ON THE DEPTH, TEMPERATURE OF THE OCEAN WATERS, AND MARINE DEPOSITS OF THE SOUTH-WEST PACIFIC OCEAN.*

By SIR JOHN MURRAY, K.C.B., LL.D, D.Sc., F.R.S

INTRODUCTION.

A large amount of information has been acquired during recent years concerning that part of the ocean lying to the east of Australia, more especially in connection with the work of surveying ships engaged in examining the route for the British Pacific cable between British Columbia and Australia. It seems desirable to bring together all the available observations as they are of very great importance to all who take an interest in oceanography and the allied sciences.

In this communication it is proposed to deal with the observations as to the depth of the ocean, the temperature of the waters of the ocean, the marine deposits which cover the floor of the ocean, and the percentage of carbonate of lime, contained in these deposits.

The region under consideration (see Map I.) is that portion of the South Pacific bounded on the west by the coasts of Tasmania, Australia, and New Guinea; on the north by the equator; on the east by the meridian of 160° W. longitude; and on the south by the parallel of 50° S. latitude. The total water-surface within these boundaries is estimated at about 11,000,000 square miles. It will be observed that the maps used in illustration of this article do not include the whole of the region under consideration, but they cover by far the greater part of it, and serve to show all the more interesting physical features.

Within this region all the physical conditions are of the most varied description. Many different geological formations are represented on the land surfaces, including recent coral reefs and volcanic islands. There are many evidences of volcanic activity, and volcanic material is found spread over the bottom, sometimes in great abundance; volcanic debris, usually in the form of pumice and volcanic glass, was observed in every deposit-sample examined.

This region has been the subject of many interesting speculations regarding the distribution of land and water in former geological periods. It has been maintained by some naturalists (Hutton, Forbes, and others) that at one time it was the site of a great Pacific continent joining New Zealand and New Caledonia with Australia, and Forbes believes that Australia was formerly conjoined with the Antarctic continent through New Zealand and the Chatham Islands,

*Read at the Anniversary Celebration of the Royal Geographical Society of Australasia, Queensland, June 29, 1906.

and through Antarctica with South Africa and South America. Wallace in discussing the distribution of animals also refers in some detail to the supposed distribution of land and water in this region in past ages. A more accurate knowledge of the present-day conditions in this ocean will much assist those who endeavour to reconstruct the past history of our globe.

I. Topography of the Sea-Floor.

The floor of the ocean within the region under consideration shows probably greater diversity than in any similar area on the face of the globe, rising in some places to form submerged plateaus and banks, on which may be situated emerged islets, island groups and large islands, and sinking in other places to great depths, sometimes exceeding 5,000 fathoms. The depth map accompanying this paper (see Map II.) shows at a glance this remarkable diversity, the contour lines of depth being of the most sinuous description, great deeps alternating with shallow banks and ridges. A few of the main features exhibited by the map may be here alluded to. There are about two thousand soundings in depths exceeding 100 fathoms actually laid down on this map, but that number does not nearly represent the total number of soundings which have been taken into account in laying down the contour lines of depth, for so numerous are they in some localities that only a very small proportion could be laid down on such a small scale, and in these cases we have prepared large-scale maps of certain small districts, laying down the soundings in position before drawing in the contour lines. This was necessary in many places where search had been made for reported dangers, usually resulting in the discovery of banks more or less deeply submerged beneath the surface of the sea. Such a bank was discovered in the Coral Sea by Captain Balfour of H.M.S. "Penguin," and formed the subject of a short paper to which the reader is referred for further particulars.* Although the soundings are thus in certain localities crowded together in great profusion, there are, on the other hand, large stretches in which the soundings are few in number and the contour lines of depth could only be drawn in hypothetically, as, for instance, in the northern portion of the region between the Phœnix, Gilbert, and Solomon groups of islands.

One of the points of greatest interest in this region is the fact that, with one exception (viz., a sounding of 5,269 fathoms obtained by the U.S.S. "Nero" near Guam Island, one of the Ladrone group in the North Pacific, the deepest sounding known), it includes the greatest depths hitherto recorded

*See Murray, Balfour Shoal: a submarine elevation in the Coral Sea, *Scott. Geogr. Mag.*, vol. xiii. p. 120, 1897.

on the surface of the earth. There are three small depressions where the bottom sinks to more than 5,000 fathoms beneath the surface of the sea, two of them situated directly to the east of the Kermadec Islands, the depths being 5,155 and 5,147 fathoms, and the third, a little farther north, situated to the south of the Friendly Islands, where the depth is 5,022 fathoms. These great depths are known as the Aldrich and Oldham Deeps, the term "deep" being applied in recent oceanographical literature to those parts of the ocean where the depth exceeds 3,000 fathoms or three geographical miles. These three depressions form part of a remarkable series of seven, in which the depths exceed 4,000 fathoms, running in a line south-west from the Samoan group of islands towards the east coast of New Zealand. This deep rift in the earth's crust is thrown into greater relief owing to the fact that it runs practically parallel with, and comparatively close to, the shallow ridge running north-east from New Zealand, on which the Kermadec and Friendly groups of islands are situated. The peculiar depth conditions in the neighbourhood of this deep rift are associated with much volcanic activity, for the material brought up from the deepest soundings is largely made up of volcanic debris, so that they might be called Volcanic Muds, although we have preferred to call them Red Clays, because of the large amount of iron oxide and clayey material they contain, while the deposits from the shallow ridge and around the Kermadec and Friendly Islands are true Volcanic Muds and Sands. Further evidence of volcanic activity in this locality is furnished by the appearance a few years ago of an island made up of loose volcanic scoriæ to the east of the Friendly group; when first observed this island, which was called Falcon Island, was of considerable extent and rose to a height of several hundred feet above the sea, but the loose volcanic material was gradually washed away and spread out by the action of the sea, until ultimately the island disappeared beneath the waves, and its place is now occupied by a shoal, which in the future may be the foundation of a coral atoll.

The topography of the sea-floor between Australia and New Zealand is also extremely diversified, ridges and valleys running approximately in a north and south direction alternating with each other, the valley nearest Australia being the deepest, a sounding of 3,265 fathoms having been recorded comparatively close to the Australian coast. This deep valley, which is now known as the Thomson Deep, is broken up by several elevations which do not reach the surface of the sea, the latest additions to these elevations being the "Britannia Hills," discovered by Mr. Peake in 1903 in the S.S. "Britannia" to the east of Southport, Queensland, the sum-

mits of which rise to less than 300 fathoms beneath the surface of the sea, while they are surrounded by water exceeding 2,500 fathoms in depth.

The Balfour Shoal and Britannia Hills just mentioned, and similar submarine elevations surrounded by deep water, are a striking feature of those parts of the region which have been well sounded, and when dealing with the deposits of this region we shall have occasion to refer in greater detail to some of those submarine banks, in the neighbourhood of which volcanic material is usually found in abundance, sometimes apparently of quite recent deposition, sometimes more or less profoundly altered and associated with the peroxide of manganese in the form of nodules, coatings, or small grains. The region around the Fijis has furnished many examples of submerged banks, as well as the neighbourhood of the Coral Sea, and the sea between the coast of New South Wales across towards the Fijis by New Caledonia and Norfolk Island. There are also cases in which isolated deep soundings are surrounded by shallower water, but these cases seem to be far less numerous than the instances of submarine elevations rising from deep water.

It has already been stated that little information is available regarding the depth of the sea in the northern equatorial portion of the region. This is especially the case in the seas lying between the Fiji, Ellice, Santa Cruz, and New Hebrides groups; between the New Hebrides, Santa Cruz, and Solomon groups; and between the Solomon group, New Britain, and New Guinea; and in the open ocean, lying to the north of these seas, between the Solomon and Gilbert and between the Gilbert and Phœnix groups; and future soundings may make it necessary to modify considerably the contour lines as laid down on this part of the map.

In the excellent bathymetrical charts recently published at great expense by H.S.H. the Prince of Monaco, a deep is shown between the Chatham Islands and the coast of New Zealand. This is entirely an error, due to well authenticated soundings in 345 and 319 fathoms being misinterpreted as 3,450 and 3,190 fathoms, when converting fathoms into metres.

No attempt has been made to measure accurately the areas between the various contour lines of depth, but we roughly estimate that of the total water-surface

about 25 per cent is less than 1,000 fathoms in depth;
„ 20 „ „ between 1,000 and 2,000 fathoms in depth;
„ 40 „ „ „ 2,000 „ 3,000 „ „ „ ; and
„ 15 „ „ over 3,000 „ „ „

Thus the area covered by less than 2,000 fathoms of water is estimated at about 45 per cent. (or less than half the total water-surface),

while the area covered by over 2,000 fathoms of water is about 55 per cent. (or more than half the total water-surface).

II. Temperature of the Waters of the Ocean in the South-West Pacific.

a. *Temperature of the Surface Waters.*

In his discussion of the results of the Challenger Expedition, Dr. Alexander Buchan shows that the area of high surface temperature of the ocean (over 80° Fahr.) does not quite circle the equatorial region of the globe, as it does not occur in the Pacific from long. 117° to 140° W., and that in the Western Pacific this area of high surface temperature extends east of Australia as far south as lat. 20° S. This striking extension southward of the high surface temperature is occasioned by the circumstance that, for eight months of the year, the line of lowest barometric pressure is there to the south of the equator, and necessarily accompanied by northerly winds, which propel into more southern regions the warmer waters of the surface. This point is insisted on as vital to the whole question of ocean circulation.

The influence of this high surface temperature on the temperature of the water at various depths beneath the surface may be here noted. Dr. Buchan states :—

"Turning now to the Pacific Ocean, we find that the line of least barometric pressure lies not north, but south, of the equator, from long. 160°E. to long. 130° W. An examination of the maps for the separate months shows that for eight months of the year this state of things substantially holds good, culminating in December, January, and February when barometric pressure is very low in Australia. In these months the north-east trades and ocean currents of the Western Pacific extend into the South Pacific to about lat. 15° S., as shown by the current charts now in course of preparation by the Meteorological Council. The isothermals for the depth of 100 fathoms show that the manner of the distribution of the temperature in the North and South Pacific is precisely the reverse of what obtains in the Atlantic. In the North Pacific the highest temperture, 70°, is restricted to two very small areas, whereas in the South Pacific the area marked out by the isothermal of 70° covers a very extensive region, and encloses another region, also very extensive, where the temperature exceeds 72°. In truth at this depth the South Pacific presents a region with a temperature above the general mean of the ocean, larger than the high temperature regions of all the other oceans combined. The *role* played by Australia, the low atmo-

spheric pressure of its warmer months mainly bringing about the result, deserves careful consideration."*

Referring to the specific gravities at a depth of 100 fathoms, Dr. Buchan says :—" In the Pacific Ocean, between lat. 40° N. and 40° S. and long. 150° E. to 130° W., the following are the results of the specific gravities :—

	North Pacific.	South Pacific.
Number of Observations	23	22
Highest	1.0260	1.0271
Lowest	1.0253	1.0260
Mean	1.0256	1.0264

thus showing a marked difference in the specific gravities of the ocean at this depth. Over the region of highest temperature, which is south of the equator, the specific gravities are all high, but over the North Pacific they are low. They are low also in the region of lowest temperature, 50°, being only 1.0257. It may be added that the same low specific gravity occurs in lat. 15° S. and long. 94° W., where, in respect of the south-east trades, upwelling is to be expected, but to the west of this point, where high temperatures rule, it rises to 1.0269. Hence the high specific gravities of the South Pacific convey down to this depth a temperature much greater than is done in the North Pacific, where the specific gravity is much less."*

The circumstances above pointed out with reference to the surface and subsurface waters govern the temperature conditions of the South-West Pacific, and determine the direction of currents along the eastern coast of Australia, where a warm current from the north is met, off the coast of New South Wales, by cold currents from the south.

In a paper published several years ago,‡ in which all the records of the Meteorological Office were made use of, it was shown that within this region between the equator and lat. 40° S. surface water temperatures as low as 48° F. (near New Zealand) and as high as 90° F. (in lat. 10° S.) are known ; extending the limits to 50° S. the range would be still further increased, for readings of 39° and 40 ° are recorded in that latitude. Thus within the region under consideration the known range of temperature at the surface exceeds 50° (from 39° to 90° F.). In the northern parts of the region (within the tropics) the range of temperature at the surface in any one position does not exceed 10° throughout the year ; farther south, extending from the shores of Australia and Tasmania eastwards beyond New Zealand, the annual range in any one position may exceed 10°, and

*Buchan, Report on Oceanic Circulation, *Phys. Chem. Chall. Exp.*, Part viii, p. 18.

*Buchan, *op. cit.*, p. 21.

‡Murray, on the annual range of temperature in the surface waters of the ocean, and its relation to other oceanographical phenomena, *Geographical Journal*, vol. xii., p. 113, August 1898.

off the east coast of Australia near Sydney the range approaches, if it does not exceed, 30°. This wide range of temperature is due to the warm Australian current mingling in this region with the cold Antarctic drift. In all areas like this, where a cold current occupies the surface at one time of the year and a warm current at another time, there is great destruction of life both in the surface waters and on the bottom, through the wide annual range and sudden changes of temperature, and in these areas there are always found in the deposits at the bottom of the sea much glauconite and many phosphatic nodules in process of formation, for instance, off the Atlantic coast of North America, off the Cape of Good Hope, and off Japan,*

b. *Temperature of the Intermediate Waters.*

We have collected together all the serial temperatures hitherto recorded in that part of the south-west Pacific now under consideration, and have set them forth in the following Table :—

*Mr. C. E. Wragge has prepared for me the following note on the air-temperatures and rainfall within this area :—The influence of the warm waters of the Australian current upon the climate and rainfall must not be overlooked, as it is certainly a factor figuring largely in the climatology of the coast of New South Wales, and enables condensation to take place during the passage of anticyclonic areas over the coast regions, where the rainfall is always greatest. In order to show the difference in temperature in the water where the Australian current circulates, and in regions free from such influence, the following table of temperatures is inserted as a means of comparing the temperature of the sea west of Australia with the ocean temperatures east of the continent, where the warm water flows and is finally incorporated with the north-eastern antarctic drift current. The air temperatures are also given, and the position where the observations were taken is indicated by the latitude and longitude :—

Latitude.	Longitude.	Air temperature.	Sea temperature.	
33° 28′ S.	102° 8′ E.	61.70°	62.78°	
36° 51′	150° 32′	69.62°	71.06°	east coast
36° 10′	104° 30′	57.92°	58.64°	
37° 51′	107° 21′	57.92°	58.64°	
37° 19′	153° 22′	67.64°	67.28°	east coast
39° 59′	109° 39′	55.76°	54.86°	
42° 38′	116° 42′	53.78°	51.98°	
43° 43′	124° 36′	51.26°	51.26°	
43° 40′	151° 39′	58.46°	58.28°	east coast
46° 44′	146° 67′	59.0°	54.86°	

From the above table it is observed that the readings on the east coast of the continent are higher than those on the west coast. The presence of the current is indicated by a difference of more than 7° in passing from 43° 40′ to 43° 43′. The warm water from the tropics exerts an influence upon the air temperature, for it is observed that the temperatures are correspondingly raised where the current flows. In view of this fact it might be suggested that the heated air off the south-eastern coast of Australia helps to augment the rainfall of the coast districts during periods of high barometer, when a downflow of cold air takes place from the upper regions of the atmosphere. This cold air coming in contact with the warm layer of atmosphere immediately over that portion of the sea where the current flows, would cause condensation which would lead to beneficial rain of a showery nature over the coast districts. Especially would this be so over the fertile districts of the south-eastern corner of New South Wales in winter, where the cold air from the snows of the Australian Alps would be blown across to the coasts by the west and south-west winds on the advancing side of the anticyclone, and by contact with the warm sea vapours further increased condensation and rain would result, to the eastward of the coast ranges. It therefore seems probable that the rains of winter over the regions referred to, when the barometer is steady at over 30 ins., are caused to a great extent by the influence of the warm current running along the coast, in conjunction with the downflow of cold air from above, and from the close proximity of the Australian Alps.

TABLE OF SERIAL TEMPERATURES.

Depth.	1 *Challenger.* April 4, 1874 36° 57′ 0″ S. 150 34′ 0″ E. 2200 fms.	2 *Challenger.* June 13, 1874 34° 19′ 0″ S. 151° 31′ 0″ E. 400 fms.	3 *Challenger.* June 16, 1874 34° 27′ 0″ S. 154° 57′ 0″ E. 2550 fms.	4 *Challenger.* June 19, 1874 36° 41′ 0″ S. 158° 29′ 0″ E. 2600 fms.	5 *Challenger.* June 22, 1874 38° 36′ 0″ S. 166° 39′ 0″ E. 1100 fms.	6 *Challenger.* June 23, 1874 38° 50′ 0″ S. 169° 20′ 0″ E. 275 fms.	7 *Challenger.* July 8, 1874 40° 28′ 0″ S. 177° 43′ 0″ E. 1100 fms.	8 *Challenger.* July 10, 1874 37° 34′ 0″ S. 179° 22′ 0″ E. 700 fms.	9 *Challenger.* July 14, 1874 29° 55′ 0″ S. 178° 14′ 0″ W 520 fms.	10 *Challenger.* July 17, 1874 25° 5′ 0″ S. 172° 56′ 0″ W 2900 fms.	11 *Challenger.* July 21, 1874 37° 53′ 0″ S. 163° 18′ 0″ E. 1975 fms.	12 *Challenger.* Aug. 3, 1874 19° 7′ 50″ S. 178° 19′ 35″ E. 610 fms.	13 *Challenger.* Aug. 12, 1874 19° 2′ 0″ S. 177° 10′ 0″ E. 1350 fms.
fms.	°	°	°	°	°	°	°	°	°	°	°	°	°
0	72.0	67.0	64.0	62.5	58.2	58.5	57.2	58.2	65.0	72.0	59.5	78.0	77.5
10		68.0		62.8									
20		67.8	63.2	62.5	58.1		56.5 [25]				59.8		
30		67.6		62.5									
40		67.2	63.0	62.0	57.8						59.0		
50	65.2	66.3		60.5		58.5	56.5		62.0			76.8	71.5
60		65.3	59.5	59.2	57.4						58.0		
70		64.2		58.0			56.5 [75]						
80		63.0	56.0	57.0	56.6						57.2		
90		61.8		56.4									
100	59.3	60.7	52.6	55.8	55.9	56.5	55.7	55.2	60.5	67.6	55.9	71.0	70.8
150	54.9					54.7	53.9		56.2			65.2	66.0
200	51.4	55.0	48.2	50.8	52.2	52.7	51.7	50.0	53.0	59.2	51.2	59.5	60.8
250												53.7	54.2
300	47.6	48.5	45.1	47.0	48.5		48.2	46.7	49.0	50.4	47.8	47.8	47.0
350												44.2	
400			42.8	43.8	45.3		45.4	44.8	45.7	44.0	44.9	42.3	42.0
450												40.9	
500			40.4	41.6	42.0		43.7	43.0	43.0	41.3	42.5	39.8	40.0
600			38.9	39.8	39.8		42.1	41.5		39.2	40.4	39.0	38.9
700			37.8	38.6	38.2					37.9	38.7		37.9
800			37.2	37.5	37.4					37.2	37.5		37.2
900			36.9	36.9	36.9					36.9	36.8		36.8
1000			36.6	36.5	36.5					36.7	36.4		36.4
1100			36.3	36.2						36.4			36.2
1200			36.0	36.0						36.2	35.7 [1250]		36.0
1300			35.7	35.7						36.0			
1400			35.4	35.4									
1500			35.1	35.1							34.8		
Bottom	34.5			34.4	36.4		37.2	40.0		34.3	34.7		36.0

