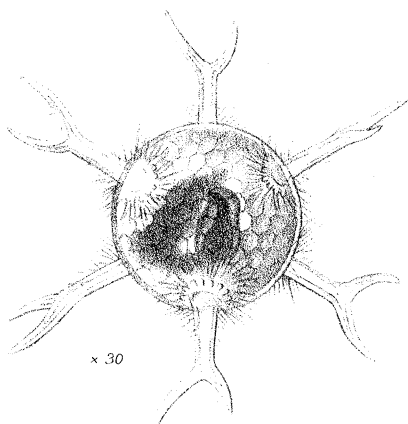
× 80



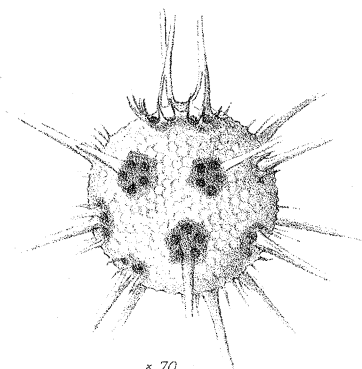
× 40



× 15



× 30



× 70

(provisionally) Challengeridæ.

## Pacific Ocean (continued).

| Station. | Specimen.  | Num-<br>ber. | Depth.   | Locality. |           |
|----------|--|--------------|----------|-----------|-----------|
|          |  |              |          | Lat.      | Long.     |
|          |  |              | fathoms. | °         | °         |
| 198.     | Ophidiid, blind .....                            | 1            | 2150     | 2 55 N.   | 124 53 E. |
|          | Another Ophidiid .....                           | 1            |          |           |           |
|          | Scopelid, with sense-organ .....                 | 1            |          |           |           |
|          | Other Scopelids .....                            |              |          |           |           |
| 200.     | Small Macrurids .....                            | 2            | 255      | 6 48 N.   | 122 25 E. |
|          | Scopelid .....                                   | 1            |          |           |           |
|          | <i>Argyropelecus</i> .....                       | 1            |          |           |           |
|          | <i>Fistularia serrata</i> .....                  | 1            |          |           |           |
| 205.     | Ophidiids .....                                  | 2            | 1050     | 16 42 N.  | 119 22 E. |
| 206.     | Scopelid .....                                   |              | 2100     | 17 54 N.  | 117 14 E. |
| 207.     | <i>Trachipterus</i> , c. f. <i>spinola</i> ..... | 1            | 700      | 12 21 N.  | 122 15 E. |
|          | <i>Halosaurus Owenii</i> .....                   | 1            |          |           |           |
| 210.     | <i>Synaphobranchus pinnatus</i> .....            | 1            | 375      | 9 26 N.   | 123 46 E. |
|          | Ophidiid .....                                   | 1            |          |           |           |
|          | <i>Sternoptyx diaphana</i> .....                 | 5            |          |           |           |
| 214.     | <i>Coccia</i> , c. f. <i>ovata</i> .....         | 7            | 500      | 4 31 N.   | 127 7 E.  |
|          | <i>Malacosteus niger</i> .....                   | 4            |          |           |           |
|          | Macrurids, 3 species .....                       | 4            |          |           |           |
|          | <i>Synaphobranchus pinnatus</i> .....            | 2            |          |           |           |
|          | Scopelid ( <i>Scopelus</i> ) .....               | 1            |          |           |           |
| 216.     | Scopelid ( <i>Odontostomus</i> ) .....           | 1            | 2000     | 2 56 N.   | 134 11 E. |
|          | <i>Chauliodus Sloanii</i> .....                  | 1            |          |           |           |
|          | <i>Synaphobranchus</i> .....                     | 1            |          |           |           |
| 218.     | Ophidiid .....                                   | 1            | 1070     | 2 33 N.   | 144 4 E.  |
|          | <i>Sternoptyx diaphana</i> .....                 | 1            |          |           |           |
|          | <i>Coccia</i> .....                              | 1            |          |           |           |
|          | Small transparent fish .....                     | 1            |          |           |           |
| 219.     | <i>Lophius</i> , <i>Solea</i> .....              |              | 150      | 1 50 S.   | 146 42 E. |
|          | <i>Peristethus</i> (Gobiid) .....                | 4            |          |           |           |
| 220.     | Lophioid ( <i>Melanocetus</i> ) .....            | 1            | 1100     | 0 42 S.   | 147 22 E. |
|          | <i>Xenoccephalus</i> (Gadoidei) .....            | 1            |          |           |           |
|          | <i>Maurolicus</i> .....                          | 1            |          |           |           |
| 223.     | <i>Coccia</i> .....                              | 1            | 2325     | 5 31 N.   | 145 13 E. |
| 226.     | <i>Coccia</i> .....                              | 1            | 2300     | 14 44 N.  | 162 13 E. |
|          | Small transparent fish .....                     |              |          |           |           |
| 230.     | <i>Coccia</i> .....                              | 1            | 2425     | 26 29 N.  | 137 57 E. |
|          | Another Sternoptychid .....                      | 1            |          |           |           |
| 232.     | Scopelid, new ...                                | 1            | 345      | 35 10 N.  | 139 30 E. |
|          | Sternoptychid ...                                | 1            |          |           |           |
|          | <i>Melanocetus</i> .....                         | 1            |          |           |           |
|          | Shark, small ...                                 | 1            |          |           |           |
|          | <i>Lepidopus</i> .....                           | 1            |          |           |           |
|          | Macrurids .....                                  |              | several  |           |           |
|          | Gadids .....                                     |              |          |           |           |
|          | <i>Synaphobranchus</i> .....                     |              |          |           |           |
|          | <i>Muraenas</i> .....                            |              |          |           |           |
|          | <i>Beryx</i> .....                               |              |          |           |           |
| 235.     | <i>Scorpaena</i> .....                           |              | 565      | 34 7 N.   | 138 0 E.  |
|          | <i>Myxene</i> .....                              |              |          |           |           |
|          | <i>Sternoptyx</i> .....                          | 1            |          |           |           |
|          | <i>Stomias boa</i> .....                         | 1            |          |           |           |
|          | <i>Halosaurus Owenii</i> .....                   | 2            |          |           |           |
|          | Ophidiids .....                                  | 2            |          |           |           |
|          | Macrurids, 3 species .....                       | 9            |          |           |           |
|          | <i>Platycephalus</i> .....                       | 1            |          |           |           |
|          | <i>Raja</i> .....                                | 1            |          |           |           |
|          | <i>Synaphobranchus</i> .....                     | 4            |          |           |           |