TABLE OF SERIAL TEMPERATURES.—*Continued.*

Depth.	14 *Challenger.* Aug. 15, 1874 18° 30′ 0″ S. 173° 52′ 0″ E. 1450 fms.	15 *Challenger.* Aug. 19, 1874 16° 47′ 0″ S. 165° 20′ 0″ E. 2650 fms.	16 *Challenger.* Aug. 21, 1874 15° 58′ 0″ S. 160° 48′ 0″ E. 2325 fms.	17 *Challenger.* Aug. 24, 1874 14° 47′ 0″ S. 153° 43′ 0″ E. 2450 fms.	18 *Challenger.* Aug. 27, 1874 13° 6′ 0″ S. 148° 37′ 0″ E. 2275 fms.	19 *Challenger.* Aug. 28, 1874 12° 42′ 0″ S. 146° 46′ 0″ E. 1700 fms.	20 *Challenger.* Aug. 29, 1874 12° 8′ 0″ S. 145° 10′ 0″ E. 1400 fms.	21 *Challenger.* Feb. 22, 1875 0° 39′ 0″ S. 138° 55′ 0″ E. 2000 fms.	22 *Challenger.* Mar. 1, 1875 2° 33′ 0″ S. 144° 4′ 0″ E. 1070 fms.	23 *Challenger.* Mar. 11, 1875 0° 42′ 0″ S. 147° 0′ 0″ E. 1100 fms.	24 *Gazelle.* July 28, 1875 3° 7.5′ S. 150° 22′ E. 1420 fms.	25 *Gazelle.* Aug. 11, 1875 3° 57′ S. 152° 10.7′ E. 680 fms.	26 *Gazelle.* Aug. 23, 1875 5° 45.5′ S. 152° 54.2′ E. ..
fms.	°	°	°	°	°	°	°	°	°	°	°	°	°
0	77.5	79.0	79.0	80.0	78.5	78.0	77.5	83.0	84.0	83.8	86.2	85.2	84.6
10								83.0	83.2				
20	76.0 [25]				77.0 [25]			83.0	83.0				
30								83.0	82.5				
40								82.9	82.1				
50	75.2	76.0		75.4	74.0	76.2	76.6	82.5	81.5	81.6	82.0	81.2	81.5
60								81.4	80.9				
70								80.0	80.0				
75	72.9				71.0		74.3						
80								78.3	78.4				
90								76.4	75.8				
100	69.7	71.5	71.1	72.8	67.5	69.5	70.8	74.0	72.8	77.1	70.2	70.6	76.0
150	64.0	65.0		61.8	60.4	61.5	62.5	56.0	57.8	64.0			
200	56.8	57.0	55.5	53.5	52.0	54.5	54.2	49.7	50.0	52.0	51.4	51.0	58.5
250		51.5		48.5	47.0	48.9	48.0			48.5			
300	45.2	47.5	45.2	45.5	44.0	45.0	44.3	45.1	45.2	46.2	43.8	43.8	47.4
350				43.2		42.8	42.1			44.6			
400	41.8	42.3	41.6	41.5	41.0	41.2	41.0	42.5	42.4	43.1			
450				40.5									
500	40.3	40.0	40.0	39.6	39.3	39.3	39.7	40.7	40.5	41.0	39.8		
600		38.5	38.9	38.8	38.3	38.4		39.2	39.2	39.7			
700		38.0	38.3	38.3	37.9	37.9		38.1	38.4	39.0			
800		37.4	37.7	37.8	37.4	37.5		37.3	37.9	38.2			
900		36.8	37.2	37.3	37.0	37.1		36.7	37.4	37.5			
1000		36.3	36.8	36.8				36.2		36.8			
1100		35.8	36.4	36.4	36.3	36.3		35.7					
1200			36.0	36.0				35.3					
1300		35.8	36.0	36.0	35.8	36.0		35.2					
1400			36.0	36.0				35.2					
1500		35.8	36.0	36.0	35.8	36.0		35.2					
Bottom	36.2	35.8	36.0	36.0	35.8	36.0	36.0	35.2	36.4	36.2	37.2	38.4	

TABLE OF SERIAL TEMPERATURES.—*Continued.*

Depth.	27 *Gazelle.* Sep. 13, 1875 14° 52.6′ S. 156° 10.5′ E. ..	28 *Gazelle.* Sep. 14, 1875 16° 0.4′ S. 156° 38.2′ E. ..	29 *Gazelle.* Sep. 19, 1875 22° 21.0′ S. 154° 17.5′ E. 520 fms.	30 *Gazelle.* Oct. 21, 1875 28° 28.3′ S. 156° 1.8′ E. ..	31 *Gazelle.* Oct. 25, 1875 33° 40.0′ S. 166° 28.1′ E. 1525 fms.	32 *Gazelle.* Oct. 26, 1875 34° 0′ S. 169° 59.5′ E. 975 fms.	33 *Gazelle.* Nov. 12, 1875 35° 21′ S. 175° 40′ E. 597 fms.	34 *Gazelle.* Nov. 13, 1875 33° 16.2′ S. 176° 25.7′ E. 1480 fms.	35 *Gazelle.* Nov. 15, 1875 30° 52.8′ S. 177° 5.5′ E. 2270 fms.	36 *Gazelle.* Nov. 19, 1875 28° 21.8′ S. 179° 40.4′ E. 1600 fms.	37 *Gazelle.* Nov. 22, 1875 23° 24.7′ S. 179° 17′ E. 1750 fms.	38 *Gazelle.* Nov. 25, 1875 19° 9′ S. 179° 39.5′ E. 975 fms.	39 *Gazelle.* Dec. 5, 1875 15° 53.9′ S. 178° 11.7′ W. 1330 fms.
fms.	°	°	°	°	°	°	°	°	°	°	°	°	°
0	78.8	79.6	74.4	72.8	63.6	61.6	62.8	65.0	67.4	72.5	76.4	76.5	80.6
10													
20													
25													
30													
40													
50	76.2	76.2	71.0	63.8	60.0	59.0	60.4	59.2	64.2	65.8	72.2	74.4	77.4
60													
70													
75													
80													
90													
100	69.8	72.8	69.4	64.4	58.0	56.5	58.0	57.0	62.2	63.0	68.8	69.8	73.4
150													
200	52.2	55.0	57.2	58.2	54.5	50.8	52.2	51.0	59.6	58.6	62.0	58.8	59.6
250													
300	44.6	45.0	50.2	45.8	49.8	46.6	48.0	47.6	50.5	49.2	50.8	53.2	45.8
350													
400													
450							44.4						
500	40.0	40.0	41.0	44.0	42.8	41.8		42.2	43.8	47.2	45.5	40.6	39.0
600													
700					38.8	38.0		38.8	39.0		37.0	38.5	37.4
800													
900		36.5		39.2	36.8	37.0		36.6	37.4	36.6	36.8	36.4	36.4
1000													
1100					36.5			36.0		36.4	36.2		36.4
1200									36.2				
1300													
1400													
1500													
Bottom			41.0		35.8	36.5	41.5	35.4	35.5	35.4	35.2	36.2	36.0

TABLE OF SERIAL TEMPERATURES.—*Continued.*

Depth.	40 *Gazelle.* Dec. 9, 1875 14° 52.4′ S. 175° 32.7′ W. 905 fms.	41 *Gazelle.* Dec. 13, 1875 18° 40′ S. 174° 9.5′ W. 510 fms.	42 *Gazelle.* Dec. 21, 1875 17° 4.6′ S. 172° 53′ W. 1575 fms.	43 *Gazelle.* Dec. 23, 1875 14° 28.1′ S. 172° 18.5′ W. 2600 fms.	44 *Gazelle.* Dec. 31, 1875 18° 24′ S. 168° 27′ W. 2735 fms.	45 *Gazelle.* Jan. 3, 1876 22° 57.3′ S. 165° 15.5′ W. 2740 fms.	46 *Gazelle.* Jan. 4, 1876 25° 50′ S. 161° 42.1′ W. 2780 fms.	47 *Egeria.* 1887 39° 36′ S. 142° 28′ E. 967 fms.	48 *Egeria.* 1888 34° 0′ 0″ S. 176° 56′ 0″ E. 1694 fms.	49 *Egeria.* 1888 31° 6′ 0″ S. 178° 22′ 0″ E. 2087 fms.	50 *Egeria.* 1888 26° 8′ 0″ S. 179° 20′ 0″W. 612 fms.	51 *Egeria.* 1888 22° 50′ 0″ S. 176° 21½′ W. 760 fms.	52 *Egeria.* 1888 24° 26′ 0″ S. 175° 10′ 0″W. ..
fms.	°	°	°	°	°	°	°	°	°	°	°	°	°
0	81.6	78.8	85.4	84.6	79.6	77.2	77.6		64.0	66.0	70.5	72.0	
10													
20													
25													
30													
40													
50	79.8	74.2	78.4	78.6	75.0	74.6	69.4						
60													
70													
75													
80													
90											60.7		
100	72.8	69.6	73.0	72.8	71.6	69.2	64.4	52.1	58.9	60.0		60.3 [160]	66.2
150													
200	59.5	61.0	61.8	56.0	60.2	59.8	60.0	48.2	53.8	55.2	58.8 [190]		57.6
250												52.0 [260]	
300	45.0	47.2	46.0	46.4	45.6	47.6	51.0	46.9 (uncor'd)	49.3	49.1	50.3 [290]		49.1
350												43.5 [360]	
400								45.3 (uncor'd)	46.8	47.0	45.9 (390]		43.3
450												44.0 [460]	
500	40.0		40.5	39.6		40.8	42.8	41.0	42.7	42.3	41.7 [490]	39.2 [560]	41.3
600								38.4	41.3	40.5		38·5 [660]	39.3
700	36.8		37.4			40.0	40.6	37.2 (uncor'd)	39.7	40.0			37.7
800								37.2 (uncor'd)	38.7	37.8			36.8
900	36.2		36.4	36.2		37.2	37.2			37.3			36.7
1000													
1100													
1200						35.6	35.6						
1300				35.4									
1400													
1500													
Bottom	36.2	38.2	34.8	33.8		33.8	33.8	34.3 (uncor'd)	35.2	35.5	40.2	37.9	

TABLE OF SERIAL TEMPERATURES.—*Continued.*

Depth.	53 *Egeria.* Nov. 11, 1888 20° 19′ 0″ S. 177° 24′ 0″W. 1539 fms.	54 *Egeria.* Nov. 11, 1888 19° 38′ 0″ S. 179° 14′ 0″W. 849 fms.	55 *Egeria.* Nov.13, 1888 19° 13′ 0″ S. 179° 1′ 0″ E. 1381 fms.	56 *Egeria.* Nov. 13, 1888 19° 13′ 0″ S. 178° 24′ 0″ E. 1425 fms.	57 *Egeria.* Nov. 14, 1888 20° 5′ 0″ S. 178° 4′ 0″ E. 1947 fms.	58 *Egeria.* Nov. 16, 1888 21° 48′ 0″ S. 177° 34′ 0″ E. 2218 fms.	59 *Egeria.* Nov. 16, 1888 23° 38′ 0″ S. 176° 52′ 0″ E. 2437 fms.	60 *Egeria.* May 2, 1889 34° 25′ 0″ S. 171° 13′ 0″ E. 772 fms.	61 *Egeria.* May 10, 1889 38° 34′ 0″ S. 175 °56′ 0″ E. 1628 fms.	62 *Egeria.* May 14, 1889 29° 51′ 0″ S. 177° 24½′ E. 2220 fms.	63 *Egeria.* Aug. 23, 1889 13° 0′ 0″ S. 173° 59½′ W. 2263 fms.	64 *Egeria.* Aug. 25, 1889 15° 0′ 0″ S. 177° 36½′ W. 839 fms.	65 *Egeria.* Aug. 25, 1889 14° 34′ 0″ S. 176° 52½′ W. 1282 fms.
fms.	°	°	°	°	°	°	°	°	°	°	°	°	°
0	75.5		76.1			73.0	72.0	64.0	67.0	69.0	82.5	79.5	79.0
10													
20													
25						70.0	70.3						
30													
40													
50	73.9		74.1			69.1	67.8					77.4	
60													
70													
75						68.0	65.7						
80													
90													
100	68.6	70.2	69.0		70.5	67.5				60.7	72.5	73.2	73.8
150								53.2 [161]				63.8	
200	61.5	60.6	59.7		60.0	61.0		71.0 [195]		56.9	52.0	56.8	58.0
250													
300	48.7	48.4	49.9		49.6					49.8	45.0		46.8
350				44.6 [380]									
400	42.9	43.2	43.2		43.7		43.7 [430]			45.4	42.5		41.4
450									43.6 [470]				
500		49.8	49.0		43.2						40.5		39.8
550	40.0 [536]												
600		38.6	39.0		39.0					40.6	40.0		39.0
650													
700		37.8	38.1		38.3	61.8 [725]				39.2	38.5		37.8
800		36.9	37.1		37.0	(uncorrected)				37.8	38.2		37.3
900			37.3				45.5 [936]			37.0	37.5		37.2
1000	36.6 [1039]						(uncorrected)						
1100													
1200						36.5 [1218]							
1300													
1400							35.8 [1436]						
1500													
1700						35.5 [1718]							
1900							35.4 [1936]						
Bottom	35.9	37.0	35.1	35.2	35.1	35.1	35.1		35.0	35.5	34.2	37.2	36.5

TABLE OF SERIAL TEMPERATURES.—*Continued.*

Depth.	66 *Egeria.* June 20, 1890 33° 1′ S. 170° 6′ E. 2258 fms.	67 *Egeria.* June 27, 1890 27° 58½′ S. 178° 27′ W. 1366 fms.	68 *Egeria.* June 29, 1890 25° 22′ S. 177° 28½′ W. 806 fms.	69 *Egeria.* Aug. 29, 1890 19° 32½′ S. 179° 21½′ E. 1655 fms.	70 *Egeria.* Sep. 1, 1890 18° 44¾′ S. 173° 29′ E. 1506 fms.	71 *Egeria.* Sep. 4, 1890 18° 2¼′ S. 167° 49¼′ E. 1556 fms.	72 *Dart.* Nov. 25, 1892 18° 11′ S. 167° 23′ E. 2790 fms.	73 *Dart.* Dec. 3, 1892 27° 10′ S. 162° 57′ E. 633 fms.	74 *Dart.* May 23, 1893 25° 39.7′ S. 165° 4.2′ E. ..	75 *Dart.* May 23, 1893 26° 15.2′ S. 164° 36.5′ E. 1580 fms.	76 *Dart.* May 24, 1893 24° 16′ S. 165° 58′ E. 2000 fms.	77 *Dart.* May 11, 1897 33° 10.5′ S. 152° 26.5′ E. 534 fms.	78 *Dart.* May 11, 1897 32° 53′ S. 152° 59′ E. 1631 fms.
fms.	°	°	°	°	°	°	°	°	°	°	°	°	°
0	65.0	70.0	70.0	73.8	74.8	77.9	82.0	75.0	75.5	74.5	75.0	65.1	71.2
10													
20									72.0	70.7	74.0		
25													
30													
40									71.7	72.8	70.4		
50		69.0											
60									68.2	71.2	69.5		
70													
75													
80									68.0	67.7	66.2		
90													
100		63.2	63.5						65.0	66.0	65.0	59.8	61.2
150	54.0 [160]												
200		57.0	56.5				50.0			59.0		52.5	52.0
250								55.6 [280]					
300		52.2	50.8	51.3	47.8 [330]					49.9			47.7
350													
400		45.6	45.4							47.2			
450						44.3 [425]							
500		42.2	41.7							42.7			
550													
600		40.1											
650													
700													
800		38.0											
900		37.2											
1000		37.1											
1100													
1200													
1300													
1400													
1500													
1700													
1900													
Bottom	35.7	36.7	37.2	36.7	36.4	35.9	35.5	41.1		36.0			36.0

TABLE OF SERIAL TEMPERATURES.—*Continued.*

	79	80	81	82	83	84	85	86	87	88	89	90	91
	Dart.	*Dart.*	*Dart.*	*Dart.*	*Penguin.*	*Penguin.*	*Penguin.*	*Penguin.*	*Penguin.*	*Penguin.*	*Penguin.*	*Penguin.*	*Penguin.*
	May 13, 1897	May 14, 1897	May 14, 1897	May 15, 1897	July 15, 1893	Aug. 7, 1894	Aug. 7, 1874	Aug. 8, 1894	Aug. 9, 1894	Aug. 10, 1894	Aug. 11, 1894	Aug. 12, 1894	Aug. 12, 1894
Dep.h.	31° 7.2′ S.	29° 22.5′ S.	28° 59.5′ S.	28° 24.3′ S.	11° 16.7′ S.	23° 30.5′ S.	23° 17.6′ S.	22° 29.8′ S.	21° 7.3′ S.	19° 33.3′ S.	18° 35.1′ S.	18° 48.8′ S.	19° 0.6′ S.
	153° 43′ 0″ E.	153° 51′ 0″ E.	153° 57.5′ E.	154° 2.5′ E.	145° 14′ 0″ E.	153° 52.7′ E.	154° 33′ 0″ E.	155° 8.6′ E.	155° 21.6′ E.	156° 26.9′ E.	157° 10.5′ E.	157° 0.6′ E.	156° 49.2′ E.
	2565 fms.	495 fms.	1089 fms.	1300 fms.	790 fms.	660 fms.	470 fms.	1810 fms.	1762 fms.	1568 fms.	1758 fms.	884 fms.	980 fms.
fms.	°	°	°	°	°	°	°	°	°	°	°	°	°
0	71.0	73.5	72.6	70.0	79.0	73.0	72.0	74.0	73.8	73.0	74.8	73.8	75.0
10	70.5	72.9	73.1										
20	71.2	73.3	75.0										
25													
30	70.7	72.8	74.8										
40	71.5	71.0	72.8										
50	70.4	73.5	69.1										
60		73.3 [65]											
70													
75	69.3		67.8										
80													
90													
100	68.9		67.0	74.0		69.3	63.3	68.0	69.3	65.4	71.6	68.5	
150	64.3	63.3 [165]	62.3		64.2 [165]								
200	60.6		59.9	62.8		59.8	59.7	62.6	62.5	62.3	63.2	62.9	
250		52.2 [265]			52.0 [270]								
300	53.5		49.8	55.8		51.5	50.6	55.7	52.4	52.2	52.1	51.9	49.7 [310]
350		47.8 [365]											
400	47.3			50.0		45.9		45.9	47.2	46.6	45.2	45.3	
450													
500	44.1			46.2		42.0		42.1	42.1	41.4	41.7	42.1	
600									40.0	40.4	39.6	40.6	
700												38.5	
800								39.4	38.5	38.1	38.0		
900													
1000								38.7		37.0	36.2		
1100													
1200													
1300													
1400													
1500													
Bottom		44.4			37·5	39.9	43.6	34.7	34.8	35.5	35.0	37.1	36.8

TABLE OF SERIAL TEMPERATURES.—*Continued.*

Depth.	92 *Penguin.* Aug. 17, 1894 22° 1.8′ S. 156° 42′ 0″ E. 690 fms.	93 *Penguin.* Aug. 18, 1894 24° 23.2′ S. 155° 46.7′ E. 2400 fms.	94 *Penguin* Sep. 8, 1894 18° 22′ S. 157° 58′ E. 1965 fms.	95 *Penguin.* Sep. 9, 1894 17° 14.5′ S. 158° 33.8′ E. 1968 fms.	96 *Penguin.* Sep. 10, 1894 16° 0.9′ S. 159° 18.6′ E. 1290 fms.	97 *Penguin.* Sep. 10, 1894 15° 53.3′ S. 158° 53.6′ E. 1912 fms.	98 *Penguin.* Sep. 11, 1894 14° 0.8′ S. 160° 15.3′ E. 1025 fms.	99 *Penguin.* Sep. 12, 1894 12° 17.1′ S. 161° 16.3′ E. 2100 fms.	100 *Penguin.* Feb. 17, 1895 10° 42.2′ S. 160° 42′ 0″ E. 2900 fms.	101 *Penguin.* Feb. 18, 1895 12° 10.5′ S. 159° 28.5′ E. 2373 fms.	102 *Penguin.* Feb. 19, 1895 14° 3.4′ S. 158° 16.3′ E. 1779 fms.	103 *Penguin.* Feb. 20, 1895 15° 9.4′ S. 157° 38′ 0″ E. 1708 fms.	104 *Penguin.* Feb. 21, 1895 16° 39.5′ S. 156° 37 .6 E. 1482 fms.
fms.	°	°	°	°	°	°	°	°	°	°	°	°	°
0	73.7	70.6	76.2	76.8	76.2	79.2	81.7	81.4	85.0	83.6	83.5	82.2	82.5
10													
20													
25													
30													
40													
50													
60													
70													
75													
80													
90													
100	70.6	68.6	71.5	71.0	71.8	75.0	76.8	76.2	76.0	73.2	76.7	78.5	75.7
150													
200	62.4	61.9	60.3	62.3	63.5	61.0	61.2	60.8	59.9	60.3	67.0	64.8	62.0
250													
300	53.8	53.6	51.2	51.6	53.2	50.4	49.0	50.6	46.7	50.0	51.0	51.0	50.5
350													
400	46.9	46.8	46.7	47.1	43.0	44.8	44.0	44.7	43.1	46.0	44.0	45.3	44.8
450													
500	42.7	43.2	45.3	42.9	41.5	41.2	42.2	42.0	41.0	40.2	41.2	41.7	42.2
600	40.4	41.0	40.0	40.0	40.0	40.0	40.4	40.0	39.8	39.3	41.1	41.5	41.7
700										38.7	38.7	39.1	39.0
800		38.6	38.2	37.8	37.4		39.0	39.6	39.5	38.6	37.8	38.0	38.2
900											37.7	38.0	38.0
1000		37.5	36.9	36.8	36.6			36.7			37.1	37.1	37.1
1100													
1200		36.1								37.3 [1373]			
1300													
1400													
1500		35.3											
1700													
1900									36.8	37.1 [1873]			
Bottom	39.2	34.0	35.2	35.4	36.0	36.4	36.8	35.5	35.1	37.0	35.3	35.6	36.1

TABLE OF SERIAL TEMPERATURES.—*Continued.*

Depth.	105 *Penguin.* Feb. 21, 1895 17° 34.1′ S. 156° 2.5′ E. 1013 fms.	106 *Penguin.* Feb. 22, 1895 19° 0.8′ S. 154° 58.2′ E. 1594 fms.	107 *Penguin.* Feb. 23, 1895 20° 45.5′ S. 153° 50.5′ E. 1285 fms.	108 *Penguin.* June 27, 1895 38° 35.6′ S 159° 39.9′ E. 2775 fms.	109 *Penguin.* June 30, 1895 37° 7.6′ S. 168° 19.3′ E. 683 fms.	110 *Penguin.* July 1, 1895 36° 52.4′ S. 169° 56.2′ E. 1162 fms.	111 *Penguin.* July 4, 1895 35° 24′ S. 170° 53.5′ E. 1138 fms.	112 *Penguin* July 16, 1895 35° 27′ S. 178° 0.1′ E. 1524 fms.	113 *Penguin.* July 17, 1895 34° 18.7′ S. 179° 31.8′ E. 1587 fms.	114 *Penguin.* July 18, 1895 32° 48.6′ S. 179° 34.4′ W. 948 fms.	115 *Penguin.* July 19, 1895 31° 9.6′ S. 178° 3.4′ W. 2107 fms.	116 *Penguin.* July 20, 1895 29° 14.5′ S. 177° 31.6′ W. 1500 fms.	117 *Penguin.* July 22, 1895 25° 11.8′ S. 175° 46.4′ W. 2760 fms.
fms.	°	°	°	°	°	°	°	°	°	°	°	°	°
0	82.2	81.2	80.0	55.7	57.0	59.2	58.0	60.0	59.5	57.2	61.4	62.4	67.6
10													
20													
25													
30													
40													
50													
60													
70													
75													
80													
90													
100	75.0	74.0	73.0	55.5	56.3	51.0	52.0	58.0	59.0	55.5	60.2	55.0	67.0
150													
200	65.2	63.4	63.7	50.4	52.8	50.8		55.5	57.3	51.8	55.7	54.0	59.1
250													
300	52.7	53.0	52.3	47.7	49.3	49.0	47.8	51.6	49.0	47.9	50.2	47.9	51.7
350													
400	45.0	46.2	45.9	45.1	45.8	47.0	46.2	47.0			46.8		46.0
450													
500	41.9	42.6	42.3	43.2	44.5	41.5	43.4	45.0	44.0	43.0	43.2		42.7
600	39.8	40.6	41.6	41.2		41.1	42.2	42.6	42.1	41.5	41.7		40.6
700		39.1	39.2	40.6		39.9		41.2	40.2	40.2	39.9		39.0
800		38.8	38.9	38.7		38.8		39.2	38.9	38.3	38.9		38.0
900		37.0	37.4	37.2		37.6		38.0			37.6		37.2
1000		37.1	37.1	37.0		37.4		37.1	37.1		37.1		37.0
1100													
1200													
1300													
1400													
1500													
1700													
1900													
Bottom	37.1	35.1	35.9	34.5	41.0	36.2	37.0	36.1	36.1	37.1	34.5	35.6	34.1

TABLE OF SERIAL TEMPERATURES.—*Continued.*

Depth.	118 *Penguin.* July 24, 1895 22° 51.6′ S. 174° 53.6′ W. 3132 fms.	119 *Penguin.* Aug. 1, 1895 19° 24.2′ S. 176° 19.3′ W. 1275 fms.	120 *Penguin.* Aug. 2, 1895 17° 25.8′ S. 177° 57.2′ W. 1445 fms.	121 *Penguin.* Aug. 3, 1895 17° 12.9′ S. 179° 41.8′ W. 800 fms.	122 *Penguin.* Aug. 3, 1895 17° 18′ S. 179° 56.2′ W. 491 fms.	123 *Penguin.* Aug. 3, 1895 17° 26′ S. 179° 50.3′ E. 1328 fms.	124 *Penguin.* Aug. 10, 1895 16° 23′ S. 178° 2.7′ W. 1497 fms.	125 *Penguin.* Aug. 16, 1895 15° 29.7′ S. 176° 3.9′ W. 1123 fms.	126 *Penguin.* Aug. 18, 1895 15° 12.9′ S. 174° 42.3′ W. 968 fms.	127 *Penguin.* Aug. 19, 1895 14° 44.8′ S. 173° 37.1′ W. 2634 fms.	128 *Penguin.* Aug. 19, 1895 14° 28.4′ S. 172° 48.4′ W. 2835 fms.	129 *Penguin.* Aug. 20, 1895 14° 32.3′ S. 172° 2.7′ W. 2622 fms.	130 *Penguin.* Aug. 21, 1895 16° 19.7′ S. 172° 3.8′ W. 3980 fms.
fms.	°	°	°	°	°	°	°	°	°	°	°	°	°
0	72.0	76.4	77.5	78.2	79.0	78.2	78.8	80.5	81.0	80.5	80.8	82.2	81.5
10													
20													
25													
30													
40							78.5						
50													
60													
70													
75													
80													
90					75.5 [91]							80.0	79.2
100	68.0		76.0	76.1		74.4	77.2	78.8					
150							69.8						
200	58.7	61.5	62.6	63.0		61.0	64.7	62.2	59.4		60.5	60.8	61.0
250													
300	49.8	51.2	50.2	53.1	52.7 [291]	49.1	50.5	48.1	58.2		46.6	48.5	48.7
350													
400	45.8	44.7	44.1	44.2		43.5	43.8	42.7	43.5		42.5	42.4	42.4
450													
500	42.4	41.2	43.7	41.2		41.2	43.7	41.3	40.4		40.5	40.5	40.2
600	40.9	39.2	39.1	40.5		40.4	38.3	40.4	38.7		39.7	40.5	38.6
700	38.0	38.2	38.2	38.3			38.0	37.9	37.9		39.2	38.5	38.0
800	37.2	37.5	38.2				37.7		36.0		37.3	37.4	37.6
900	37.1	36.9	37.2			37.2 [928]	36.9	37.1					37.3
1000	36.9	37.0	36.8				36.5	36.9				36.2	36.4
1100		36.4				36.7 [1128]							
1200													
1300													
1400													
1500													
1700										33.2 [2088]			
1900											33.8	35.0	

TABLE OF SERIAL TEMPERATURES.—*Continued.*

Depth.	131 *Penguin.* Aug. 22, 1895 16° 46.8′ S. 173° 41.2′ W. 690 fms.	132 *Penguin.* Aug. 23, 1895 18° 5′ 0″ S. 173° 42.1′ W. 804 fms.	133 *Penguin.* July 21, 1896 8° 28.9′ S 179° 13.7′ E. 2003 fms.	134 *Penguin.* Nov. 27, 1896 26° 41′ 0″ S. 177° 31.5′ E. 2327 fms.	135 *Penguin.* Dec. 14, 1896 40° 12.6′ S. 160° 8.9′ E. 2620 fms.	136 *Penguin.* May 2, 1897 14° 33′ 0″ S. 177° 37.3′ W. 1159 fms.	137 *Penguin.* May 3, 1897 13° 16.9′ S. 176° 56′ 0″W. 2198 fms.	138 *Penguin.* May 4, 1897 11° 42.8′ S. 175° 51′ 0″W. 2335 fms.	139 *Penguin.* May 5, 1897 10° 8.7′ S. 174° 56.0′ W. 2330 fms.	140 *Penguin.* May 6, 1897 8° 57.2′ S. 174° 3′ 0″ W. 2606 fms.	141 *Penguin.* May 7, 1897 7° 27.7′ S. 173° 12.1′ W. 2790 fms.	142 *Penguin.* May 8, 1897 6° 1.5′ S. 172° 20.2′ W. 2970 fms.	143 *Penguin.* May 9, 1897 4° 52′ 0″ S. 171° 32.2′ W. 3247 fms.
fms.	°	°	°	°	°	°	°	°	°	°	°	°	°
0	79.0	76.4	81.3	70.5	63.0	82.1	81.8	83.2	84.0	84.3	85.0	84.4	84.5
10													
20													
25													
30													
50	78.0												
60													
70													
75													
80													
90													
100	77.0	73.0	77.0	62.8	52.2	75.4	70.5	72.6	74.6	77.6	74.0	77.0	75.0
150													
200	62.2	60.8	53.5	52.2	49.9		56.9	51.7	54.0	55.9	53.3		53.2
250													
300	48.3	48.0	47.0	49.1	47.2		45.5	45.1	46.1	48.8	47.6	47.3	47.6
350													
400	43.1	43.8	44.7	46.1	45.0	42.5	41.5	42.3	42.5	43.8	43.9	44.4	45.3
450													
500	41.0	40.8	41.0	43.0	43.1	40.0	40.6	40.2	42.0	41.5	41.3	41.3	42.0
600		39.2	39.5	41.1	41.0		38.6			39.8		39.7	40.4
700				39.1	40.0		38.3	38.0	38.8	38.1	39.1		39.0
800			37.0	38.0	38.6		37.4	38.3	38.5			42.2	38.3
900				37.6	37.1			37.4	37.7	37.3	37.4	38.3	37.3
1000			36.5		36.4		36.9	36.9	36.8	36.6	36.7	37.0	36.8
1100					37.1								
1200			37.0		36.8								
1300													
1400													
1500													
Bottom.				36.8	34.2	35.3	34.5	34.0		34.4	34.4	34.4	34.9

TABLE OF SERIAL TEMPERATURES.—*Continued.*

Depth.	144 *Penguin.* May 12, 1897 4° 6.5′ S. 170° 49′ W. 2970 fms.	145 *Penguin.* May 13, 1897 3° 9.5′ S. 170° 4′ W. 3008 fms.	146 *Penguin.* May 14, 1897 1° 12.8′ S. 168° 7.3′ W. 3365 fms.	147 *Penguin.* May 14, 1897 0° 53.5′ S. 167° 48.7′ W. 3043 fms.	148 *Penguin.* Sep. 8, 1897 1° 11.2′ S. 163° 56.3′ W. 2960 fms.	149 *Penguin.* Sep. 9, 1897 2° 44.5′ S. 165° 25.4′ W. 2961 fms.	150 *Penguin.* Sep. 10, 1897 4° 6.7′ S. 166° 37.7′ W. 3027 fms.	151 *Penguin.* Sep. 11, 1897 5° 30.2′ S. 167° 59.1′ W. 3110 fms.	152 *Penguin.* Sep. 12, 1897 6° 46.8′ S. 169° 8.7′ W. 3220 fms.	153 *Penguin.* Sep. 14, 1897 9° 7.7′ S. 171° 27′ W. 2245 fms.	154 *Penguin.* Sep. 15, 1897 10° 20.5′ S. 172° 37′ W. 2310 fms.	155 *Penguin.* Sep. 16, 1897 11° 39.7′ S. 173° 57.1′ W. 2553 fms.	156 *Penguin.* Nov. 21, 1897 21° 2.3′ S. 179° 26.0′ E. 1969 fms.
fms.	°	°	°	°	°	°	°	°	°	°	°	°	°
0	83.5	83.5	84.0	83.7	80.7	80.8	82.7	83.5	83.8	85.2	83.2	81.8	76.0
10					80.7	79.5	82.8	83.5	81.5	83.3	83.5	82.8	75.7
20					80.2	80.1	82.5	82.8	82.8	83.5	83.8	83.2	75.8
25			81.5										
30					80.2	79.8	82.5	83.3	80.5	82.9	83.1	82.0	76.5
40					80.2	77.2	82.8	83.5	81.1	83.2	83.2	82.5	76.3
50			79.2		80.0	78.0	82.5	83.0	80.5	83.2	82.8	82.4	75.5
60													
70													
75			77.8		75.0	78.2	77.4	78.5	78.5	77.2	76.5	77.5	
80													
90													
100	72.3	69.5	61.5	62.7	65.7	64.7	68.8	69.8	71.0	71.5	72.0	73.6	71.0
150					59.6	57.1	56.0	57.5	56.8	65.0		61.4	
200	51.4	51.9		52.5	56.2	54.1	53.7	53.4	52.8	58.8	57.0	54.8	63.0
250													
300	46.2	46.5		45.8	48.7	47.9	47.5	46.7	47.0	48.5	47.4	47.2	53.8
350													
400	43.7	43.8		42.5	44.3	44.0	44.0	43.4	43.3	43.3	43.5	43.4	45.7
450													
500	41.8	41.3		41.0	42.4	42.3	42.2		41.8	41.3	41.8	41.5	42.4
600	40.8	40.6	40.0		40.7	40.3	40.4	40.3		39.5	39.9	39.8	39.1
700	38.8	38.8	38.9		39.3	39.3	39.1	39.2		39.0	39.4	39.3	38.8
800	37.8	38.0	37.8		38.3	38.5	38.8	38.3		38.0	38.2	37.9	37.8
900	37.0	37.1	37.3		37.7	37.7	37.8	37.8		37.3	37.4	37.0	37.0
1000	36.9	37.0	36.9		37.4	37.5	37.3	37.4		37.2	36.9	36.9	
1100													
1200													
1300													
1400													
1500													
Bottom	34.9	35.0	35.0		35.0	35.8	35.2	35.0	35.7	36.6	36.9	36.3	37.9

TABLE OF SERIAL TEMPERATURES.—*Continued.*

Depth.	157 *Penguin.* Nov. 22, 1897 23° 16.6′ S. 179° 15′ E. 1788 fms.	158 *Penguin.* Nov. 22, 1897 23° 44.1′ S. 179° 9.7′ E. 1903 fms.	159 *Penguin.* Dec. 4, 1898 35° 1′ S. 171° 37.2′ E. 796 fms.	160 *Penguin.* Dec. 5, 1898 35° 57.1′ S. 169° 38.7′ E. 1298 fms.	161 *Penguin.* Dec. 6, 1898 36° 52.5′ S. 167° 15.4′ E. 704 fms.	162 *Penguin.* Dec. 7, 1898 37° 57.2′ S. 164° 23.3′ E. 878 fms.	163 *Penguin.* Dec. 8, 1898 39° 17′ S. 161° 0′ E. ..	164 *Penguin.* Dec. 9. 1898 40° 32.0′ S. 157° 25′ E. ..	165 *Penguin.* Dec. 13, 1898 22° 15.5′ S. 175° 32.3′ E. 2351 fms.	166 *Penguin.* Dec. 14, 1898 24° 59.6′ S. 174° 9.1′ E. 2420 fms.	167 *Penguin.* Dec. 15, 1898 26° 38′ S. 172° 26.5′ E. 2070 fms.	168 *Penguin.* Dec. 18, 1898 31° 18′ S. 163° 46.2′ E. 1010 fms.	169 *Penguin.* Dec. 19, 1898 31° 36′ S. 163° 13.8′ E. 770 fms.
fms.	°	°	°	°	°	°	°	°	°	°	°	°	°
0	74.5	73.3	62.2	63.3	63.0	62.2	61.8	60.5	77.0	76.0	75.5	70.8	71.0
10	74.0	73.5	62.5	63.0	63.5	61.8	61.8	59.8	77.5	73.8	75.3		
20	74.5	72.8	61.4	62.7	63.4	61.5	61.0	60.2	75.0	70.5	75.5		
25													
30	73.8	72.7	59.0	60.8	63.2	61.0	60.5	59.2	74.8	69.0	75.5		
40	74.3	72.2	58.2	58.7	63.2	60.5	56.0	58.0	73.4	68.0	74.5		
50	73.8	72.5	57.8	58.8	57.5	57.2	54.5	57.7	71.9	66.5	69.2		
60													
70													
75			57.4	58.8	56.7	57.2	55.2	57.0	71.8	65.5			
80													
90													
100	68.0	67.0	56.1	58.2	55.8	56.5	52.3	54.5	68.0	63.8	65.7		
150			53.3	54.9	53.7	54.3	51.0	52.3	65.5	60.0			
200	62.3	60.0	50.7	52.2	51.7	52.3	49.8	51.6	62.3	56.5	60.0		
250													54.1 [270]
300	54.4	52.6		50.1			46.8	48.0	51.4	49.2	51.3		
350													
400	46.5	45.7		46.3			45.8	46.0	47.1		46.8		
450													45.1 [470]
500	43.2	43.0		43.8			42.3	42.7	43.0	42.3	45.0	44.5 [510]	
600	39.8							41.0	41.0	40.4	41.2		
700	39.0						38.4	38.7	38.7	38.9	39.3	40.5 [710]	
800	37.8						37.8	37.8					
900	37.2						37.0	37.1					
1000	37.2						37.0	36.6					
1100													
1200													
1300													
1400													
1500													
Bottom	35.5	35.5	41.0	36.8	40.5	39.5			36.0	35.9	35.9	37.1	39.2

TABLE OF SERIAL TEMPERATURES.—*Continued.*

Depth.	170 *Penguin.* Dec. 19, 1898 31° 56.9′ S. 162° 36.8′ E. 710 fms.	171 *Penguin.* Dec. 19, 1898 32° 12.4′ S. 161° 55.8′ E. 595 fms.	172 *Penguin.* Dec. 19, 1898 32° 24.7′ S. 161° 20.9′ E. 770 fms.	173 *Penguin.* Dec. 20, 1898 32° 41.5′ S. 160° 40.6′ E. 780 fms.	174 *Penguin.* Dec. 20, 1898 32° 57.9′ S. 160° 1.7′ E. 875 fms.	175 *Penguin.* Dec. 20, 1898 33° 4.3′ S. 159° 23.8′ E. 2250 fms.	176 *Penguin.* Dec. 21, 1898 33° 7.5′ S. 157° 40.2′ E. 1645 fms.	176a *Penguin.* Apr. 8, 1902 32° 26.7′ S. 167° 7.5′ E. 653 fms.	176b *Penguin.* Apr. 9, 1902 32° 40.5′ S. 165° 10′ E. 1768 fms.	176c *Penguin.* Apr. 10, 1902 33° 7.5′ S. 163° 16.5′ E. 469 fms.	176d *Penguin.* Apr. 11, 1902 31° 44.5′ S. 161° 24.5′ E. 763 fms.	176e *Penguin.* Apr. 13, 1902 31° 25.5′ S. 160° 53.2′ E. 778 fms.	176f *Penguin.* Apr. 32, 1902 30° 45.4′ S. 159° 50′ E. 843 fms.
fms.	°	°	°	°	°	°	°	°	°	°	°	°	°
0	71.0	70.8	71.0	69.0	71.0	68.4	68.5	68.0	71.6	68.2	69.6	71.0	71.0
5								68.0	70.3	67.0	66.5	71.1	
10								67.8	70.8	67.5	68.0	70.5	71.0
20								66.6	70.0	66.5	69.6	71.3	70.5
25													
30								66.0	70.5	66.8	68.7	70.5	70.8
40							68.0 [45]	63.5	68.5		69.9	71.7	70.8
50								61.9	68.5		69.0 [41]	71.5	69.5
60													
70			63.3										
75								58.2	66.7			70.3	68.4
80				61.3									
90													
100								56.6	65.0				
150													
200	56.3 [210]	57.2 [195]					58.9 [145]		57.4				
250							52.8 [245]						
300									51.3				
350			47.6 [370]		46.3 [375]		48.7 [345]						
400	46.1 [410]	47.8 [395]											
450							45.9 [445]						
500				46.9 [580]			43.2 [545]						
600							41.4 [645]						
700													
800													
900													
1000													
1100							36.9 [1145]						
1200						36.9 [1250]							
1300													
1400													
1500						35.4 [1750]							
Bottom	40.4	42.6	39.5	39.5	38.0	34.6	35.4	41.8	36.4	44.6	39.8	39.8	34.0