## Pacific Ocean (continued).

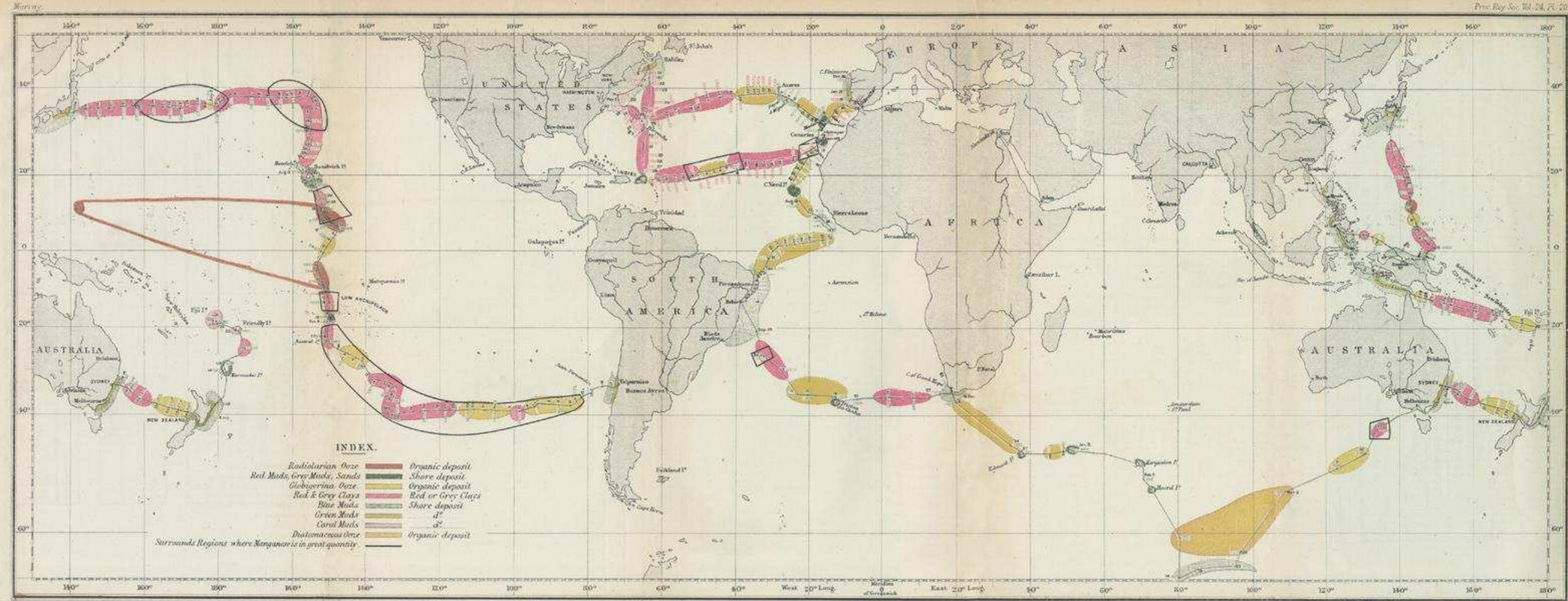
| Station. | Specimen.  | Number. | Depth.   | Locality. |           |
|----------|--|---------|----------|-----------|-----------|
|          |  |         |          | Lat.      | Long.     |
| 236.     | <i>Coccia</i> .....  |         | fathoms. | ° ' ° '   |           |
|          | Sternoptychids .....                                       |         | 775 }    | 34 58 N.  | 139 30 E. |
|          | Large Ophidiid .....                                       | 1       | 420 }    |           |           |
|          | Macrurids .....  | 3       |          |           |           |
| 237.     | <i>Synaphobranchus</i> .....                               | 8       | 1875     | 34 37 N.  | 140 32 E. |
|          | Large Scopelid .....                                       | 1       |          |           |           |
|          | <i>Notocanthus</i> .....                                   | 1       |          |           |           |
|          | Sternoptychids ( <i>Coccia</i> , <i>Maurolicus</i> ) ..... | 2       |          |           |           |
| 244.     | Stomiad .....  |         | 2900     | 35 22 N.  | 169 53 E. |
| 246.     | <i>Synaphobranchus pinnatus</i> .....                      | 1       | 2050     | 36 10 N.  | 178 0 E.  |
|          | Macrurids, 2 species .....                                 | 6       |          |           |           |
| 265.     | <i>Coccia</i> .....  | 1       | 2900     | 12 42 N.  | 152 11 W. |
| 271.     | Large Macrurid .....                                       | 1       | 2425     | 0 33 S.   | 151 34 W. |
|          | Scopelid, with mucif. canals .....                         | 1       |          |           |           |
|          | Trichiurid .....   | 1       |          |           |           |
| 272.     | Ophidiid, transparent .....                                | 1       | 2600     | 3 48 S.   | 152 56 W. |
| 276.     | Scopelid .....   | 1       | 2350     | 13 28 S.  | 149 30 W. |
| 281.     | Scopelid .....   | 1       | 2385     | 22 21 S.  | 150 17 W. |
| 285.     | Stomiad .....  | 1       | 2375     | 32 36 S.  | 137 43 W. |
| 286.     | Sternoptychid .....  | 1       | 2335     | 33 29 S.  | 133 27 W. |
| 289.     | Scopelid, with elongated pectoral rays .....               | 1       | 2550     | 39 41 S.  | 131 23 W. |
| 291.     | Small Sternoptychid .....                                  | 1       | 2025     | 39 13 S.  | 118 49 W. |
| 295.     | Nemichthyid, nov. gen. ....                                | 1       | 1500     | 38 7 S.   | 94 4 W.   |