TABLE OF SERIAL TEMPERATURES.—*Continued.*

Depth.	176g *Penguin.* Apr. 14, 1902 31° 30.7′ S. 154° 23.2′ E. 2560 fms.	176h *Penguin.* Apr. 9, 1903 34° 31′ S. 177° 20.2′ E. 1400 fms.	177 *Waterwitch.* May 5, 1895 34° 40′ S. 154° 3′ E. 2690 fms.	178 *Waterwitch.* May 6, 1895 34° 38′ S. 157° 22′ E. 2600 fms.	179 *Waterwitch.* May 7, 1895 35° 2.5′ S. 159° 27′ E. 2700 fms.	180 *Waterwitch.* May 9, 1895 35° 8.5′ S. 164° 13′ E. 630 fms.	181 *Waterwitch.* May 11, 1895 35° 0′ S. 170° 26′ E. 1135 fms.	182 *Waterwitch.* May 11, 1895 35° 14.4′ S. 169° 13′ E. 565 fms.	183 *Waterwitch.* May 13, 1895 32° 49′ S. 173° 37′ E. 1090 fms.	184 *Waterwitch.* May 14, 1895 31° 38′ S. 174° 4.7′ E. 1970 fms.	185 *Waterwitch.* May 15, 1895 29° 40.3′ S. 175° 11′ E. 2340 fms.	186 *Waterwitch.* May 16, 1895 28° 19.5′ S. 175° 34.7′ E. 2260 fms.	187 *Waterwitch.* May 17, 1895 25° 59.6′ S. 175° 33′ E. 2435 fms.
fms.	°	°	°	°	°	°	°	°	°	°	°	°	°
0	73.5	67.0	70.5	67.0	65.8	63.5	63.2	63.0	67.0	68.0	69.1	71.0	74.0
10	72.8			66.5	65.5	62.8	63.2	63.0	66.5	67.8	69.0	70.8	73.8
20	73.0			66.1	65.3	62.8	63.2	63.0	66.5	67.8	68.9	70.8	73.8
25								[illegible]	[illegible]				
30	74.0			65.9	65.3		63.2	62.5	66.5	67.8	68.8	70.8	73.8
40	72.8												
50	72.0			65.5	64.0		63.0	58.8	64.7	64.5	67.5	67.6	71.0
60							[illegible]						
70							[illegible]						
75	72.5			64.1	60.9		59.0	57.8	62.5	62.8	65.2	65.2	68.2
80													
90													
100	70.5	60.6	65.5	61.3	57.8		57.5	57.0	61.0	61.8	63.0	63.6	65.8
150				56.0	55.8		55.0		58.0	59.5	60.6	61.8	62.3
200	66.0	56.9	57.3	52.8	52.5	51.8			54.4		56.8	57.8	59.2
250													
300	56.0	52.4		49.0	48.9		48.6		50.1		50.0	50.6	50.2
350													
400	50.6	48.1											
450													
500	45.5	45.8	43.2	43.3	43.5		43.0		45.2		43.1	42.9	43.1
600		42.9											
700	41.2	40.8							38.9		38.2	37.9	37.9
800		40.5	38.9	38.5	38.8								
900	38.0	39.6											
1000													
1100													
1200													
1300													
1400													
1500													
Bottom	34.0	36.2	34.2	34.3	34.9	40.6	36.2	43.1	36.9	35.6	35.8	35.8	35.3

TABLE OF SERIAL TEMPERATURES.—*Continued.*

176g *Penguin.* Apr. 14, 1902 31° 30.7′ S. 154° 23.2′ E. 2560 fms.	176h *Penguin.* Apr. 9, 1903 34° 31′ S. 177° 20.2′ E. 1400 fms.	177 *Waterwitch.* May 5, 1895 34° 40′ S. 154° 3′ E. 2690 fms.	178 *Waterwitch.* May 6, 1895 34° 38′ S. 157° 22′ E. 2600 fms.	179 *Waterwitch.* May 7, 1895 35° 2.5′ S. 159° 27′ E. 2700 fms.	180 *Waterwitch.* May 9, 1895 35° 8.5′ S. 164° 13′ E. 630 fms.	181 *Waterwitch.* May 11, 1895 35° 0′ S. 170° 26′ E. 1135 fms.	182 *Waterwitch.* May 11, 1895 35° 14.4′ S. 169° 13′ E. 565 fms.	183 *Waterwitch.* May 13, 1895 32° 49′ S. 173° 37′ E. 1090 fms.	184 *Waterwitch.* May 14, 1895 31° 38′ S. 174° 4.7′ E. 1970 fms.	185 *Waterwitch.* May 15, 1895 29° 40.3′ S. 175° 11′ E. 2340 fms.	186 *Waterwitch.* May 16, 1895 28° 19.5′ S. 175° 34.7′ E. 2260 fms.	187 *Waterwitch.* May 17, 1895 25° 59.6′ S. 175° 33′ E. 2435 fms.
°	°	°	°	°	°	°	°	°	°	°	°	°
73.5	67.0	70.5	67.0	65.8	63.5	63.2	63.0	67.0	68.0	69.1	71.0	74.0
72.8			66.5	65.5	62.8	63.2	63.0	66.5	67.8	69.0	70.8	73.8
73.0			66.1	65.3	62.8	63.2	63.0	66.5	67.8	68.9	70.8	73.8
74.0			65.9	65.3		63.2	62.5	66.5	67.8	68.8	70.8	73.8
72.8												
72.0			65.5	64.0		63.0	58.8	64.7	64.5	67.5	67.6	71.0
72.5			64.1	60.9		59.0	57.8	62.5	62.8	65.2	65.2	68.2
70.5	60.6	65.5	61.3	57.8		57.5	57.0	61.0	61.8	63.0	63.6	65.8
			56.0	55.8		55.0		58.0	59.5	60.6	61.8	62.3
66.0	56.9	57.3	52.8	52.5	51.8			54.4		56.8	57.8	59.2
56.0	52.4		49.0	48.9		48.6		50.1		50.0	50.6	50.2
50.6	48.1											
45.5	45.8	43.2	43.3	43.5		43.0		45.2		43.1	42.9	43.1
	42.9											
41.2	40.8							38.9		38.2	37.9	37.9
	40.5	38.9	38.5	38.8								
38.0	39.6											

TABLE OF SERIAL TEMPERATURES.—*Continued.*

Depth.	188 *Waterwitch.* May 18, 1895 24° 8.5′ S. 176° 8.2′ E. 2490 fms.	189 *Waterwitch.* May 19, 1895 21° 12.2′ S. 177° 5.9′ E. 2235 fms.	190 *Waterwitch.* May 20, 1895 19° 9′ S. 177° 52.7′ E. 1102 fms.	191 *Waterwitch.* Sep. 17, 1895 18° 54.5′ S. 179° 51′ E. 1780 fms.	192 *Waterwitch.* Sep. 19, 1895 14° 37.7′ S. 178° 52 5′ W. 1118 fms.	193 *Waterwitch.* Sep. 20, 1895 12° 49.5′ S. 177° 29.7′ W. 1880 fms.	194 *Waterwitch.* Sep. 21, 1895 11°.26′ S. 176° 27.7′ W. 1985 fms.	195 *Waterwitch.* Sep. 25 1895 10° 59.8′ S. 176° 36.2′ W. 1910 fms.	196 *Waterwitch.* Sep. 30, 1895 15° 43.6′ S. 179° 43′ W. 820 fms.	197 *Waterwitch.* Dec. 4, 1895 20° 5.5′ S. 176° 24′ E. 1408 fms.	198 *Waterwitch.* Dec. 5, 1895 21° 58.7′ S. 174° 23.2′ E. 1060 fms.	199 *Waterwitch.* Dec. 6, 1895 24° 18.5′ S. 172° 21′ E. 2200 fms.	200 *Waterwitch.* Dec. 7, 1895 25° 41′ S. 170° 56′ E. 2060 fms.
fms.	°	°	°	°	°	°	°	°	°	°	°	°	°
0	75.2	78.0	81.0	75.2	80.7	81.5	82.7	84.0	81.5	77.0	76.5	74.3	73.3
10	74.0	78.0	80.5	75.0	80.4	81.0	82.4	83.5		77.0	75.7	73.8	71.4
20	74.0	77.8	80.4	74.5	79.6	80.7	82.3	82.8	80.0	77.0	75.3	71.5	70.5
25													
30	74.0	77.5	80.4	74.0	79.5	80.6	82.3						
40													
50	69.2	77.2	78.0	73.8	78.8	80.6	81.3	82.4	77.9	74.5	72.5	68.2	68.5
60													
70													
75	68.2	72.5	75.0	73.1	78.6	77.3	77.3	79.3	76.9	72.5	69.9	66.1	67.3
80													
90													
100	65.0	70.8	71.8	71.5	76.1	76.5	75.0	76.0	73.0	70.8	68.5	64.4	64.0
150	63.2	65.2	64.8	67.0	66.9	64.8	64.0	62.5	68.5	66.9	66.8	62.0	62.2
200	57.2	61.3	59.3	61.5		58.8	56.2	56.8	59.6	60.4	61.9	57.3	58.3
250													
300	49.2	49.2	48.8	50.0	46.8	45.8	45.9		48.1	48.7	51.6	49.0	50.8
350													
400													
450													
500	42.4	42.6	41.9	41.3	40.2	41.1	41.3		40.3	42.0	42.3	42.5	43.7
600													
700													
800	37.6	37.3	37.3	37.3	37.1	37.3	37.4			38.0	38.8	37.7	37.9
900													
1000													
1100													
1200													
1300													
1400													
1500													
Bottom	35.3	35.5	36.2	35.4	36.3	35.0	34.9	34.9	37.6	37.0	37.6	35.5	35.5

TABLE OF SERIAL TEMPERATURES.—*Continued.*

Depth.	201 *Waterwitch.* Dec. 8, 1895 27° 52.5′ S. 168° 59.8′ E. 1900 fms.	202 *Waterwitch.* Dec. 9, 1895 29° 0.7′ S. 167° 36.3′ E. 820 fms.	203 *Waterwitch.* Dec. 10, 1895 29° 2.5′ S. 163° 59.5′ E. 1225 fms.	204 *Waterwitch.* Dec. 11,1895 29° 3′ S. 161° 31.7′ E. 780 fms.	205 *Waterwitch.* Dec. 12, 1895 28° 50.2′ S. 158° 59 E. 1778 fms.	206 *Waterwitch.* Dec. 13, 1895 28° 47′ S. 157° 2.9′ E. 2515 fms.	207 *Waterwitch.* Dec. 14, 1895 28° 43.5′ S. 154° 11′ E. 1425 fms.	208 *Waterwitch.* May 17, 1896 33° 7′ S. 153° 34.7′ E. 2725 fms.	209 *Waterwitch.* May 18, 1896 32° 54′ S. 156° 9.5′ E. 1425 fms.	210 *Waterwitch.* May 20, 1896 31° 37′ S. 161° 53.5′ E. 780 fms.	211 *Waterwitch.* May 21, 1896 30° 14.2′ S. 164° 57′ E. 1855 fms.	212 *Waterwitch.* May 22, 1896 29° 33.3′ S. 166° 44.7′ E. 1740 fms.	213 *Waterwitch.* May 23. 1896 27° 49.7′ S. 168° 6.7′ E. 1785 fms.
fms.	°	°	°	°	°	°	°	°	°	°	°	•	°
0	73.2	72.0	71.6	73.0	76.0	78.2	78.2	70.5	70.2	72.0	70.0	70.5	72.0
10	69.3	68.8	71.1	72.0	74.5	76.6	77.2	71.0	69.5	71.8	70.8	70.5	71.8
20	68.7	67.7	68.9	70.9	71.8	75.0	75.0	70.5	69.0	71.0	70.5	70.5	71.5
25													
30									66.8	70.5			
40													
50	65.3	64.5	66.5	66.3	68.0	69.7	68.9	68.8	66.5	70.5	69.5	70.3	71.5
60													
70													
75	62.5	63.5	64.5	65.3	66.5	66.1	65.8	67.3	63.8	66.0	67.8	65.5	64.9
80													
90													
100	60.7	62.3	63.8	63.9	65.0	64.8	64.0	64.2	61.0	64.0	65.0	63.5	61.8
150	57.8	59.5		60.6	61.4	60.2	59.0	57.0	56.2	58.0	62.0	60.3	58.2
200	54.5	55.3	60.0	57.8	58.0	56.5	55.6	52.0	53.0	56.0	58.2	57.8	55.0
250													
300	49.9	50.7	53.4	50.6	51.5	50.6		48.7	47.9	49.2	53.2	52.2	50.6
350													
400													
450													
500	47.6	43.5	45.3	43.4	43.7	43.5		43.3	42.3	42.6	44.2	44.2	43.0
600													
700													
800	38.1		38.7		38.5	38.4		38.4	37.7		39.0	38.8	38.0
900													
1000													
1100													
1200													
1300													
1400													
1500													
Bottom	35.5	38.4	35.8	39.5	34.5	34.1	35.4	34.3	35.4	38.5	35.8	36.3	35.8

TABLE OF SERIAL TEMPERATURES.—*Continued.*

201	202	203	204	205	206	207	208	209	210	211	212	213
erwitch.	*Waterwitch.*	*Waterwitch.*	*Waterwitch.*	*Waterwitch.*	*Waterwitch.*	*Waterwitch.*	*Waterwitch.*	*Waterwitch.*	*Waterwitch.*	*Waterwitch.*	*Waterwitch.*	*Waterwitch.*
8, 1895	Dec. 9, 1895	Dec. 10, 1895	Dec. 11,1895	Dec. 12, 1895	Dec. 13, 1895	Dec. 14, 1895	May 17, 1896	May 18, 1896	May 20, 1896	May 21, 1896	May 22, 1896	May 23, 1896
52.5′ S.	29° 0.7′ S.	29° 2.5′ S.	29° 3′ S.	28° 50.2′ S.	28° 47′ S.	28° 43.5′ S.	33° 7′ S.	32° 54′ S.	31° 37′ S.	30° 14.2′ S.	29° 33.3′ S.	27° 49.7′ S.
59.8′ E.	167° 36.3′ E.	163° 59.5′ E.	161° 34.7′ E.	158° 59 E.	157° 2.9′ E.	154° 11′ E.	153° 34.7′ E.	156° 9.5′ E.	161° 53.5′ E.	164° 57′ E.	166° 44.7′ E.	168° 6.7′ E.
00 fms.	820 fms.	1225 fms.	780 fms.	1778 fms.	2515 fms.	1425 fms.	2725 fms.	1425 fms.	780 fms.	1855 fms.	1740 fms.	1785 fms.
°	°	°	°	°	°	°	°	°	°	°	•	°
73.2	72.0	71.6	73.0	76.0	78.2	78.2	70.5	70.2	72.0	70.0	70.5	72.0
69.3	68.8	71.1	72.0	74.5	76.6	77.2	71.0	69.5	71.8	70.8	70.5	71.8
68.7	67.7	68.9	70.9	71.8	75.0	75.0	70.5	69.0	71.0	70.5	70.5	71.5
								66.8	70.5			
65.3	64.5	66.5	66.3	68.0	69.7	68.9	68.8	66.5	70.5	69.5	70.3	71.5
62.5	63.5	64.5	65.3	66.5	66.1	65.8	67.3	63.8	66.0	67.8	65.5	64.9
60.7	62.3	63.8	63.9	65.0	64.8	64.0	64.2	61.0	64.0	65.0	63.5	61.8
57.8	59.5		60.6	61.4	60.2	59.0	57.0	56.2	58.0	62.0	60.3	58.2
54.5	55.3	60.0	57.8	58.0	56.5	55.6	52.0	53.0	56.0	58.2	57.8	55.0
49.9	50.7	53.4	50.6	51.5	50.6		48.7	47.9	49.2	53.2	52.2	50.6
47.6	43.5	45.3	43.4	43.7	43.5		43.3	42.3	42.6	44.2	44.2	43.0
38.1		38.7		38.5	38.4		38.4	37.7		39.0	38.8	38.0

TABLE OF SERIAL TEMPERATURES.—*Continued.*

Depth.	214 *Waterwitch* May 26, 1896 24° 42.7′ S. 169° 39.6′ E. 1262 fms.	215 *Waterwitch* June 1, 1896 23° 13.7′ S. 170° 7.2′ E. 1238 fms.	216 *Waterwitch.* June 3, 1896 23° 22.2′ S. 170° 5.8′ E. 1770 fms.	217 *Waterwitch.* June 12, 1896 23° 21·7′ S. 169° 26.4′ E. 940 fms.	218 *Waterwitch.* June 17, 1896 21° 23.2′ S. 170° 57.9′ E. 1342 fms.	219 *Waterwitch.* Nov. 5, 1896 15° 45.7′ S. 176° 35.2′ E. 1660 fms.	220 *Waterwitch.* Nov. 6, 1896 15° 50.4′ S. 176° 21.3′ E. 1700 fms.	221 *Waterwitch.* Nov. 9, 1896 15° 32.2′ S. 175° 20.5′ E. 1632 fms.	222 *Waterwitch.* Nov. 10, 1896 15° 33.8′ S. 175° 22.2′ E. 1672 fms.	223 *Waterwitch.* Nov. 30, 1896 29° 39.2′ S. 164° 15.5′ E. 1825 fms.	224 *Waterwitch.* Dec. 1, 1896 29° 49.2′ S. 161° 48.2′ E. 665 fms.	225 *Waterwitch.* Dec. 2, 1896 29° 42.5′ S. 158° 24.4′ E. 1070 fms.	226 *Waterwitch.* Dec. 3, 1896 30° 21′ S. 155° 27.6′ E. 2480 fms.
fms.	°	°	°	°	°	°	°	°	°	°	°	°	°
0	73.2	76.2	75.6	76.2	75.0	81.5	82.0	82.1	82.0	69.5	70.5	74.5	73.8
10	72.8	75.6	75.2	76.2	75.0	80.0	80.5	81.0	80.8	69.5	70.0	74.0	73.8
20	72.8	75.6	75.0	75.8	75.0	80.0	80.2	80.0	79.8	66.6	69.8	73.9	73.5
25													
30	72.8		74.7			80.0	80.0	80.0	79.2	64.9	69.3	72.2	72.0
40													
50	68.8	74.1	72.5	75.2	74.5	79.2	79.7	78.1	77.5	62.7	67.8	69.5	70.0
60													
70													
75	65.5	71.1	70.7	71.8	72.5	77.5	77.5	77.1	76.0	60.6	66.5	67.9	68.6
80													
90													
100	63.2	68.0	68.0	71.2	70.8	74.1	73.0	75.3	72.6	59.0	66.0	66.7	67.0
150	60.5		64.4	65.2	64.5	68.0	67.2	66.6	66.7	54.8	64.8	61.2	63.8
200	56.8		60.2	61.4	57.2	61.0	60.8	58.2	59.7	52.8	60.5	58.5	61.3
250									53.3	49.0	56.5		55.6
300	48.7		50.8	51.4	51.0	47.6	47.8	47.3	49.0	47.3	53.8		53.1
350													
400													
450													
500	41.3		41.9	42.6	41.2	40.2	39.7	39.9	40.0	41.9	43.6		43.9
600													
700													
800	37.8		37.1	37.2	37.0	38.0	38.0	37.9	37.4	37.2			38.3
900													
1000													
1100													
1200													
1300													
1400													
1500													
Bottom	36.0	35.9	35.2	36.6	35.3	36.0	36.1	35.9	35.8	35.3	40.8	36.4	33.8

It will be observed from this Table that no fewer than 234 serial observations are available, and we propose to discuss these in some detail. In the first place in order to show the general distribution of temperature throughout the region, we have prepared four temperature sections, three of them longitudinal sections from east to west, separated by 10° of latitude, and an oblique section from south-west to north-east.

Section No. 1 runs in an easterly direction from the coast of Australia, approximately in latitude 13° S.; the serials used in preparing this section, proceeding from west to east are Nos. 20, 19, 18, 17, 102, 101, 98, 99, 193, 137, 63.

Section No. 2 runs parallel to section No. 1 but approximately 10° farther south; in preparing this section we have made use of serials Nos. 84, 9, 85, 86, 92, 76, 217, 216, 215, 199, 198, 165, 188, 59, 158, 157, 37, 51, 118, 45.

Section No. 3 runs parallel to sections Nos. 1 and 2, but 10° still farther to the south, that is approximately in latitude 33° S. In preparing this section we have made use of serials Nos. 77, 78, 208, 209, 176, 175, 174, 173, 172, 171, 170, 31, 66, 183, 61, 34, 48, 113, 114, 115. The gradual widening out of the spaces between the isothermal lines in the more southern sections should be noted.

Section No. 4 runs obliquely from a point in deep water off the coast of New South Wales, in latitude 36° S. and longitude 157° E., to a point in deep water to the north-east of the Phœnix group of islands in latitude 1° S. and longitude 168° W. In preparing this section we have made use of serials Nos. 4, 178, 179, 175, 174, 173, 172, 171, 170, 210, 169, 168, 211, 203, 212, 213, 214, 200, 199, 198, 70, 14, 197, 13, 196, 192, 136, 137, 193, 194, 195, 138, 155, 139, 154, 140, 153, 141, 142, 143, 152, 144, 151, 145, 150. The widening out towards the south of the spaces between the isothermal lines should also be noted in this north and south section.