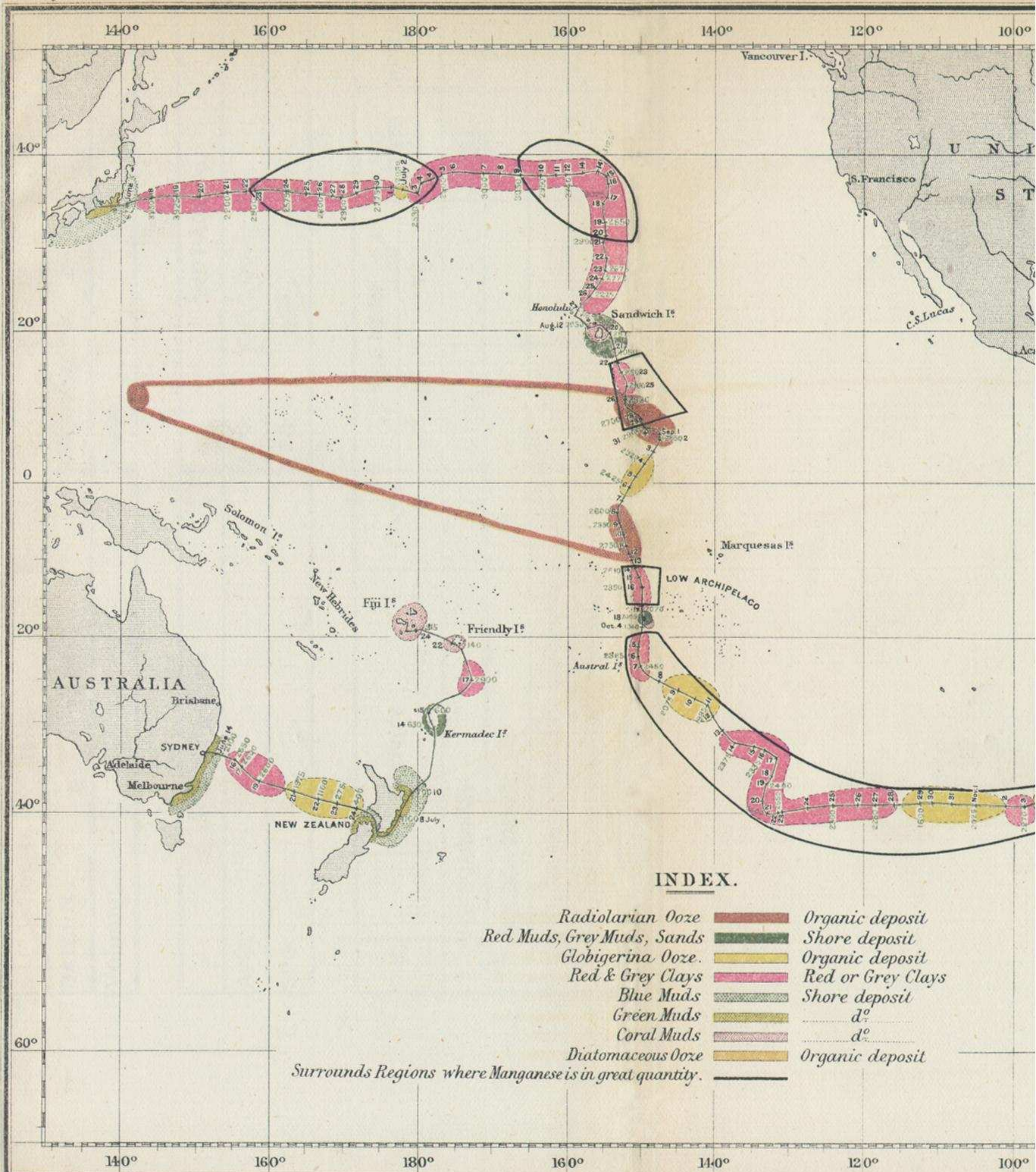
III. "Preliminary Report to Professor WYVILLE THOMSON, F.R.S., Director of the Civilian Scientific Staff, on the true Corals dredged by H.M.S. 'Challenger' in deep water between the dates Dec. 30th, 1870, and August 31st, 1875." By H. N. MOSELEY, Naturalist to the Expedition. (Published by permission of the Lords of the Admiralty.) Received February 14, 1876. Read March 16.

The following Report is to be regarded as merely preliminary, and will be followed by a full account of the corals dredged by the 'Challenger,' which can be prepared only after the termination of the present voyage.

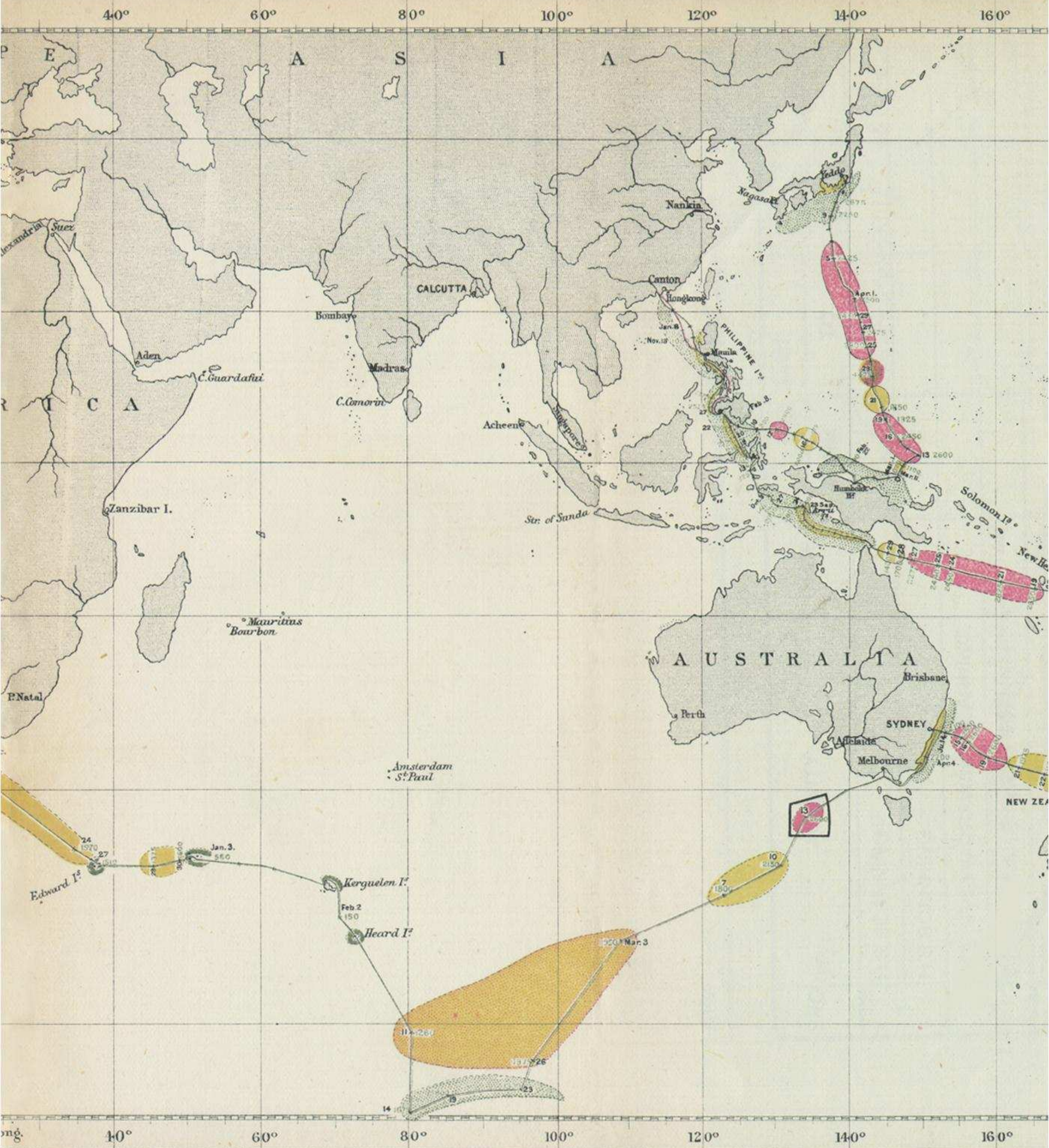
Many specimens have been sent home for greater security, and are thus not available for comparison. Moreover, in the case of corals, it is impossible to determine, with any accuracy, specific relations without making comparisons with museum collections, which, of course, has been impossible in the present instance.