In these sections the vertical scale is exaggerated 500 times as compared with the horizontal scale; the slope of the bottom is therefore 500 times less steep than represented.

Different shades of red are used to indicate temperatures over 50° F. (the deeper the shade of red the higher the temperature), while different shades of blue are used to indicate temperatures under 50° F. (the deeper the shade of blue the lower the temperature). It is unnecessary to enter into a minute description of these sections; a glance will show that the warm water, represented by the red colour, forms a relatively thin surface stratum, the higher isotherms being crowded closer together in tropical regions and becoming more widely separated on proceeding farther and farther south. The isotherm of

50° in no case exceeds a depth of 350 fathoms, and the isotherm of 40° is never found deeper than 750 fathoms, so that the great mass of water deeper than 750 fathoms has a temperature under 40°, and in the deep water to the east of Australia and to the east of the Kermadec and Friendly Islands, the temperature is under 35°. A comparison of these sections with Dr. Buchan's maps of mean temperature at various depths published in the "Challenger Report on Ocean Circulation," shows a close agreement, though the temperature indicated in the sections is usually slightly higher than that shown on the maps of mean temperature.

The 234 serial temperatures given in the Table show as a general rule a gradual fall in the temperature with increase of depth from the surface down to the bottom. The Table contains, however, a few exceptions to this general rule, which may be here enumerated. Commencing with those exceptions which occur between the surface and 100 fathoms, we may note that the "Dart" (serial No. 82) records a rise of 4° (from 70° to 74°) between the surface and 100 fathoms, but this may perhaps be ascribed to a misprint. Proceeding to the less conspicuous examples, we find that in serial No. 2 the readings at 10, 20, 30 and 40 fathoms were higher than at the surface, the maximum difference being 1° at 10 fathoms. In serial No. 4 the readings at the surface, 20 fathoms and 30 fathoms were identical, while the reading at 10 fathoms was 0.3° higher. In serial No. 11 the reading at 20 fathoms was 0.3° higher than at the surface. In serial No. 30 the reading at 100 fathoms was 0.6° higher than at 50 fathoms. In serial No. 75 the reading at 40 fathoms was 2.1°, and at 60 fathoms 0.5°, higher than at 20 fathoms. In serial No. 79 the surface temperature was 71°, falling at 10 fathoms to 70.5°, rising at 20 fathoms to 71.2°, falling at 30 fathoms to 70.7°, and rising again at 40 fathoms to 71.5°, *i.e.*, 0.5° higher than at the surface. In serial No. 80 the surface temperature was recorded as 73.5°, falling at 10 fathoms to 72.9°, rising at 20 fathoms to 73.3,° falling to 72.8° at 30 fathoms and 71.0° at 40 fathoms, then rising to the extent of 2.5° at 50 fathoms, the temperature at 50 fathoms being given as identical with that at the surface. In serial No. 81 the surface temperature was 72.6°, rising at 10 fathoms to 73.1°, and at 20 fathoms to 75.0°, falling at 30 fathoms to 74.8° and at 40 fathoms to 72.8°. Thus the water from 10 to 40 fathoms was warmer than at the surface, the maximum difference of 2.4° being recorded at 20 fathoms. In serial No. 149 the surface temperature was 80.8°, falling at 10 fathoms to 79.5°, rising at 20 fathoms to 80.1°, falling at 30 fathoms to 79.8° and at 40 fathoms to 77.2°, rising at 50 fathoms to 78.0° and at 75 fathoms to 78.2.° In serial No. 150 the readings at 10 fathoms

and at 40 fathoms were 0.1° higher than at the surface, while at 20, 30, and 50 fathoms the readings were 0.2° lower. In serial No. 151 the readings at the surface, 10, and 40 fathoms were identical, while the reading at 20 fathoms was 0.7°, and at 30 fathoms 0.2°, lower. In serial No. 152 the reading at 20 fathoms was 1.3° higher than at 10 fathoms, and the reading at 40 fathoms 0.6° higher than at 30 fathoms. In serial No. 153 the reading at 20 fathoms was 0.2° higher than at 10 fathoms, and the readings at 40 and 50 fathoms were 0.3° higher than at 30 fathoms. In serial No. 154 the temperature at 10 fathoms was 0.3°, and at 20 fathoms 0.6°, higher than at the surface, and the reading at 40 fathoms was 0.1° higher than at 30 fathoms ; the temperature recorded at 40 fathoms was identical with that at the surface. In serial No. 155 the reading at 10 fathoms was 1°, at 20 fathoms 1.4°, at 30 fathoms 0.2°, at 40 fathoms 0.7°, and at 50 fathoms 0.6°, higher than at the surface. In serial No. 156 the reading at 10 fathoms was 0.3°, and at 20 fathoms 0.2°, lower than at the surface, while at 30 fathoms the reading was 0.5°, and at 40 fathoms 0.3°, higher than at the surface. In serial No. 157 the reading at 10 fathoms was 0.5° below that at the surface, at 20 fathoms it was identical with that at the surface, the reading at 30 fathoms was 0.7°, and the reading at 40 fathoms was 0.2°, below that at the surface. In serial No. 158 the reading at 10 fathoms was 0.2° higher than at the surface, and the reading at 50 fathoms was 0.3° higher than at 40 fathoms. In serial No. 159 the reading at 10 fathoms was 0.3° higher than at the surface. In serial No. 160 the readings at 50 fathoms and at 75 fathoms were 0.1° higher than at 40 fathoms. In serial No. 161 the reading at 10 fathoms was 0.5°, at 20 fathoms 0.4°, and at 30 and 40 fathoms 0.2°, higher than at the surface. In serial No. 164 the reading at 20 fathoms was 0.4° higher than at 10 fathoms. In serial No. 165 the reading at 10 fathoms was 0.5° higher than at the surface. In serial No. 167 the readings at the surface, 20 fathoms, and 30 fathoms were identical, while the reading at 10 fathoms was 0.2° lower. In serial No. 176b. the reading at 10 fathoms was 0.5° higher than at 5 fathoms, and the reading at 30 fathoms was 0.5° higher than at 20 fathoms. In serial No. 176c. the reading at 10 fathoms was 0.5° higher than at 5 fathoms, and the reading at 30 fathoms was 0.3° higher than at 20 fathoms. Serial No. 176d. is peculiar, the temperature recorded at the surface being 69.6°, falling at 5 fathoms to 66.5° (possibly a misprint for 69.5°), rising at 10 fathoms to 68.0°, and at 20 fathoms to 69.6° (identical with the surface reading), falling at 30 fathoms to 68.7°, rising at 40 fathoms to 69.9° (or 0.3° higher than at the surface), and falling to 69.0° at 41 fathoms. In serial 176e. the readings at 5, 20, 40, and 50 fathoms

were higher than at the surface (the greatest difference being 0.7° at 40 fathoms), while at 10 fathoms and at 30 fathoms the readings were 0.5° lower than at the surface. In serial No. 176f. the readings at 30 and 40 fathoms were 0.3° higher than at 20 fathoms. In serial No. 176g. the highest reading (74.0°) was recorded at 30 fathoms, being 0.5° higher than at the surface, 1.2° higher than at 10 and at 40 fathoms, 1.0° higher than at 20 fathoms, 2.0° higher than at 50 fathoms, and 1.5° higher than at 75 fathoms. In serial No. 181 the readings at the surface, 10, 20, and 30 fathoms were identical. In serial No. 182 the readings at the surface, 10 and 20 fathoms were identical. In serials Nos. 183, 184, 186, 187, and 188 the readings at 10, 20, and 30 fathoms were identical. In serials Nos. 190 and 194, the readings at 20 and 30 fathoms were identical, and only 0.1° lower than at 10 fathoms. In serial No. 193 the readings at 30 and 50 fathoms were identical, and only 0.1° lower than at 20 fathoms. In serial No. 197 the readings at the surface, 10 fathoms, and 20 fathoms were identical. In serial No. 208 the readings at the surface and 20 fathoms were identical, while the reading at 10 fathoms was 0.5° higher. In serial No. 210 the readings at 30 fathoms and 50 fathoms were identical. In serial No. 211 the reading at 10 fathoms was 0.8°, and at 20 fathoms 0.5°, higher than at the surface. In serials Nos. 212 and 218 the readings at the surface, 10 fathoms and 20 fathoms were identical. In serial No. 213 the readings at 20 and 50 fathoms were identical. In serial 214 the readings at 10, 20 and 30 fathoms were identical. In serial No. 215 the readings at 10 and 20 fathoms were identical. In serials No. 217, 223, and 226 the readings at the surface and at 10 fathoms were identical. In serial No. 219 the readings at 10, 20, and 30 fathoms were identical. In serial No. 221 the readings at 20 and 30 fathoms were identical.

Proceeding now to the exceptions to the general rule of decrease of temperature with increase of depth occurring in depths greater than 100 fathoms, we find that these exceptions fall under two categories: (1) Observations showing a rise in the temperature and (2) those showing a uniform temperature at successive depths. There are 15 examples belonging to the first category. In serial No. 51 the temperature was recorded as 0.5° higher at 460 fathoms than at 360 fathoms. In serial No. 54 the temperature at the bottom in 849 fathoms was recorded as 0.1° higher than at 800 fathoms. In serial No. 55 the temperature at 900 fathoms was recorded as 0.2° higher than at 800 fathoms. In serial No. 58 the temperature at 725 fathoms was recorded as 0.8° higher than at 200 fathoms. In serial No. 59 the temperature at 936 fathoms was recorded

as 1.8° higher than at 430 fathoms. In serials Nos. 106 and 119 the temperature was recorded as 0.1° higher at 1,000 fathoms than at 900 fathoms. In serial No. 120 the temperature at the bottom in 1,445 fathoms was recorded as being 0.2° higher than at 1,000 fathoms. In serial No. 123 the temperature at the bottom in 1,328 fathoms was recorded as being 0.2° higher than at 1,128 fathoms. In serial No. 133 the temperature was recorded as being 0.5° higher at 1,200 fathoms than at 1,000 fathoms. In serial No. 135 the temperature was recorded as being 0.7° higher at 1,100 fathoms than at 1,000 fathoms. In serial No. 138 the temperature at 800 fathoms was recorded as being 0.3° higher than at 700 fathoms. In serial No. 142 the temperature at 800 fathoms was recorded as being 2.5° higher than at 600 fathoms, and 0.9° higher than at 500 fathoms. In serial No. 156 the temperature at the bottom in 1,969 fathoms was recorded as being 0.9° higher than at 900 fathoms. Belonging to the second category we have thirteen examples, of which seven indicate a uniform temperature from a certain distance above the bottom down to the bottom, viz.:—

In serial No.	154		from	1,000	fathoms	to the bottom in		2,310	fathoms.	
„ „	„	15	„	1,100	„	„	„	„	2,650	„
„ „	„	16& 17	„	1,200	„	„	„	„	2,325 and 2,450	fathoms.
„ „	„	18, 19 & 21	„	1,300	„	„	„	„	2,275, 1,700, and 2,000	respectively.

The remaining six examples show a uniform temperature at intermediate depths, viz.:—

In serial No.	39	identical readings were taken at					900 and 1,100	fathoms.	
„ „	„	47 & 120	„	„	„	„	„	700 „	800 „
„ „	„	129	„	„	„	„	„	500 „	600 „
„ „	„	157 & 163	„	„	„	„	„	900 „	1,000 „

Most of the exceptions noted in depths less than 100 fathoms show a rise in the temperature of less than a degree, but a rise is recorded of :—

1°	between	the surface	and	10	fathoms.	2.1°	between	20	and 40 fathoms.
1°	„	4	„	75	„	2.4°	„	the surface	„ 20 „
1.3°	„	10	„	20	„	2.5°	„	40	„ 50 „
1.4°	„	the surface	„	20	„				

The majority of the exceptions in depths over 100 fathoms show a rise in the temperature of only one or two tenths of a degree, and may therefore be purely instrumental errors or errors in reading small scale thermometers. There are only five observations indicating in intermediate waters a rise in the temperature of more than half a degree, viz. :—

0.7°	between	1,000	and	1,100	fathoms	1.8°	between	430	and 936 fathoms
0.8°	„	200	„	725	„	2.5°	„	600	„ 800 „
0.9°	„	900	„	1,939	„				

The seven serial observations indicating a uniform temperature from a certain distance above the bottom down to the bottom have

already been mentioned. Six of these were taken by the "Challenger" in 1874, four in the Coral Sea, one to the west of the New Hebrides, and one off the north coast of New Guinea. The seventh was taken by the "Penguin" in 1897 to the westward of Gente Hermosa; on the following day the "Penguin" found the same temperature at 1,000 fathoms, falling to the extent of only about half a degree at the bottom in 2,553 fathoms. The "Challenger" observations in the Coral Sea pointed to the possibility of this basin being cut off from the general oceanic circulation of the Pacific by a barrier covered by about 1,300 fathoms of water, but no confirmation is afforded by subsequent observations.

Notwithstanding the exceptions noted above, the great majority of the serial observations conform to the general rule of fall of temperature with increasing depth, and in order to show the gradual decrease of temperature with increase of depth in the intermediate waters of this region the following Table has been prepared showing (1) the number of observations, (2) the range of temperature, and (3) the mean temperature, at intervals of 100 fathoms, from the depth of 100 fathoms down to 1,500 fathoms. For the sake of comparison we have inserted the mean temperature for the whole ocean, where these have been calculated by Dr. Buchan in his "Challenger Report on Ocean Circulation." The means calculated for the ocean as a whole are, as might be expected, always lower than the means calculated for the region under consideration.

Depth in Fathoms.	Number of Ob'ations.	Range of Temperature.	Mean Temperature.	Mean Temperature of the whole Ocean (according to Dr. Buchan)
		° °	°	°
100	195	from 51.0 to 80.0 F.	65.3 F.	60.7 F.
200	190	„ 48.2 „ 67.0 „	55.9 „	50.1 „
300	180	„ 43.8 „ 58.2 „	49.6 „	44.7 „
400	108	„ 41.0 „ 50.0 „	45.1 „	41.8 „
500	167	„ 39.0 „ 47.6 „	42.4 „	40.1 „
600	91	„ 38.3 „ 42.6 „	40.3 „	39.0 „
700	85	„ 36.8 „ 41.2 „	38.8 „	38.1 „
800	114	„ 36.0 „ 39.6* „	38.0 „	37.3 „
900	74	„ 36.2 „ 39.2 „	37.3 „	36.8 „
1,000	60	„ 36.2 „ 38.7 „	36.9 „	36.5 „
1,100	18	„ 35.7 „ 37.1 „	36.7 „	..
1,200	14	„ 35.3 „ 37.0 „	36.4 „	..
1,300	10	„ 35.3 „ 36.2 „	35.8 „	..
1,400	5	„ 35.2 „ 36.0 „	35.6 „	..
1,500	10	„ 34.8 „ 36.0 „	35.5 „	35.3 „

*A quite exceptional reading of 42.2° at 800 fathoms is probably an error, the temperature at 600 fathoms in the same serial being 39.7°.

Another interesting subject of enquiry is the rate or amount of fall in the temperature with increase of depth. In the surface waters down to 200 fathoms the fall of temperature evidently varies to an

extraordinary extent, as shown by the observations given in the Table ; thus the amount of fall at the same position shown in the 195 cases where the temperature is recorded both at the surface and at 100 fathoms, varies from 0.2° to 22.5°, while the fall of temperature shown in the 188 cases where the temperature is recorded both at 100 and 200 fathoms varies from 0.2° to 25.1°. Between these extremes every gradation occurs, and it seems impossible to trace any relation between the latitude and the amount of fall in the temperature of the upper 200 fathoms. As a rule, however, a large fall is usually found in the tropics, and generally indicates movements of water in different directions, while the few cases in which a fall of less than 1° is recorded either between the surface and the depth of 100 fathoms, or between the depth of 100 fathoms and the depth of 200 fathoms, at the same time and in the same position, are all recorded south of the tropics. The mean difference between the temperature at the surface and at the depth of 100 fathoms in the same position is 7.34°, while the mean difference between the temperature at 100 and 200 fathoms in the same position is 10.1°. The observations therefore seem to show that the temperature between 100 and 200 fathoms may vary to a greater extent than between the surface and a depth of 100 fathoms. As we proceed into water deeper than 200 fathoms the temperature varies less and less, and the amount of fall as calculated at intervals of 100 fathoms gradually diminishes. This is well shown in the following table giving the minimum, maximum, and mean amount of fall in the temperature at intervals of 100 fathoms from the surface down to 1,000 fathoms, and the number of observations on which the figures are based.

Depth in Fathoms.	Number of Observations.	Minimum Fall of Temperature.	Maximum Fall of Temperature.	Mean Fall of Temperature.
		°	°	°
0 to 100	195	0.2	22.5	7.34
100 ,, 200	188	0.2	25.1	10.09
200 ,, 300	179	1.2	16.0	8.26
300 ,, 400	110	1.0	10.2	4.51
400 ,, 500	107	0.1	5.5	2.65
500 ,, 600	87	0.2	5.4	1.77
600 ,, 700	71	0.3	2.7	1.26
700 ,, 800	63	0.1	2.2	0.93
800 ,, 900	55	0.1	1.8	0.77
900 ,, 1,000	44	0.1	1.3	0.46

c. *Temperature of the Bottom Waters.*

In addition to the 207 observations of temperature at the bottom included in the Table of serial temperatures given in the preceding section, 812 isolated observations of the bottom temperature have

been recorded in this region of the Pacific, as shown in the following Table :—

Table of Isolated Observations of the Temperature at the Bottom.

Challenger— Date.	Latitude. ° ′	Longitude. ° ′	Depth. fms.	Temp. F °
12 June, 1874	34 3½ S.	151 51½ S.	650	40.8
12 „ „	34 8	152 0	950	36.5
17 „ „	34 50	155 28	2600	34.5
14 July „	29 45	178 11 W.	630	39.5
15 „ „	28 33	177 50	600	39.5
25 Aug. „	13 50	151 49 E.	2440	35.8
Egeria—				
No. 49, 1887	39 43 S.	140 51 E.	2335	34.1
„ 6, 1888	31 51	178 31	1801	35.2
„ 13, „	27 32	179 42	1686	35.3
„ 24, „	25 9	178 44 W.	871	37.2
„ 263 „	24 18	175 50	2030	34.5
„ 264 „	24 26	175 38	2449	34.5
„ 266 „	24 59	174 46	3110	33.7
„ 267 „	24 55	174 29	2990	33.7
„ 268 „	24 44	174 18	3006	33.5
„ 269 „	24 49	174 7	2889	33.6
„ 270 „	24 49	173 56	3036	33.7
„ 271 „	24 37	175 8	4428	33.7
„ 274 „	23 18	175 38	941	37.0
„ 275 „	23 12	175 40	596	40.2
„ 276 „	23 7	175 39	456	42.8
„ 299 „	21 9	175 31	863	36.8
„ 300 „	21 14	175 42	412	45.4
„ 301 „	21 19	175 53	1003	36.6
„ 302 „	21 24	176 3	1216	36.3
„ 393 „	21 29	176 13	1347	36.4
„ 304 „	21 46	176 19	1330	36.3
„ 305 „	21 48	176 30	1153	36.6
„ 306 „	21 44	176 32	1369	36.4
„ 307 „	21 44	176 37	1498	36.4
„ 308 „	21 44	176 41	1252	36.5
„ 309 „	21 44	176 45	1153	36.5
„ 310 „	21 44	176 49	1228	36.5
„ 311 „	22 8	176 39	1359	36.4
„ 312 „	22 8	176 33	1296	36.0
„ 316 „	21 40	176 44	1278	36.0
„ 345 „	20 40	176 10	1331	36.0
„ 351 „	19 24	179 52	1718	35.1
„ 355 „	20 56	177 55 E.	1780	35.2
„ 357 „	22 44	177 17	2314	35.0
„ 359 „	24 35	176 30	2481	35.5
„ 360 „	25 35	176 17	2476	35.4
„ 361 „	26 33	176 13	2484	35.5
„ 362 „	27 26	175 39	2594	35.5
„ 6, 1889	33 36	161 25½	946	51.0 (?)
„ 7 „	33 41	163 14½	496	49.0
„ 8 „	34 0½	166 21½	1656	35.6
„ 9 „	34 3	168 45½	1095	38.8
„ 10 „	34 6	169 46½	1186	38.5
„ 12 „	34 18	175 46	1098	36.3
„ 14 „	32 31	176 4½	2170	35.0*
„ 15 „	31 47	176 8½	2288	35.5
„ 16 „	30 12	176 34	2380	35.6
„ 17 „	29 52½	176 39	2390	35.5