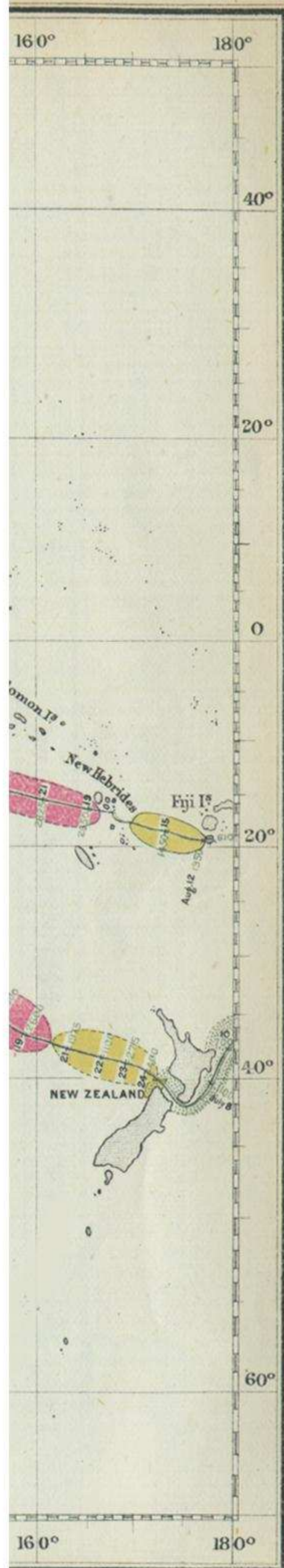
The list of corals obtained here given has been made as accurate as circumstances would permit. The amount of corals obtained by the 'Challenger' in deep water has been small, considering the very large number of dredgings which have been made. Corals have been yielded by only about forty-eight of the numerous dredgings and trawlings. Of

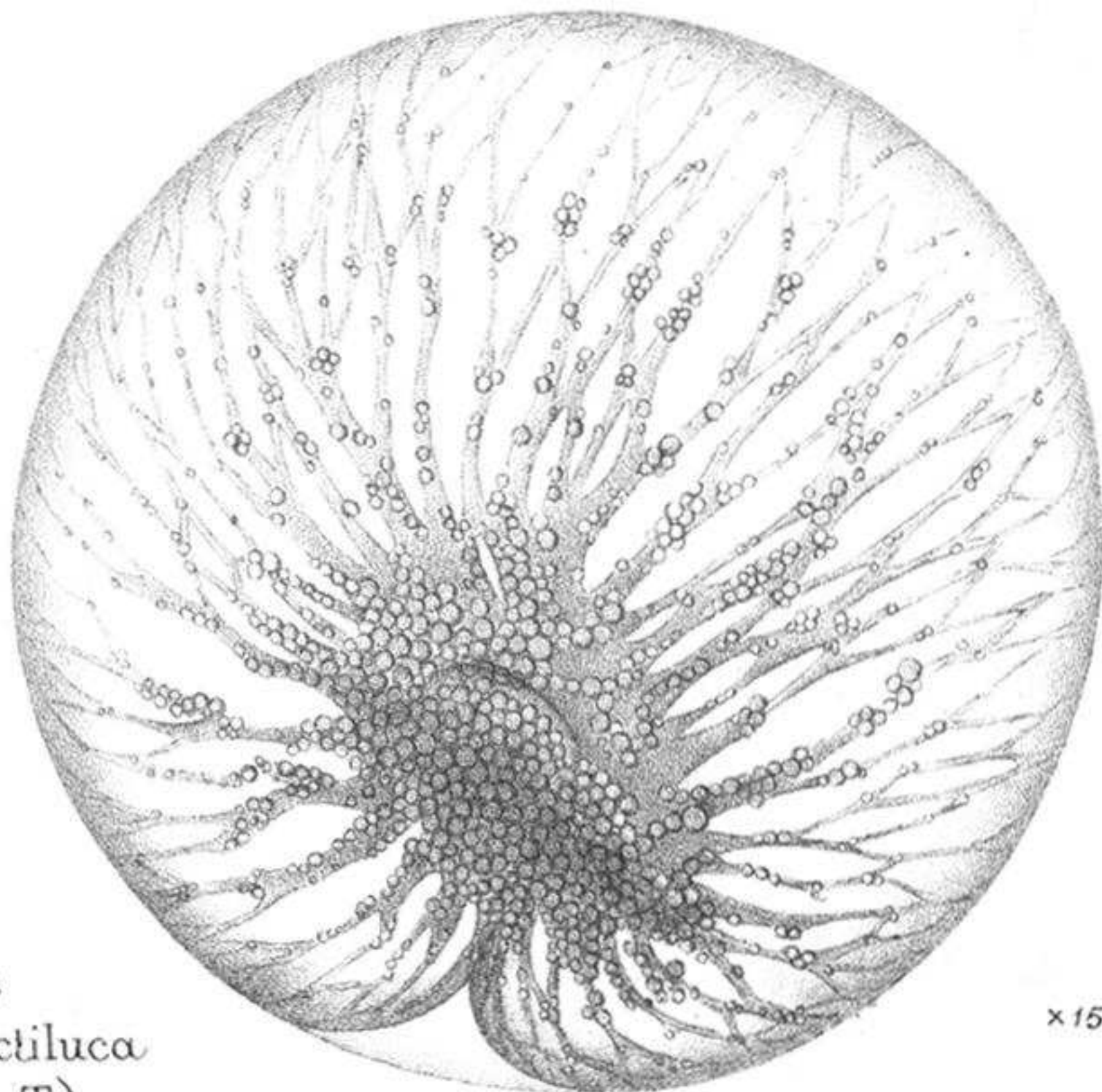












nat. size  
0.5 mm.

*Pyrocistis*  
*pseudonociluca*  
(Wy.T.)

× 150.

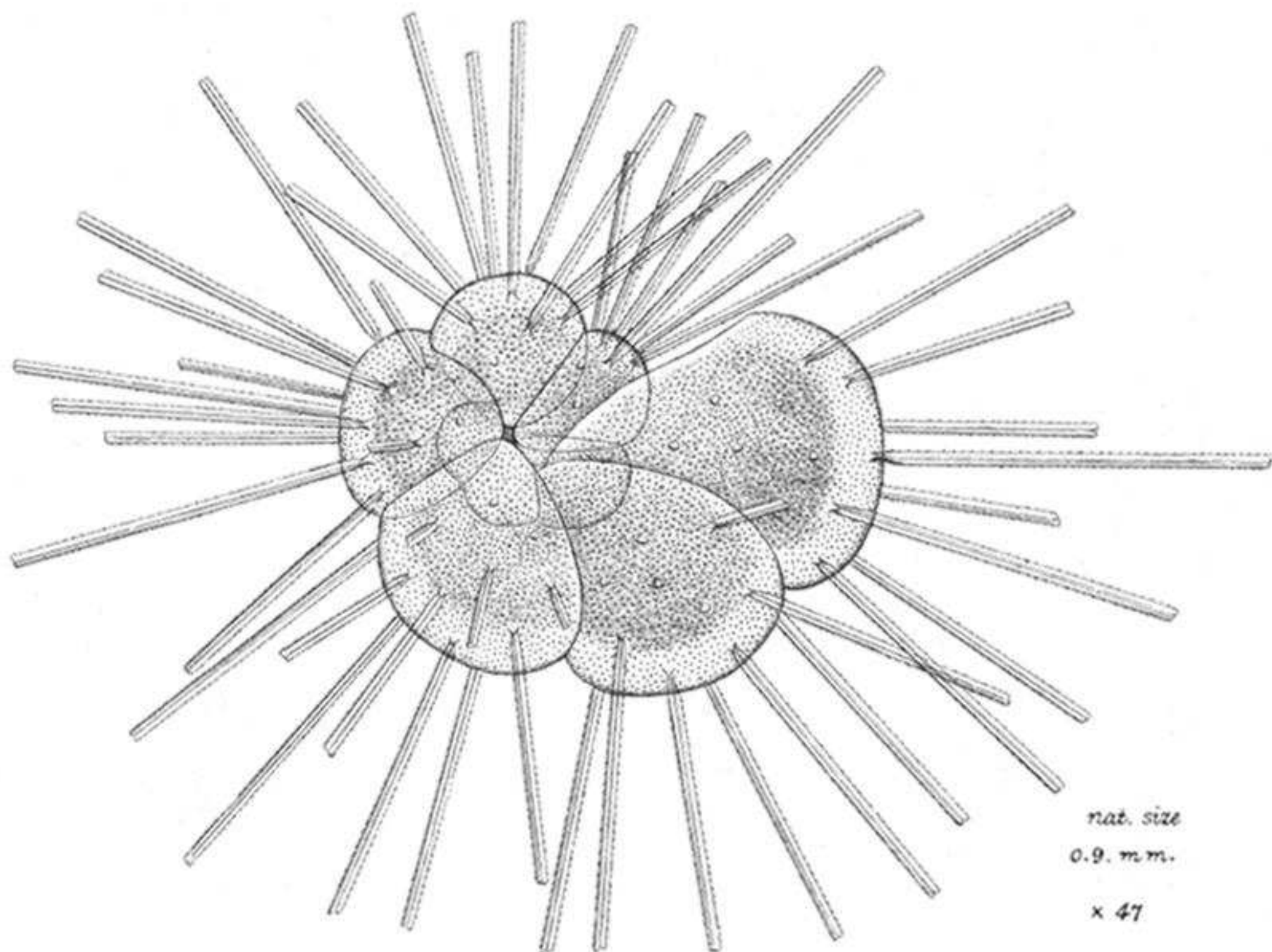


nat. size. 1 mm.