Egeria— Date.	Latitude. ° ′	Longitude. ° ′	Depth. fms.	Temp F. °
No. 23 1889	28 29	177 46	2030	35.2
„ 24 „	26 15	179 15½	972	46.8(?)
„ 25 „	25 34	179 42	1272	35.9
„ 26 „	24 38	179 36 W.	1208	35.8
„ 30 „	22 39	178 6	1486	36.3
„ 32 „	20 25	173 53½	2089	35.0
„ 33 „	19 56	173 43	2225	34.5
„ 34 „	19 31	173 40	2235	34.6
„ 35 „	19 16	173 38	1795	35.0
„ 36 „	18 24	173 2	2525	34.5
„ 37 „	17 56¾	172 42½	3092	34.5
„ 39 „	5 21	171 38¼	3312	34.5
„ 40 „	5 58	171 23¾	3100	34.5
„ 41 „	6 45	171 17½	2956	34.5
„ 42 „	12 32	171 23½	2790	34.0
„ 43 „	11 52½	171 15½	2664	34.0
„ 44 „	10 52½	171 18½	2724	34.0
„ 45 „	10 24½	171 20½	2680	33.5
„ 46 „	8 30½	171 7½	2518	34.5
„ 47 „	7 52	171 1½	2766	34.0
„ 48 „	11 0½ S.	172 10¼ W.	2606	33.8
„ 49 „	11 35	172 49½	2573	34.0
„ 50 „	12 16	173 16½	2560	34.0
„ 53 „	13 38	175 23½	2394	32.5
„ 54 „	14 1	176 11½	1512	35.8
„ 57 „	15 20½	178 24½	1209	36.5
„ 58 „	15 39	179 3¾	1410	36.0
„ 59 „	16 40½	179 2½	805	38.0
„ 60 „	19 51	179 7½ E.	1700	35.6
„ 61 „	20 1	179 7½	1765	35.6
„ 62 „	20 9	179 17½	1876	35.8
„ 63 „	20 16	179 23	1839	35.6
„ 64 „	20 11¾	179 28	1828	34.9
„ 65 „	20 21½	179 55 W.	1565	35.9
„ 66 „	20 23	179 43	1456	36.1
„ 67 „	2 22¾	179 35½	1392	36.1
„ 68 „	20 20	179 26	1240	36.2
„ 69 „	20 19½	179 15½	1075	36.9
25 June, 1890	29 37	178 52½	1966	35.5
26 „ „	29 3½	179 32½	931	37.0
26 „ „	28 42½	179 4	1430	36.5
27 „ „	27 30¾	178 16¾	1649	36.2
28 „ „	26 37	177 57	1106	36.7
28 „ „	26 10½	177 48½	1220	36.7
29 „ „	24 43½	177 11½	658	38.5
29 „ „	24 20½	176 50½	889	36.7
30 „ „	24 0½	176 32¾	753	37.8
30 „ „	23 45½	176 24¾	282	54.5
30 „ „	23 40½	176 23	193	60.5
4 July „	22 58¾	176 4½	214	61.2
4 „ „	22 59½	175 49¾	160	67.0
28 Aug., „	19 58	178 16½	226	59.3
31 „ „	19 13	175 31 E.	1780	36.5
2 Sept. „	18 19	171 44¾	1700	36.4
3 „ „	18 5	169 54½	1190	36.7

*Another thermometer, which came up reversed, recorded temperature at bottom 32.5°.

Egeria— Date.	Latitude. ° ′	Longitude. ° ′	Depth. fms.	Temp. F. °
3 Sept., 1890	18 1	168 58¾	695	38.9
5 „ „	17 56¼	165 47¼	2525	36.4
12 „ „	15 26	150 49½	800	38.4
13 „ „	14 56½	149 47¼	999	37.4
13 „ „	14 33½	148 58¼	1204	36.9
14 „ „	14 6	147 59	1315	37.1
15 „ „	13 7	146 13¾	1680	36.1
7 Decr., 1891	27 1.2	160 38.3	1003	37.0
3 „ 1892	27 16	162 56	660	41.0
4 „ „	28 29.5	162 0	864	37.5
5 „ „	29 38	161 8	837	38.0
6 „ „	30 35.2	159 46	845	37.8
7 „ „	32 29.3	158 41	2317	34.2
Dart—				
2 Decr., 1893	27 27.5	161 6.2	970	38.0
21 Aug., 1894	25 33.5	163 17	715	38.5
5 Decr., „	26 39.6	159 33	168	60.0
Penguin—				
15 July, 1893	11 12.8	145 53.5	865	37.3
16 „ „	11 7.6	146 39	985	36.7
16 „ „	10 59.1	147 23	1437	35.0
17 „ „	10 46.8	148 18.1	1310	35.5
17 „ „	10 48.4	149 8.4	1140	35.0
18 „ „	10 52.7	149 56.2	865	37.2
23 „ „	10 31	153 30.8	1685	34.5
23 „ „	10 14.8	154 14.8	2047	34.8
8 Aug., 1894	22 49.9	155 17.6	1760	34.9
9 „ „	20 10	156 3.9	1740	34.5
10 „ „	18 42.6	157 4.4	1785	35.4
11 „ „	18 25.6	157 0.9	1763	36.2
11 „ „	18 35.4	156 49.7	1760	35.5
11 „ „	18 35.4	156 59.4	1798	35.0
11 „ „	18 41.5	157 3.4	1772	35.4
12 „ „	18 50.9	156 58.3	870	37.0
12 „ „	18 56.2	156 57.8	836	37.5
12 „ „	19 3.3	156 56.5	974	37.1
12 „ „	19 10.2	156 54.9	1192	35.9
12 „ „	19 11.5	156 49.1	1343	35.7
12 „ „	19 6.1	156 49.9	1227	36.3
12 „ „	18 59.5	156 43.3	1186	35.9
12 „ „	18 52.1	156 41.7	1000	36.5
13 „ „	18 52	156 33.5	1163	35.9
13 „ „	18 46.7	156 39.1	1020	36.7
13 „ „	18 46.7	156 48.7	1184	36.3
13 „ „	18 44.1	157 3	1760	35.0
13 „ „	18 44.8	156 59.6	1549	35.3
13 „ „	18 42.3	156 52.2	1571	35.3
14 „ „	18 33.3	156 39.5	1642	35.5
14 „ „	18 42.3	156 42.5	1402	35.5
14 „ „	18 49.2	156 42.5	974	36.9
14 „ „	18 53.2	156 50.7	910	37.3
14 „ „	18 59.8	157 1.9	854	37.6
14 „ „	18 49.5	157 12.6	1645	34.9
15 „ „	18 41.8	157 7.8	1713	35.3
15 „ „	18 41.3	157 19.5	1650	35.5
15 „ „	18 53.5	157 6.9	1570	34.8
15 „ „	19 2.7	157 4.6	1000	36.7
15 „ „	19 4.2	157 12	1412	35.7
15 „ „	19 9.2	157 31.1	1527	35.4
16 „ „	1 50.8	156 54.6	1552	34.5
16 „ „	20 45.6	156 40.8	1407	35.7
17 „ „	21 49	156 5.7	950	37.5

Penguin— Date.	Latitude. ° ′	Longtiude. ° ′	Depth. fms.	Temp. F. °
17 „ „	22 32.1	156 38.7	1085	36.6
17 „ „	23 2.3	156 36.2	1085	36.6
18 „ „	23 25.5	156 23.3	1020	36.7
6 Sept., „	21 53.2	155 1.7	1800	34.6
6 „ „	21 36.7	155 32	1745	34.6
8 „ „	18 45.6	157 35	1515	35.3
8 „ „	17 59.1	157 30.4	1845	35.5
8 „ „	17 36.3	157 9.9	1525	35.8
9 „ „	17 1.6	158 10.2	1612	35.8
10 „ „	14 46.3	159 27	1095	36.6
11 „ „	13 7.6	160 39.3	1454	36.6
12 „ „	11 29.5	161 46.5	2750	36.1
13 „ „	11 10.6	162 16.1	2240	36.2
13 „ „	10 57.6	162 21.9	508	41.2
13 „ „	10 50.8	162 25	230	58.2
6 Jan., 1895	11 14.5	154 56	990	37.0
17 Feb. „	11 12.6	160 4.5	1507	36.0
17 „ „	11 33.3	159 51.3	805	38.2
18 „ „	12 59.1	159 4.5	1552	35.8
20 „ „	16 13.7	157 25.6	1220	36.0
21 „ „	18 11.5	155 34.7	1060	36.6
22 „ „	19 52.5	154 26.7	1584	35.6
4 June „	41 30.5	148 51.5	865	37.5
4 „ „	40 58.4	148 58	1590	35.8
25 „ „	36 21.9	156 8.2	2660	34.5
26 „ „	37 28.4	158 6.9	2700	34.5
28 „ „	38 14.7	161 30.7	2688	34.8
29 „ „	38 8.3	163 56.7	1418	38.8
29 „ „	37 26.8	165 26.1	910	39.1
30 „ „	37 21.5	166 57.1	547	45.3
16 July, „	35 2.2	178 51.3	991	37.0
16 „ „	35 2.2	178 51.3	1035	37.0
17 „ „	33 34.5	179 56.3 W.	1052	37.0
18 „ „	32 7.2	179 6.2	304	49.0
18 „ „	31 58.2	178 58.5	561	41.4
19 „ „	31 45.5	178 47.6	1005	37.0
19 „ „	31 33.5	178 35.3	1337	36.1
19 „ „	30 48.2	178 15.2	1157	36.5
19 „ „	30 13.6	177 59.5	1200	36.3
20 „ „	29 35.3	177 41.1	1547	35.6
20 „ „	28 24.6	177 4.1	1728	35.2
21 „ „	27 31.6	176 39.6	1673	35.5
21 „ „	26 40.2	176 16	1878	35.6 (?)
22 „ „	25 52.3	176 4.7	1975	35.0
24 „ „	22 21.2	174 36	2547	34.2
24 „ „	21 55.3	174 33.3	2120	34.5
25 „ „	21 20.4	174 39.9	971	37.1
25 „ „	21 15.8	174 43.8	833	37.6
25 „ „	21 13.1	174 48	737	38.3
31 „ „	20 12.7	175 36.5	1197	37.0
1 Aug., „	18 52.7	176 40.1	928	40.6
1 „ „	18 22.9	177 8.1	1211	36.6
2 „ „	17 55.6	177 31.7	1320	37.0
2 „ „	17 1.2	178 18.2	1187	36.3
2 „ „	16 38.2	178 40.6	398	44.6
2 „ „	16 38	178 47.4	538	39.8
2 „ „	16 38	178 56.5	721	37.8
2 „ „	16 39	179 5.8	788	38.5
2 „ „	16 45.5	179 14.2	771	38.4
2 „ „	17 2.7	179 31.4	835	36.8
3 „ „	17 35.5	179 34.2 E.	1432	36.7
3 „ „	17 42.9	179 21.2	957	37.0

PENGUIN— Date.	Latitude.	Longitude.	Depth.	Temp. F.
	° ′	° ′	fms.	°
8 Aug. 1895	17 51.8	179 12.7	650	39.4
3 „ „	17 59.4	179 4.1	753	38.2
3 „ „	18 12.2	178 50.4	755	38.2
4 „ „	18 15.8	178 40.1	743	38.2
4 „ „	18 19	178 31.2	785	38.0
8 „ „	18 18.8	178 45.6	955	38.2
8 „ „	18 18.7	178 58.1	1147	36.8
8 „ „	18 18.8	179 6	1210	36.8
9 „ „	18 2.1	179 40.6	1337	36.9
9 „ „	17 52	179 45	1437	36.8
9 „ „	17 42.1	179 57	1415	37.1
9 „ „	17 31.6	179 54.7 W.	1374	37.2
9 „ „	17 21.2	179 46.3	863	38.2
9 „ „	17 9.6	179 50.6	1047	37.9
9 „ „	17 3.5	179 43.2	888	38.8
9 „ „	16 54.5	179 32	779	37.2
10 „ „	16 48	179 20.9	694	37.0
10 „ „	16 12.3	177 35.1	1352	36.5
11 „ „	15 59.6	177 44.6	1301	36.7
11 „ „	15 55.3	177 35.7	1432	37.0
11 „ „	15 46.7	177 19.4	1330	36.4
11 „ „	15 54	177 17.2	1298	36.5
11 „ „	15 57.7	177 8.7	770	37.4
11 „ „	16 7.6	177 13.5	868	37.0
11 „ „	16 17.5	177 14.9	1276	36.3
16 „ „	15 31.2	175 52.3	1158	36.6
17 „ „	15 27.7	175 47.8	669	37.0
17 „ „	15 29.6	175 31	1138	36.6
20 „ „	14 12.2	172 11.1	2128	34.4
20 „ „	14 4.1	171 49.5	1027	36.7
20 „ „	14 49.4	171 51.9	2532	34.1
20 „ „	15 7.9	172 18.7	3112	34.8
21 „ „	15 32.5	172 3.5	3532	34.3
21 „ „	15 52.9	172 36.8	2427	34.2
22 „ „	16 28.8	173 1.4	1611	35.5
22 „ „	17 2.9	173 35.4	600	39.0
23 „ „	17 26.2	173 24.7	816	37.2
23 „ „	17 47.4	173 32.9	740	37.4
23 „ „	18 22.7	173 50.3	1141	36.3
23 „ „	18 27.6	173 59.3	1134	36.4
26 „ „	19 43.5	175 9.1	800	37.8
26 „ „	19 51.5	175 12.6	830	37.9
26 „ „	20 0	175 15.4	1027	37.5
26 „ „	20 9.3	175 20.7	1123	36.8
27 Decr. „	24 5.8	174 17.4	3185	35.0
28 „ „	26 43.2	175 13.7	3350	37.0
1 Jan., 1896	31 15.3	177 18.4	3715	35.0
16 July „	8 35.4	179 17.5 E.	2298	37.0
16 „ „	8 34.3	179 16.2	1768	39.6
16 „ „	8 33.3	179 14.9	1348	39.0
27 Nov. „	27 24	177 5	2295	37.0
28 „ „	28 55	176 15.5	2360	37.8
16 Decr. „	41 4	156 15 7	2470	34.8
13 April, 1897	30 56.3	160 20.7	740	38.3
14 „ „	29 31.4	163 51.3	1030	40.3
18 „ „	24 3.5	171 24.6	2380	34.5
19 „ „	22 50.4	172 38	1847	35.0
19 „ „	22 23.7	173 6.1	799	37.5
20 „ „	21 14	174 37.6	1844	35.3
29 „ „	16 57.7	179 27 W.	820	37.5
29 „ „	16 49.7	179 18.7	753	38.2
30 „ „	16 18.5	179 3	432	42.0

PENGUIN— Date.	Latitude	Longitude.	Depth.	Temp. F.
	° ′	° ′	fms.	°
30 April. 1897	16 28.2	179 9.5	427	42.4
30 „ „	16 33.2	179 12.5	632	39.0
30 „ „	16 40.5	179 19.5	588	39.5
1 May „	15 58.5	178 44.2	1494	35.3
1 „ „	15 48	178 37.7	1165	36.5
1 „ „	15 37.5	178 31.2	994	36.7
2 „ „	14 28.7	177 46.5	1411	35.3
2 „ „	14 18.2	177 40.5	1077	36.7
2 „ „	14 9.7	177 35.5	798	37.7
2 „ „	14 5	177 33.5	1022	37.0
3 „ „	13 6.2	176 49.2	2140	35.3
3 „ „	12 49.7	176 41.7	1123	36.0
3 „ „	12 45	176 36.7	1382	35.5
3 „ „	11 9.7	175 36.5	1992	34.4
5 „ „	9 55	174 46.5	2293	34.3
5 „ „	9 41	174 37.5	2290	34.3
12 „ „	3 49.1	170 35.2	1630	35.0
12 „ „	3 53.5	170 37.7	2391	35.0
13 „ „	2 53	169 49.8	2783	34.8
13 „ „	1 48	168 38.7	2933	34.8
7 Sept. „	0 3.5	163 2.7	2879	35.0
7 „ „	0 22.7	163 20.2	2945	35.0
8 „ „	1 36	164 16.3	2941	35.0
9 „ „	1 56.5	164 42.3	2905	34.8
9 „ „	3 10	165 47.3	2212	35.7
9 „ „	3 27	166 3.4	2498	35.0
10 „ „	4 29.2	167 1.2	3101	35.0
12 „ „	7 6.4	169 31	3131	35.5
12 „ „	7 26	169 51	2852	35.3
13 „ „	8 37.5	170 58.8	2420	36.3
14 „ „	9 16.3	171 35.7	2051	37.0
14 „ „	9 22	171 48.7	1790	37.0
14 „ „	9 32	171 58.9	2023	37.3
14 „ „	9 47.4	172 11.2	2186	37.2
15 „ „	10 34	172 53	1810	37.5
15 „ „	10 41.9	173 3.1	2365	37.0
15 „ „	10 57.3	173 24.3	2583	36.1
16 „ „	11 19	173 40.3	2560	35.5
19 „ „	12 51.8	175 23.8	1501	37.0
19 „ „	12 59.2	175 30.8	2010	37.0
20 „ „	13 10.3	175 41.3	2225	36.6
20 „ „	13 21.4	175 51.7	1898	37.0
20 „ „	13 42.4	176 10.4	1939	36.9
20 „ „	13 52.2	176 19.2	1264	37.9
20 „ „	14 0	176 26.3	785	39.5
20 „ „	14 2.2	176 28.3	1100	38.3
20 „ „	14 8.3	176 34	1035	39.0
20 „ „	14 13.7	176 39.2	1116	39.1
21 „ „	14 20.1	176 45	1126	39.1
21 „ „	14 24	176 59.9	1174	39.0
21 „ „	14 30	177 2.5	1068	38.0
21 „ „	14 35.7	177 6.9	894	39.2
21 Nov.. „	21 47 3	179 25.6 E.	2043	37.8
21 „ „	22 26.3	179 22.0	1988	37.8
22 „ „	22 49.0	179 20.0	1948	37.9
22 „ „	24 29.4	179 2.1	2018	35.5
23 „ „	25 6.2	178 55.4	1983	35.5
23 „ „	25 42.7	178 47.6	2183	35.6
23 „ „	26 9.8	178 41.9	2290	35.6
24 „ „	26 57.8	178 35.9	2318	35.6
24 „ „	27 45.5	178 29.5	1803	35.6
24 „ „	28 35.0	178 22.5	2080	35.6

PENGUIN—

Date.	Latitude.	Longitude.	Depth.	Temp. F.
	° ′	° ′	fms.	°
25 Nov. 1897	29 59.5	177 37.0	2143	35.8
26 „ „	31 39.2	176 49.6	2210	35.8
26 „ „	32 23.5	176 29.2	2116	35.8
26 „ „	33 0.7	176 16.0	2086	35.7
27 „ „	33 56.3	175 54.4	1463	35.4
4 Dec. „	35 10.2	171 4 .5	1072	37.0
4 „ „	35 17.3	170 49.0	1127	37.0
4 „ „	35 23.6	170 34.5	994	37.8
5 „ „	36 9.1	169 20 1	1298	36.8
7 „ „	38 24.0	163 15.0	2182	35.1
16 April, 1898	33 50.8	158 47.7	2338	35.0
17 „ „	33 57.4	161 37.8	933	38.0
29 „ „	36 3.4	178 55.4	1389	36.2
2 May „	32 16.6	175 54.7 W.	3220	36.9
3 „ „	31 28.0	175 5.7	3100	35.3
5 „ „	29 17.8	175 11.7	3105	35.1
6 „ „	27 28.5	174 31.9	2630	34.4
6 „ „	26 38.5	174 178	2420	34.1
7 „ „	25 53.4	174 6.2	2775	34.2
8 „ „	23 24.0	173 40.3	3205	34.5
8 „ „	22 14.0	173 29.3	3420	34.3
8 „ „	21 36.0	173 43.4	4762	34.5
8 „ „	21 8.3	174 7.6	2115	34.9
11 Decr. „	22 40.1	179 57.6 E.	1238	35.8
13 „ „	23 52.0	175 8.8	2430	36.0
13 „ „	24 25.0	174 39.8	2483	35.9
14 „ „	25 30.6	173 32.3	2380	35.9
14 „ „	26 1.8	172 56.5	2428	35.9
15 „ „	27 19.5	171 58.2	2328	35.8
15 „ „	27 55.5	171 22.5	1632	35.9
16 „ „	29 27.5	169 12.7	1200	36.6
16 „ „	29 35.3	168 51.6	1269	34.2
17 „ „	30 29.3	166 16.6	1819	36.0
18 „ „	30 45.5	165 34.7	1768	36.0
18 „ „	30 57.0	164 52.7	1557	36.2
18 „ „	31 2.6	164 33.7	1196	36.8
18 „ „	31 10.3	164 12.7	1173	36.8
20 „ „	33 6.7	158 32.6	1430	35.8
21 „ „	33 7.0	157 9.6	2210	34.6
21 „ „	33 17.0	156 46.4	2677	34.8
21 „ „	33 23.0	156 9.6	815	38.1
7 April, 1902	32 28.0	168 46.5	1043	37.0
8 „ „	31 58.5	168 24.5	1187	36.4
8 „ „	32 8.5	168 3.5	363	50.4
8 „ „	32 13.0	167 47.5	906	39.2
8 „ „	32 25.0	167 25.2	297	50.0
8 „ „	32 29.7	166 11.5	947	37.5
9 „ „	32 30.0	165 56.0	1381	36.2
9 „ „	32 31.5	165 31.5	1800	34.6
9 „ „	32 52.7	164 37.0	1725	36.2
10 „ „	33 8.0	163 59.5	1092	37.4
10 „ „	33 14.5	163 36.5	566	41.0
10 „ „	33 14.5	163 36.5	566	41.0
10 „ „	32 52.0	162 52.0	473	44.8
10 „ „	32 34.5	162 26.5	508	42.8
11 „ „	32 18.5	162 1.0	573	42.6
11 „ „	31 11.0	160 30.0	768	40.0
11 „ „	31 2.0	160 14.0	842	38.6
12 „ „	30 45.2	159 43.2	992	36.3
12 „ „	30 44 5	159 29.1	1215	36.2
13 „ „	31 13.0	155 19.5	2468	34.2