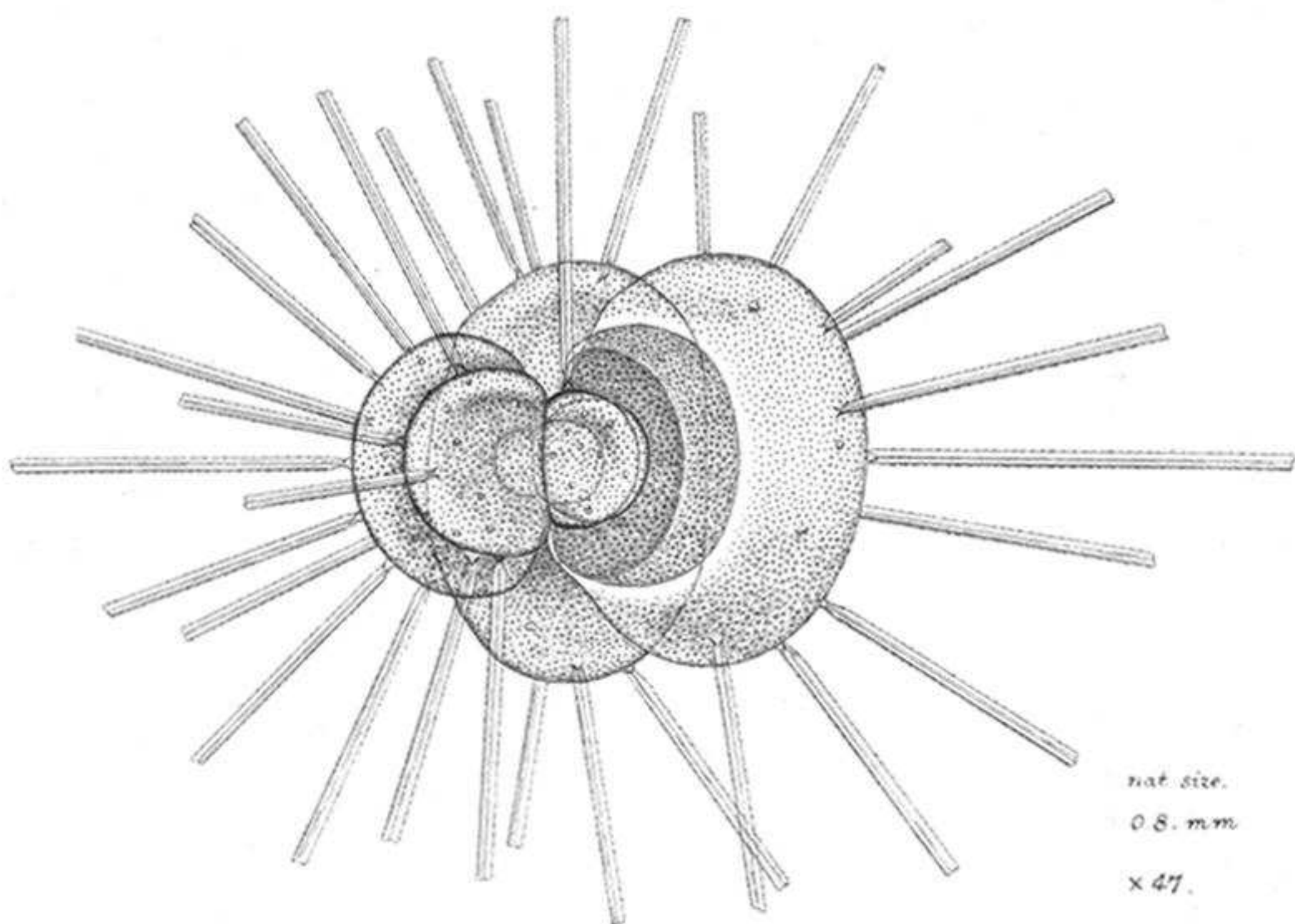
*Pyrocistis*  
*fusiformis*.  
(Wy.T.)