WATERWITCH—

Date.	Latitude	Longitude.	Depth.	Temp
	° ′	° ′	fms.	°
10 May, 1895	35 11.5	165 47.2	830	39.3
12 „ „	34 11	173 39.2	1095	36.3
12 „ „	33 41.5	173 48.2	1020	37.1
13 „ „	33 10.3	173 58.7	1724	36.9
13 „ „	32 51	173 49.8	1320	35.8
13 „ „	32 36.2	173 41.5	1310	36.3
13 „ „	32 20	174 14	1980	35.7
14 „ „	31 35.3	174 25	2110	35.8
14 „ „	31 30.5	174 13	2020	35.7
14 „ „	31 29	173 45	1745	35.6
16 „ „	28 30.8	175 9.3	2410	35.4
16 „ „	28 19.3	174 52.3	2280	35.6
16 „ „	28 19.5	175 13.2	1260	36.2
16 „ „	28 5	175 17	2270	36.3
18 „ „	25 0.3	175 55	2505	35.6
18 „ „	23 9.2	176 27.3	2390	35.4
19 „ „	22 11.7	176 52.7	2270	35.4
19 „ „	20 31.3	177 19.4	1200	36.2
19 „ „	20 31.3	177 19.4	1175	36.2
20 „ „	19 45.5	177 35.7	1220	36.1
20 „ „	19 8.2	177 56	280	55.1
20 „ „	18 48.6	178 0.5	1180	35.9
21 „ „	18 27.2	178 27	1130	36.1
17 Sept. „	18 44.9	179 54.8	511	41.0
17 „ „	18 49.5	179 52.7	1625	35.3
17 „ „	18 59.7	179 50.3	1710	35.3
17 „ „	19 3.7	179 50.5	1435	35.3
17 „ „	19 3	179 55.5	1600	35.3
19 „ „	14 57	179 1.5 W.	1175	36.2
19 „ „	14 20.2	178 37.7	1250	36.3
20 „ „	13 3.7	177 41	1648	35.2
21 „ „	11 9.6	176 13.3	1873	35.1
22 „ „	12 17	176 20	1420	35.4
22 „ „	12 30	176 31	1635	35.6
22 „ „	12 43.5	176 52.5	1378	35.6
25 „ „	11 14.7	176 46.3	1535	35.2
25 „ „	11 29	176 55	1965	34.9
30 „ „	14 52.5	179 32.5	1395	35.6
30 „ „	15 10	179 42.8	1305	36.1
30 „ „	15 24.3	179 46.5	1472	35.5
30 „ „	15 35	179 47.8	1675	35.5
30 „ „	15 47.5	179 41.5	293	51.0
4 Dec. „	20 50.3	175 42.5 E.	1766	36.4
5 „ „	21 32.5	174 55.7	1400	36.5
5 „ „	22 41.2	173 44	1560	36.8
7 „ „	25 3.2	171 37.8	2312	35.4
7 „ „	23 27	170 17.2	2033	35.3
8 „ „	27 13	169 42.7	2132	35.3
9 „ „	29 0.2	166 50	1950	35.5
10 „ „	29 4	165 37.5	1795	35.5
11 „ „	29 3	163 11.7	820	38.5
11 „ „	29 3.5	162 24.2	710	40.1
11 „ „	28 58.2	160 48	875	38.3
12 „ „	28 52	159 57	1575	35.0
13 „ „	28 53.2	158 6	1612	35.3
13 „ „	28 43	155 55.5	2379	33.8
14 „ „	28 35.2	154 49.5	2565	34.0
17 May, 1896	33 44	152 49	2660	33.8
18 „ „	33 3.5	155 11	2903	33.9
18 „ „	32 50	157 5	2020	34.4
19 „ „	32 25.7	158 22.5	2300	34.3

Waterwitch— Date.	Latitude.	Longitude.	Depth.	Temp. F.
	° ′	° ′	fms,	°
19 May, 1896	32 20.5	158 56.7	2325	34.3
20 „ „	31 41·5	161 11	748	38.6
20 „ „	31 18.4	162 38.2	630	40.8
21 „ „	30 56	163 20.2	805	40.8
21 „ „	30 38.2	164 3.7	1125	36.8
22 „ „	29 50.2	165 52	1410	35.8
22 „ „	29 13.7	167 34	1265	36.1
23 „ „	28 34.7	167 50.7	455	47.0
23 „ „	27 7.2	168 36.7	1750	34.5
25 „ „	26 21.2	168 54.2	1665	35.8
26 „ „	25 29.7	169 13.8	1380	35.9
27 „ „	23 18.5	170 38.7	2310	35.4
3 June „	23 18.2	170 6.7	1865	34.9
3 „ „	23 14.1	170 6.2	1200	35.7
3 „ „	23 12.9	170 6.2	1200	35.5
3 „ „	23 14.2	170 5	1360	35.5
3 „ „	23 16	169 46.5	1808	35.1
3 „ „	23 8.2	169 46.6	1808	35.1
3 „ „	23 10.7	169 39.2	1370	35.3
12 „ „	23 15.8	169 26 9	900	36.8
12 „ „	23 11.7	169 28.2	550	40.5
15 „ „	22 12.4	171 7.9	1416	35.3
15 „ „	22 17	171 7.9	1008	36.5
15 „ „	22 12	171 14.6	1252	35.3
15 „ „	22 14.5	171 18.8	946	36.5
16 „ „	22 3.2	171 17	1470	35.3
16 „ „	21 56.5	171 15	1602	35.3
16 „ „	21 49.7	171 12.2	1470	35.5
16 „ „	21 42.5	171 9.5	1510	35.3
16 „ „	21 36	171 5.7	1280	35.7
16 „ „	21 29.2	171 2.1	1370	35.5
16 „ „	21 22.5	170 58.2	1245	35.7
16 „ „	21 19.5	171 1.2	1462	35.3
16 „ „	21 24.2	171 9.6	1342	35.6
17 „ „	21 25.9	170 55.7	1245	35.6
17 „ „	21 25.9	170 52.4	1210	35.6
17 „ „	21 26.1	170 47.8	1420	35.7
17 „ „	21 26.3	170 43.2	1280	35.5
17 „ „	21 26.6	170 38.7	1150	35.9
17 „ „	21 21.6	170 38.7	1249	35.9
17 „ „	21 20.2	170 43.8	1170	36.0
17 „ „	21 19	170 49.4	1315	35.9
17 „ „	21 17.6	170 54.9	842	37.0
17 „ „	21 19.1	170 56.4	940	36.5
18 „ „	21 22	170 53.1	719	38.6
18 „ „	21 16.2	170 52.5	1535	35.4
18 „ „	21 19.2	170 51.6	1340	35.8
18 „ „	21 22.1	170 50.8	1280	35.7
18 „ „	21 23.1	170 53.3	1295	35.7
18 „ „	21 22.2	170 56	1112	35.8
18 „ „	21 20.1	170 56.7	1090	35.9
18 „ „	21 20.8	170 54.8	601	40.2
18 „ „	21 21.3	170 54.5	717	38.2
18 „ „	21 19.9	170 55.2	676	38.6
18 „ „	21 20.8	170 55.3	745	38.4
18 „ „	21 28	170 50.1	1450	35.6
18 „ „	21 31.7	170 47.4	1372	35.6
19 „ „	21 32.3	170 54	1090	35.9
19 „ „	21 35.3	170 55.9	1195	35.8
19 „ „	21 41.9	170 59.2	1415	35.4
19 „ „	21 48.5	171 2.4	1410	35.6
19 „ „	21 54.5	171 5.9	1551	35.5

Waterwitch— Date.	Latitude.	Longitude.	Depth.	Temp. F.
	° ′	° ′	fms.	°
19 June, 1896	22 0.7	171 8.7	1437	35.6
19 „ „	22 6.5	171 11.9	1420	35.6
20 „ „	22 17.7	171 21.9	616	39.8
20 „ „	22 19.2	171 21.9	456	40.2
21 „ „	22 3.7	172 35.7	1815	35.5
21 „ „	21 52.7	173 40.5	1410	36.0
22 „ „	21 31.2	174 13.4	1770	35.9
4 Novr., „	15 53.9	176 45.3	910	37.8
4 „ „	15 53	176 44.8	610	39.8
4 „ „	15 52.2	176 45.5	722	38.8
4 „ „	15 53	176 43.7	750	38.6
4 „ „	15 46.1	176 35.8	1680	36.2
4 „ „	15 46.4	176 32	1580	36.2
4 „ „	15 46.6	176 27.8	1532	36.8
4 „ „	15 44.9	176 27.2	1655	35.3
4 „ „	15 43.2	176 27.3	1749	36.0
4 „ „	15 43.4	176 31.6	1623	36.0
4 „ „	15 43.7	176 35.1	1620	35.4
4 „ „	15 43.9	176 40.3	1683	36.3
4 „ „	15 40.7	176 36.0	1325	36.4
5 „ „	15 40.7	176 32	1624	36.0
5 „ „	15 41.8	176 28.4	1758	36.0
5 „ „	15 39.9	176 28.5	1734	35.3
5 „ „	15 39.9	176 24.4	1715	35.1
5 „ „	15 39.9	176 20.4	1739	36.0
5 „ „	15 39.9	176 16.5	1738	35.9
5 „ „	15 44.1	176 16.8	1809	36.0
5 „ „	15 44.3	176 21.2	1740	36.0
6 „ „	15 44.2	176 12.8	1815	35.9
6 „ „	15 44.5	176 7.9	1590	35.9
6 „ „	15 44.7	176 3.1	1500	36.0
6 „ „	15 44.6	175 58.1	1524	36.0
6 „ „	15 44.6	175 53.3	1080	36.8
6 „ „	15 42.2	175 53.6	633	39.1
6 „ „	15 42.2	175 52.7	417	43.6
8 „ „	15 43.8	175 42	958	37.7
8 „ „	15 42.5	175 37.4	1785	36.2
8 „ „	15 42.7	175 31.6	1780	36.0
8 „ „	15 42.8	175 25.9	1720	35.8
8 „ „	15 42.7	175 20.3	1575	36.0
8 „ „	15 42.9	175 14.7	1732	35.1
8 „ „	15 38.2	175 14.2	1570	36.1
8 „ „	15 38.3	175 19.4	1695	36.2
9 „ „	15 42.7	175 21.2	1555	36.1
9 „ „	15 41.8	175 17.7	1638	36.0
9 „ „	15 30	175 18.2	1673	36.0
9 „ „	15 30.2	175 13.1	1540	36.1
9 „ „	15 30	175 8.1	1657	36.0
9 „ „	15 25.7	175 8.5	1555	36.1
10 „ „	15 27.3	175 27.2	1650	36.0
10 „ „	15 33.3	175 27.7	1710	35.9
10 „ „	15 33.8	175 17.6	1757	35.7
10 „ „	15 33.9	175 10.5	1687	35.6
10 „ „	15 33.9	175 3.9	1600	36.0
10 „ „	15 33	174 56.7	1475	35.6
10 „ „	15 33	174 49.5	1655	35.8
10 „ „	15 26.9	174 50.4	1580	35.3
10 „ „	15 26.2	174 59.5	1705	35.5
10 „ „	15 31	174 58.3	1522	35.8
11 „ „	15 34.6	174 56.2	1672	35.6
11 „ „	15 39	174 50.9	1724	35.8
11 „ „	15 38.7	174 59.7	1710	35.7

WATERWITCH—

Date.	Latitude ° ′	Longitude ° ′	Depth. fms.	Temp. F. °
11 Nov. 1896	15 39.6	175 7.8	1485	35.8
11 „ „	15 42.3	175 6	1662	35.6
11 „ „	15 47.6	175 10.2	1773	35.8
11 „ „	15 49.1	175 17.3	1660	36.2
12 „ „	15 37	175 32.1	1758	35.7
12 „ „	15 35.7	175 43	1710	35.8
12 „ „	15 30.5	175 56.8	1475	35.8
13 „ „	15 39.5	176 38.3	1395	36·2
13 „ „	15 39.2	176 36.9	1480	35.7
13 „ „	15 41.8	176 44.8	1715	35.6
13 „ „	15 46.2	176 45	1390	35.6
26 „ „	23 16	170 10.8	1830	35.2
27 „ „	23 1.25	170 5.1	1455	35.5
27 „ „	23 13	170 4.2	1490	35.5
28 „ „	23 52.8	169 21.3	1105	36.2
28 „ „	24 47.9	168 44.4	1290	36.5
28 „ „	25 41.2	168 15.2	1210	36.0
29 „ „	26 28.7	167 48	758	38.7
29 „ „	26 55.5	167 32.2	410	47.7
29 „ „	27 16.3	167 20.6	458	43.3
29 „ „	27 39.7	167 6.7	1492	36.2
29 „ „	28 15.8	166 44	1900	35.8
30 „ „	29 33.7	165 17.5	1855	35.5
30 „ „	29 42.7	163 15.5	759	38.7
1 Decr. „	29 46.1	162 27.2	650	41.5
1 „ „	29 44.5	160 26.7	1000	36.9
2 „ „	29 43.7	159 50.9	1300	35.6
2 „ „	29 40.7	159 5.8	1558	35.0
2 „ „	29 56.2	157 24.1	1780	34.3
3 „ „	29 59	156 29.6	2725	34.1
3 „ „	30 35	154 34.1	2672	34.2
4 „ „	30 51.5	153 52.3	2170	34.0

U.S.S. ALBATROSS—

22 Nov., 1899	18 54	162 31	W.	2498	34.7
28 „ „	18 59	164 47		2882	33.4
24 „ „	19 4	167 41		2472	33.9
26 „ „	20 15	172 0		3141	34.0
27 „ „	21 18	173 51		4540	34.15
6 Dec. „	18 43	175 28		1381	36.2
7 „ „	18 50	178 28		453	42.9
7 „ „	18 54	178 35		324	47.0
7 „ „	18 56	178 43		600	39.3
7 „ „	18 56	178 50		450	42.4
9 „ „	18 56.5	179 16		990	37.0
21 „ „	12 43	179 50		1445	35.6

S. S. BRITANNIA—

18 May, 1901	27 58 10	153 27 40	E.	10	69.0
18 „ „	27 58 12	153 30 20		25	69.2
18 „ „	28 0 10	153 50 30		75	62.9
18 „ „	28 2 2	153 58 6		223	53.4
18 „ „	28 2 15	154 5 6		530	42.5
18 „ „	28 7 34	154 11 36		910	37.9
19 „ „	28 6 22	154 18 30		1092	36.9
19 „ „	28 11 58	154 25 10		1446	36.2
19 „ „	28 17 30	154 46 45		2197	35.0
19 „ „	28 0 35	154 50 12		2645	35.3
19 „ „	28 8 15	155 34 15		824	38.8
31 „ „	28 1 29	155 37 0		220	58.2
31 „ „	27 51 0	155 54 30		2676	34.4
31 „ „	27 47 54	155 23 52		1738	35.5
2 June „	28 42 0	155 20 0		2450	34.4
2 „ „	28 30 30	155 13 45		2496	34.4

S. S. BRITANNIA.

Date.	Latitude. ° ′ ″	Longitude. ° ′ ″	Depth. fms.	Temp. F. °
3 June, 1901	28 52 0	155 48 45	2430	34.4
3 „ „	28 49 30	156 21 0	2785	34.5
4 „ „	28 52 30	157 8 30	2566	34.5
5 „ „	28 59 39	157 46 18	1552	34.7
5 „ „	29 1 45	158 25 30	1389	35.7
5 „ „	28 56 0	159 11 0	1597	35.1
7 „ „	28 53 0	160 14 0	1290	36.8
7 „ „	29 1 41	160 32 54	908	38.6
7 „ „	28 51 0	160 54 0	850	38.8
8 „ „	28 54 16	161 48 9	840	38.6
8 „ „	28 59 4	162 23 21	726	39.3
8 „ „	29 2 30	162 44 0	750	39.9
8 „ „	29 0 20	163 1 16	843	38.6
9 „ „	28 59 30	163 23 30	974	37.7
9 „ „	29 2 40	163 44 1	1072	37.2
9 „ „	28 53 24	164 13 15	1638	36.5
9 „ „	29 9 42	164 24 28	1875	36.4
9 „ „	28 58 39	164 48 12	1879	36.4
10 „ „	29 2 0	165 23 0	1407	36.5
10 „ „	29 4 30	166 1 30	1830	36.3
11 „ „	29 9 45	166 32 6	1840	36.2
11 „ „	29 3 30	167 1 0	1760	36.4
11 „ „	29 4 38	167 24 20	1220	36.6
11 „ „	29 5 35	167 32 0	1210	36.8
11 „ „	29 5 17	167 37 20	1132	37.0
14 „ „	29 0 25	167 18 50	1143	37.0
14 „ „	29 0 15	167 28 10	1143	36.9
14 „ „	28 58 52	167 40 0	600	42.1
14 „ „	29 0 30	167 42 15	664	41.2
15 „ „	28 59 17	167 45 20	328	50.4
15 „ „	29 0 37	167 47 5	225	56.6
15 „ „	29 0 50	167 48 12	49	62.8
15 „ „	29 0 40	167 47 40	125	62.0
15 „ „	29 1 19	167 49 10	30	61.1
15 „ „	29 1 12	167 55 0	19	63.5
15 „ „	28 58 25	167 47 22	175	58.7
16 „ „	28 57 0	167 41 0	372	47.7
16 „ „	28 57 46	167 40 20	450	46.4
16 „ „	28 53 50	167 37 18	596	42.3
16 „ „	28 54 40	167 54 30	26	66.0
16 „ „	28 48 20	168 1 50	29	63.9
16 „ „	28 42 43	168 6 24	356	48.0
18 „ „	29 10 0	167 53 0	40	67.3
18 „ „	29 12 17	167 56 20	32	68.0
18 „ „	29 15 2	167 59 51	36	68.1
18 „ „	29 17 18	168 4 2	32	67.6
18 „ „	29 20 48	168 9 30	103	67.3
21 „ „	29 20 58	168 10 10	116	62.5
21 „ „	29 20 25	168 9 10	85	61.1
21 „ „	29 18 57	168 6 29	42	63.8
21 „ „	29 21 48	168 12 15	200	58.2
21 „ „	29 25 7	168 15 11	305	49.6
21 „ „	29 26 35	168 22 1	550	42.5
22 „ „	29 33 45	168 27 19	814	38.9
22 „ „	29 40 32	168 41 40	720	39.4
23 „ „	29 41 30	168 41 0	855	38.3
23 „ „	29 38 30	168 29 24	856	38.3
23 „ „	29 41 52	168 33 11	1360	36.4
24 „ „	29 48 17	168 39 31	1583	36.3
24 „ „	30 4 0	169 0 0	1584	36.3
24 „ „	30 12 0	169 7 0	1628	36.3
24 „ „	30 25 32	169 22 0	1828	36.3