× 86

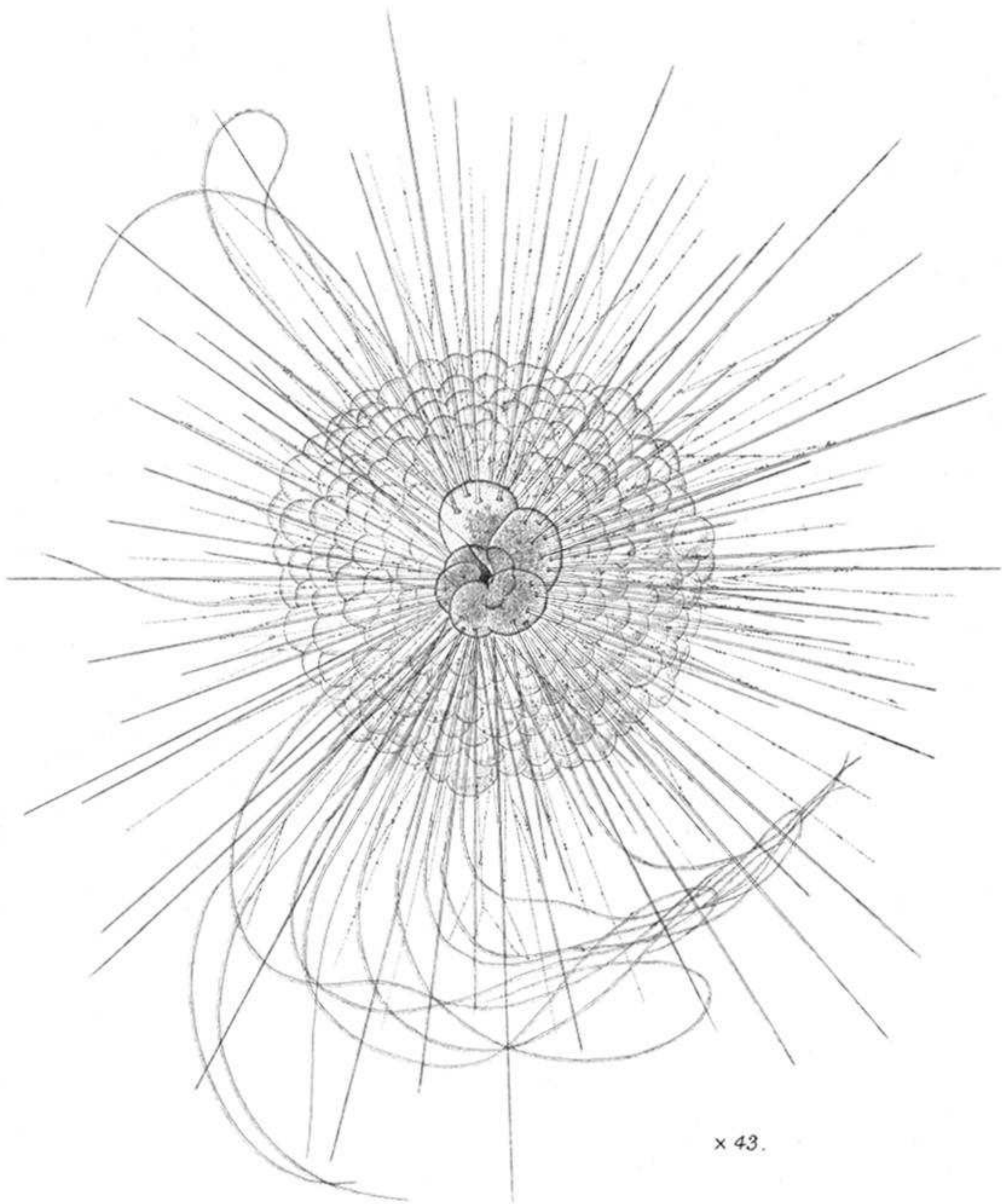


nat. size  
0.9. mm.  
x 47



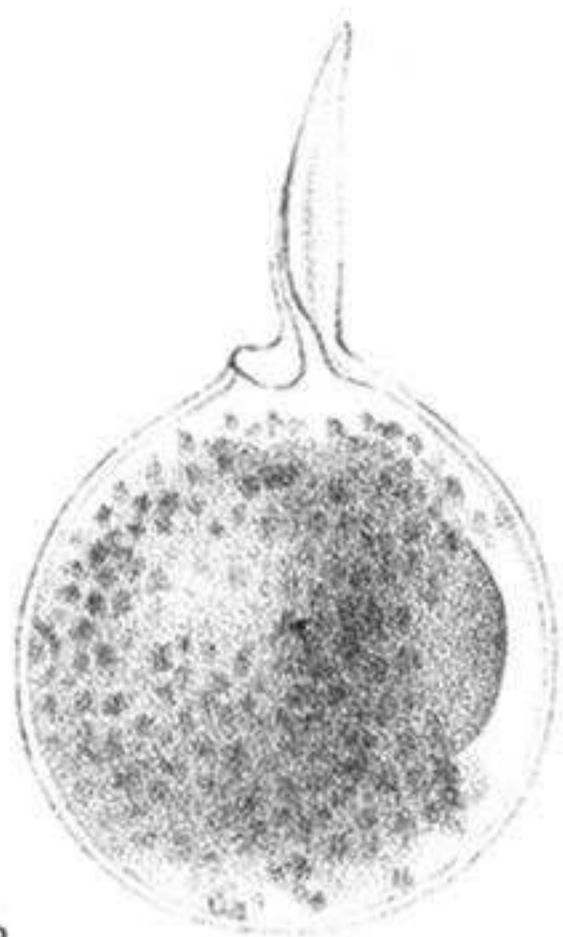
nat. size.  
0.8. mm  
x 47.

Hastigerina Murrayi (Wy.T.)

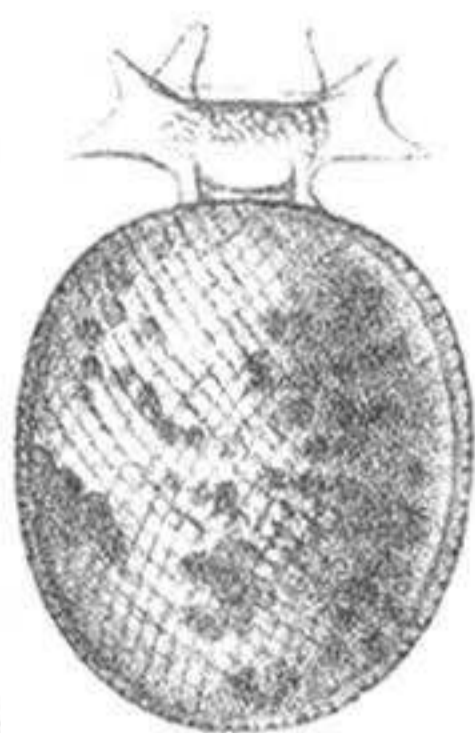


x 43.

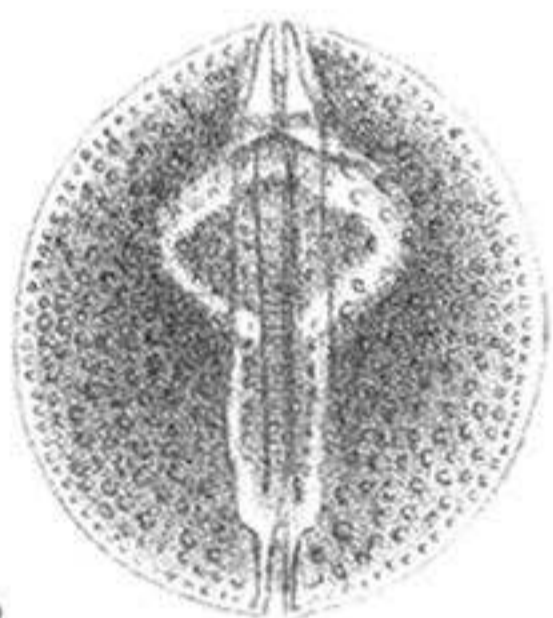
*Hastigerina Murrayi* (Wy.T.)



× 40



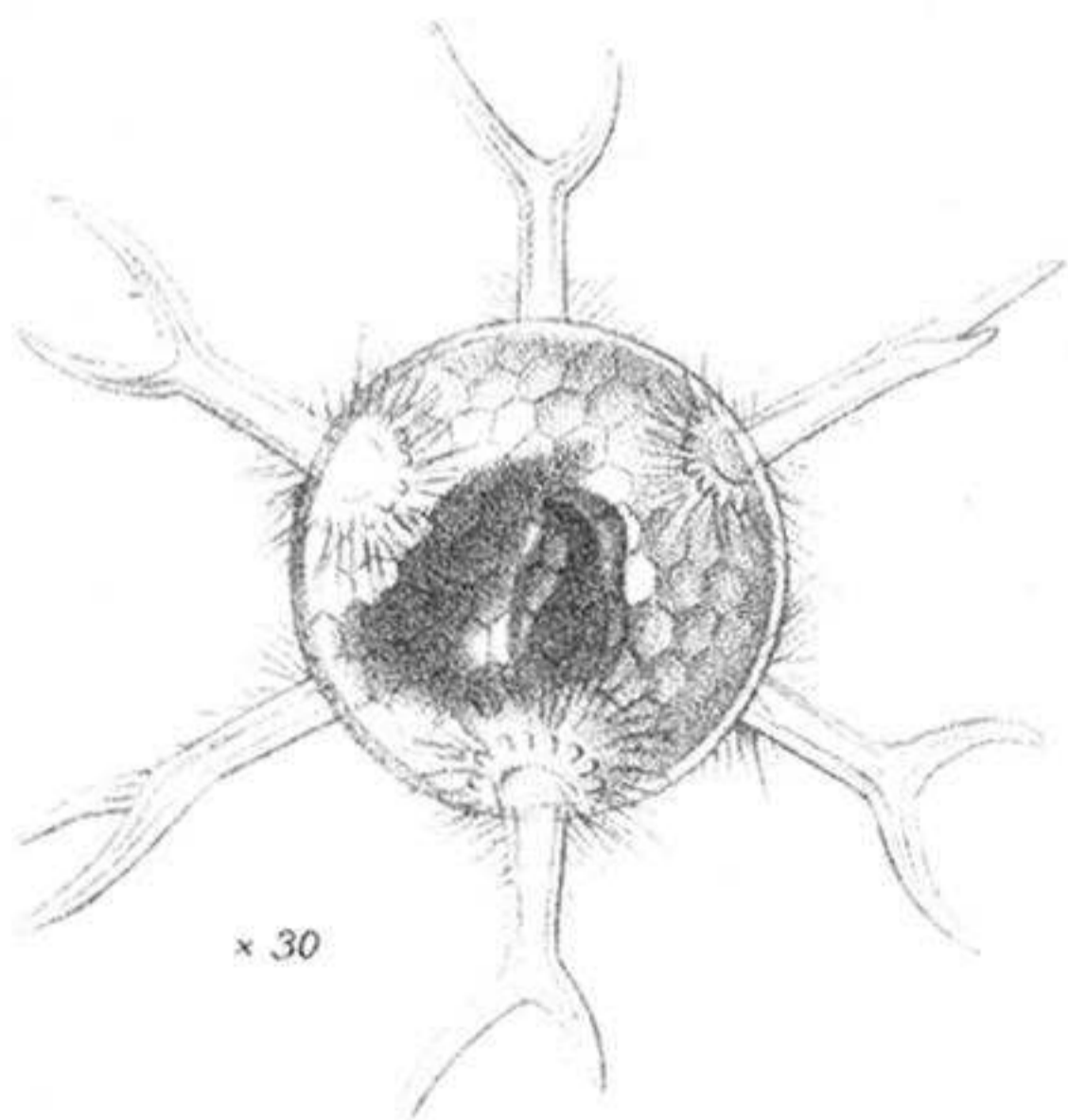
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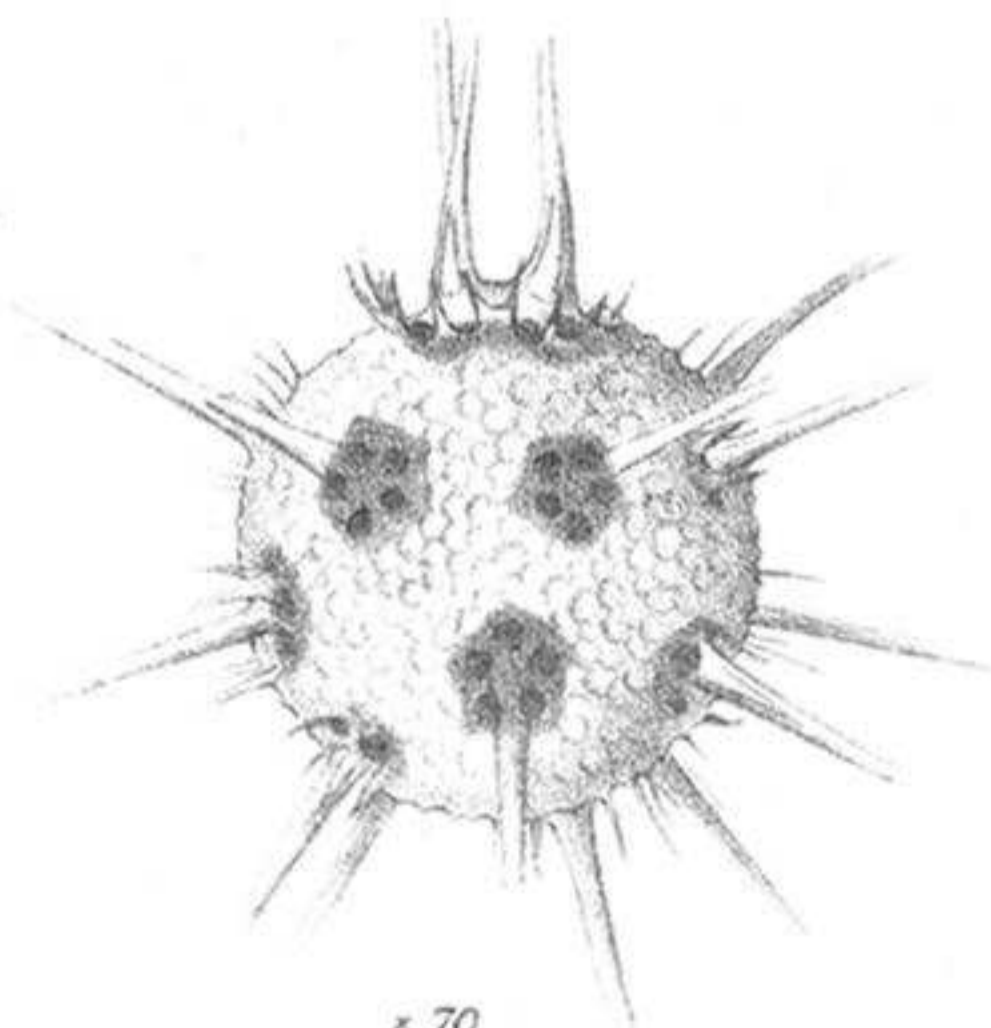
× 40



× 15



× 30



× 70

(provisionally) Challengeridæ.