Waterwitch— Date.	Latitude ° ′ ″	Longitude. ° ′ ″	Depth. fms.	Temp. F. °
25 June, 1901	31 19 30	170 20 0	2438	36.4
25 „ „	31 31 47	170 32 5	2236	36.5
25 „ „	31 46 17	170 47 53	1754	36.5
25 „ „	32 12 0	171 3 15	1745	36.4
25 „ „	32 9 15	171 19 30	1853	36.5
25 „ „	32 14 30	171 32 0	1893	36.4
25 „ „	32 23 52	171 25 54	1840	36.4
25 „ „	32 39 19	171 55 35	1220	36.4
27 „ „	33 7 0	172 28 30	1063	36.4
27 „ „	32 53 32	171 55 4	1250	36.2
28 „ „	33 41 53	173 1 25	1095	36.2
28 „ „	33 50 58	173 22 30	1116	36.4
28 „ „	34 3 26	173 24 25	1112	36.2
28 „ „	34 16 47	173 25 22	900	37.7
4 July „	34 55 10	173 29 40	23	49.8
4 „ „	35 0 23	173 48 25	13	48.4
4 „ „	34 58 45	173 49 50	25	51.4
6 „ „	34 51 30	173 34 25	64	51.2
6 „ „	34 44 0	173 34 50	104	51.9
13 „ „	34 31 42	173 34 30	168	53.1
13 „ „	34 29 30	173 36 57	465	44.5
16 „ „	29 21 38	168 9 51	147	60.9
16 „ „	29 20 0	168 7 20	42	61.0
17 „ „	28 47 35	168 2 12	33	65.9
17 „ „	28 47 8	168 2 33	35	65.9
17 „ „	28 46 50	168 2 44	42	64.7
17 „ „	28 45 50	168 4 30	210	54,7
17 „ „	28 44 30	168 6 0	314	48.7
17 „ „	28 38 15	168 12 30	1340	36.5
17 „ „	28 39 16	168 11 6	1210	36.8
17 „ „	28 25 59	168 29 40	1810	36.3
18 „ „	27 8 48	169 55 39	842	38.8
19 „ „	26 58 20	170 22 45	2150	36.5
20 „ „	26 18 29	171 6 10	1888	36.3
20 „ „	26 5 10	171 36 3	2180	35.7
20 „ „	25 42 2	171 39 59	2332	35.9
21 „ „	25 19 31	172 9 48	1922	35.9
21 „ „	25 5 15	172 36 0	2403	35.9
22 „ „	24 11 0	173 6 0	2280	35.8
22 „ „	23 41 30	173 41 15	2048	35.8
23 „ „	23 12 35	174 45 9	2350	35.8
23 „ „	22 42 46	174 48 36	2439	35.6
24 „ „	22 1 30	175 15 0	1756	35.7
24 „ „	21 38 30	175 41 0	1245	36.3
25 „ „	22 21 18	175 45 30	2158	35.8

Waterwitch— Date.	Latitude ° ′ ″	Longtiude. ° ′ ″	Depth. fms.	Temp. F. °
25 July, 1901	22 2 1	175 50 32	2144	35.8
26 „ „	21 46 36	175 54 40	2077	35.9
26 „ „	21 34 6	176 20 0	1608	35.9
26 „ „	21 33 30	176 6 0	1081	36.6
27 „ „	20 32 51	176 43 49	1839	36.0
28 „ „	19 2 0	177 34 45	1491	36.0
28 „ „	18 55 0	177 47 30	1194	36.2
28 „ „	18 36 0	178 18 0	1161	36.3
28 „ „	18 26 0	178 19 30	1132	36.4
28 „ „	18 21 30	178 20 0	1000	36.9
28 „ „	18 16 30	178 21 20	795	37.8
29 „ „	18 13 50	178 21 40	565	39.3
29 „ „	18 12 10	178 22 0	275	49.2
29 „ „	18 11 27	178 22 52	398	43.5
30 „ „	18 11 14	178 23 50	196	61.3
30 „ „	18 10 35	178 23 49	159	66.1
30 „ „	18 9 58	178 23 54	144	67.5
4 Aug. „	17 23 45	179 44 45	1237	36.2
4 „ „	17 17 45	179 53 40	1180	36.0
3 „ „	16 57 30	179 38 0 W.	801	37.6
3 „ „	16 49 50	179 27 15	375	44.1
4 „ „	16 35 0	178 43 30	425	41.9
4 „ „	16 25 30	178 35 0	930	37.0
4 „ „	16 15 14	178 23 19	1514	36.1
6 „ „	14 50 30	176 1 0	1166	36.7
6 „ „	14 30 18	175 35 36	720	38.5
7 „ „	14 28 30	175 17 40	2565	34.2
7 „ „	13 53 0	174 46 0	1490	36.0
8 „ „	13 43 45	174 16 15	2555	34.4
9 „ „	13 22 0	173 54 0	2568	34.1
9 „ „	13 8 3	173 46 4	2495	34.1
10 „ „	12 33 17	173 5 41	2528	34.5
10 „ „	11 58 30	172 33 30	2574	34.2
11 „ „	11 18 41	171 52 53	2585	34.2
12 „ „	10 5 0	170 59 0	2170	35.0
12 „ „	9 24 37	170 21 0	2387	34.5
13 „ „	8 20 34	169 31 34	2178	35.1
14 „ „	7 1 30	168 27 45	2865	34.2
15 „ „	5 44 30	167 34 0	3070	34.4
16 „ „	4 11 30	166 15 0	3027	34.9
17 „ „	3 36 3	165 44 29	2700	35.1
17 „ „	3 20 6	165 52 15	2290	35.4
18 „ „	2 18 0	164 45 30	2955	35.0
19 „ „	0 42 30	163 19 15	2960	35.0

The total number of bottom temperatures recorded in the two preceding tables is thus 1,019 ; of these

22	are in depths	under	100	fathoms,		
57	„	between	100	„ and	500	fathoms,
192	„	„	500	„	1,000	„
269	„	„	1,000	„	1,500	„
231	„	„	1,500	„	2,000	„
248	„	over	2,000	„		
1019						

From these observations we have prepared the accompanying map (see Map III) showing the temperature at the bottom over the floor of the region, in which the scale of colouring is the same as

that used in the temperature sections. The two shades of red indicate temperatures over 50° F., the darker shade indicating a temperature over 60° F., while the three shades of blue indicate temperatures under 50° F., the palest shade indicating a temperature between 40° and 50° F., the second shade a temperature between 35° and 40°, and the darkest shade a temperature under 35° F. The warmer water, indicated by the red colour, is found only in close proximity to the land masses, and the palest shade of blue also occurs only near the land and on the shallow ridge between Australia and New Zealand, so that by far the larger portion of the map is occupied by the two deeper shades of blue, indicating a temperature at the bottom under 40° F., the darkest shade of blue, indicating a bottom temperature under 35° F., being limited to those parts of the region covered by very deep water.

The two small isolated areas coloured dark blue, the one to the north-east of the Louisiade archipelago, the other to the south-east of New Caledonia, in which temperatures under 35° F., have been recorded, seem rather peculiar, and may be due to errors of observation, but future observations may show that these two deep areas are connected in some way with the larger deep areas with a similar low temperature. In the north-eastern part of the map the area with temperatures under 35° is very peculiar in form, a line of soundings run by the "Penguin" from Wallis Island to the Union Group, and thence in a north-easterly direction, giving temperatures over 35° F., while two series running parallel to the Penguin line, the one taken by H.M.S. "Egeria" and the other by Mr. Peake in the s.s. "Britannia," gave bottom temperatures under 35° F.

From the observations of temperature at the bottom we have prepared the following table to show the range of temperature and the mean temperature at various depths :—

Depth.	No. of Observations.	Range of Temperature.	Mean Temperature.
		° °	°
0 to 100 fathoms	22	48.4 to 69.2 F.	62.39
100 „ 500 „	53	40.2 „ 67.3 „	52.03
500 „ 1000 „	177	35.2 „ 45.3 „	38.59
1000 „ 1500 „	263	34.2 „ 40.3 „	36.20
1500 „ 2000 „	228	34.3 „ 39.6 „	35.72
over 2000 „	246	31.8 „ 37.8 „	35.05

The 22 observations at the bottom in depths under 100 fathoms were taken by Mr. Peake in the s.s. "Britannia" in the summer of 1901, off the coast of New South Wales, off Norfolk Island, and off the coast of New Zealand. The highest temperature was observed off the coast of New South Wales, while the lowest was recorded off the coast of New Zealand.

The 53 observations recorded on the bottom between 100 and 500 fathoms were taken in various parts of the region, the most northerly one being recorded off San Cristoval island in the Solomon group. The lowest temperature recorded (40.2°) was observed at 456 fathoms on a bank lying to the south-east of the New Hebrides, and is nearly 2° lower than any other reading at these depths. The highest reading (67.3°) was observed off Norfolk island in 103 fathoms, and a reading of 67.2° is recorded in 144 fathoms off the Fiji Islands.

The 177 observations of the temperature at the bottom in depths between 500 and 1,000 fathoms are widely scattered over the region under consideration, the most northerly observation having been taken between New Britain and New Ireland; a great many of the observations were taken in the seas around the Fijis and the Friendly Islands, on the shallow ridge between Australia and New Zealand, and in the Coral Sea. Off the coast of Australia, in latitude 39½° S., a reading of 34.3° is recorded, but as it was uncorrected we have omitted it from the Table. The next lowest reading was 35.2° observed on one of the banks about midway between the Fiji and Samoan Groups; this reading of 35.2° is one degree lower than any of the other readings at these depths. We have also omitted a reading of 51° (reported doubtful) at 946 fathoms on the shallow ridge lying between Australia and New Zealand, and a reading of 46.8° recorded at 972 fathoms on a bank about midway between New Zealand and the Fijis (also reported doubtful). The last mentioned is 1½° higher than the next highest reading, viz., 45.3° at 547 fathoms on the shallow ridge between Australia and New Zealand; this reading is again more than 2° higher than any other observation at these depths, the next highest reading being 43.1°, at 565 fathoms, farther to the north-east, on the shallow bank lying to the west of the north point of New Zealand.

The 263 observations taken at the bottom between 1,000 and 1,500 fathoms range from 34.2° to 40.3°, but the extreme observations, although not reported doubtful, differ considerably from the general run of the readings at these depths. Thus, the "Penguin" records an observation of 34.2° at 1,269 fathoms to the south-east of Norfolk Island, but the "Britannia" records 36.4° at similar depths in the same locality. The next lowest readings are two observations of 35.0° recorded by the "Penguin" at 1,140 and 1,437 fathoms in the Coral Sea, to the south of New Guinea; between them there is a record of 35.5° at 1,310 fathoms. Readings of 35.1° and 35.2° are recorded by the "Egeria" in the neighbourhood of the Fijis. The highest reading (40.3°) is recorded by the "Penguin" at 1,030 fathoms on the slope of the ridge between Norfolk Island and Middleton

Reef, but in shallower water on the ridge there is a record of 38.7° at 759 fathoms. The next highest readings are two observations of 39.1° recorded by the "Penguin" at 1,116 and 1,126 fathoms between Fiji and Wallis Island, but in the same locality we have records of 35.8° at 1,512 fathoms and 36.5° at 1,282 fathoms. The "Penguin" also records three observations of 39.0°, two at 1,005 and 1,174 fathoms, between Fiji and Wallis Island, and the third at 1,348 fathoms off Funafuti, Ellice group.

The 228 observations at the bottom in depths between 1,500 and 2,000 fathoms range from 34.3° to 39.6°; one of the observations is reported to be "doubtful" though the temperature appears to agree very well with that usually found at these depths. The reading of 39.6° recorded by the "Penguin" at 1,768 fathoms off Funafuti in the Ellice group is more than one and a half degrees higher than anything else recorded at these depths. The largest numbers of observations at one particular temperature are :—

24	observations at	36.0	16	observations at	35.3
19	„ „	35.5	13	„ „	35.9
18	„ „	35.6	11	„ „	36.1
17	„ „	35.8	10	„ „	36.3

while of the 228 observations 193 (or 85 per cent.) show a temperature of 35.0° to 36.5°, which may therefore be regarded as the normal or usual temperature at these depths.

Let us consider the extreme observations (those below 35.0° and those above 36.5°) to see if there be any indications of warmer or colder areas at the bottom at these depths within the region under consideration. Of the 22 observations under 35.0°, there are seven at 34.9° in various parts of the region between lat. 11° and 23° S.,—three situated to the north-east of Fiji in depths of 1,910, 1,965, and 1,985 fathoms, one to the south of Fiji in 1,828 fathoms, one to the south-east of New Caledonia in 1,865 fathoms, and two in the southern part of the Coral Sea, one near the Balfour Shoal in 1,645 fathoms, the other farther south in 1,760 fathoms. There are three readings of 34.8° between latitude 17° and 21° S.,—one between the Friendly and Samoa Islands in 1,575 fathoms, the other two in the Coral Sea, one near the Balfour Shoal in 1,570 fathoms, the other farther south in 1,760 fathoms. There are three observations at 34.7°,—one in lat. 22½° S. in the Coral Sea, east of the Barrier Reef, in 1,810 fathoms, another farther south between Australia and Middleton Reef in 1,552 fathoms, and the third still farther south, between Cape Howe and New Zealand, in 1,975 fathoms. There are two readings of 34.6° in the Coral Sea, east of the Barrier Reef, in 1,745 and 1,800 fathoms. There are no fewer than five observations at 34.5°—two in the Coral

Sea, east of the Barrier Reef, in 1,552 and 1,740 fathoms, one much farther south (in lat. 29° S.), to the north of Middleton Reef, in 1,778 fathoms, one north of the Louisiade Archipelago, in 1,685 fathoms, and one to the north-west of the Kermadecs, in 1,750 fathoms. There is a reading of 34.4° north-east of Fiji in 1,992 fathoms, and finally there is one observation at the minimum temperature of 34.3° between Australia and Middleton Reef in 1,780 fathoms.

From the above it will be seen that these 22 lower readings (under 35.0°) are widely scattered over the region under consideration, but thirteen of them are situated in more or less close proximity to the deep basin lying between Australia and New Zealand, which would seem to indicate that the cold water at the bottom of this basin had a cooling influence on the surrounding shallower water.

Proceeding now to the higher readings (over 36.5°), we find the observations also scattered over the region. Of the 13 observations there is one at 36.7° to the south of the Fijis, lat. 19½° S., in 1,655 fathoms. There are two observations at 36.8°,—one east of New Caledonia, lat. 22½° S., in 1,560 fathoms, the other north-west of the Fijis, lat. 15¾° S., in 1,532 fathoms. There are two observations at 36.9°,—one to the north of New Zealand, lat. 33° S., in 1,724 fathoms, the other between Fiji and Wallis Island, lat. 13¾° S., in 1,939 fathoms. There are three readings of 37.0°,—one at 1,790 fathoms, lat. 9½° S., near Duke of Clarence Island, Union group, the other two farther to the south-west, near Lalla Rookh Bank, in 1,501 and 1,898 fathoms. There is one reading of 37.5° to the south-west of the Union group, lat. 10½° S., in 1,810 fathoms. There is one reading of 37.8° at 1,988 fathoms to the south of Fiji, lat. 22° S. There are two readings of 37.9° south of Fiji, lat. 21° and 22¾° S., in 1,948 and 1,969 fathoms. Finally, there is the extraordinarily high reading of 39.6° in 1,768 fathoms off Funafuti, previously mentioned. We have already referred to the high readings of 39.0° at the bottom in 1,348 fathoms off Funafuti, and there is also a reading of 37.0° at the bottom in 2,298 fathoms; these observations, if trustworthy, indicate the presence of very warm water at great depths among these coral islands.

The 246 observations in depths over 2,000 fathoms show a range of 6°: from 31.8° to 37.8°, the mean being 35.05°. The largest numbers of observations at one particular temperature are :—

24 readings at	34.5°	13 readings at	34.4°
21 „	„ 35.0°	12 „	„ 34.2°
16 „	„ 35.8°	12 „	„ 34.0°
15 „	„ 35.5°		

while of the 246 observations, 199 (or 81 per cent.) fall between 34.0°

and 36.0°, which may be regarded as the normal temperature at these depths within the region under consideration.

Let us examine the extreme readings, *i.e.*, those below 34.0° and those above 36.0°. Commencing with the lower readings, we find that the minimum temperature of 31.8° was observed at 2,634 fathoms, to the south-west of Savaii, Samoan group, lat. 14¾° S., and in the same serial the low temperature of 33.2° is recorded at 2,088 fathoms, nearly 600 fathoms above the bottom. The next lowest reading is one of 32.5°, observed at 2,394 fathoms, to the south-east of Wallis Island, lat. 13½° S. There is one reading of 33.2° at 2,835 fathoms, south of Savaii, Samoan group, lat. 14½° S. There is a reading of 33.4° observed by the "Albatross" between the Society and Fiji groups, lat. 19° S. There are two readings of 33.5°,—one at 2,680 fathoms between the Union group and Gente Hermosa, lat. 10½° S., the other at 3,006 fathoms in the neighbourhood of the great deeps, south of the Friendly Islands, lat. 24¾° S. There is one reading of 33.6°, near the last-mentioned in 2,889 fathoms. There are four readings of 33.7° also in the neighbourhood of the great deeps, about lat. 25° S., in 2,990, 3,036, 3,110, and 4,428 fathoms. There are no fewer than seven readings of 33.8°,—three of these are in the deep basin off the east coast of Australia, one at 2,379 fathoms, lat. 28¾° S., another farther south in 2,480 fathoms, lat. 30¼° S., and the third still farther to the south-west, east of Sydney, in 2,660 fathoms, lat. 33¾° S., a fourth reading occurs at 2,606 fathoms, to the south of the Union group, lat. 11° S., a fifth farther south in 2,600 fathoms, to the south of Savaii, Samoan group, lat. 14½° S., and the remaining two were observed farther to the south-east, to the east of the great deeps, one in 2,740 fathoms, lat. 23° S., the other in 2,780 fathoms, lat. 25¾° S., long. 161¾° W. There are two readings of 33.9°,—one in the deep basin off the east coast of Australia, to the north-east of Sydney, in 2,908 fathoms, lat. 33° S., the other to the east of Savage Island, lat. 19° S.

It thus appears that the low readings occur in three widely separated localities. The three lowest recorded readings, as well as three readings slightly higher, were observed in the north-eastern part of the region, in the neighbourhood of the Union and Samoan groups. Six of the readings are in the neighbourhood of the great deeps to the south of the Friendly Islands, with four observations much farther to the east. Finally there are four observations in the deep basin to the east of Australia.

Proceeding now to the higher readings, we find that the two readings at the maximum temperature of 37.8° were taken in the deep basin lying between New Zealand and the Fijis, one at 2,043 fathoms in

lat. 21¾° S., the other much farther south at 2,360 fathoms in lat. 29° S. There is one reading of 37.3° at 2,023 fathoms, and one reading of 37.2° at 2,186 fathoms, to the south-west of Duke of Clarence Island, Union group. There are no fewer than seven observations at 37.0°—one at 2,051 fathoms, off Duke of Clarence Island, Union group, another farther to the south-west, lat. 10¾° S., in 2,665 fathoms, another still farther to the south-west, off Lalla Rookh Bank, in 2,010 fathoms, another off the island of Funafuti, Ellice group, in 2,298 fathoms, one in the Coral Sea, off Indispensable Reefs, in 2,373 fathoms, one in the deep basin between New Zealand and Fiji, lat. 27½° S., in 2,295 fathoms, and finally one at 3,350 fathoms in the neighbourhood of the great deeps north-east of the Kermadec Islands, lat. 26½° S. There are two readings of 36.9°,—one at 2,310 fathoms to the south-west of the Union group, lat. 10½° S., the other in 3,220 fathoms in the neighbourhood of the great deeps south-east of the Kermadecs, lat. 32¼° S. There is one reading of 36.8° in the deep basin between New Zealand and Fiji in 2,327 fathoms, lat. 26¾° S. There are two readings at 36.6°,—one at 2,245 fathoms near Duke of Clarence Island, Union group, the other off Lalla Rookh Bank in 2,225 fathoms. There are three readings at 36.5°,—one in 2,560 fathoms, to the south-west of the Union group, latitude 11¼° S., the other two in the deep basin to the north of New Zealand, one at 2,263 fathoms about mid-way between New Zealand and Norfolk Island, lat. 31½° S., the other in 2,150 fathoms to the north-east of Norfolk Island, lat. 27° S. There are two readings of 36.4°,—one in the deep basin to the north of New Zealand in 2,438 fathoms, about mid-way between New Zealand and Norfolk Island, lat. 31¼° S., the other in 2,525 fathoms, between New Caledonia and the New Hebrides, lat. 18° S. There are three readings of 36.3°,—one at 2,420 fathoms, to the north-east of the Union group, lat. 8½° S., another in 2,553 fathoms to the south-west of the Union group, lat. 11¾° S., and the third at 2,270 fathoms in the deep basin between New Zealand and Fiji, lat. 28° S. There is one reading of 36.2° at 2,240 fathoms, south of the southern point of San Cristoval Island, Solomon group. There are two readings of 36.1°,—one in 2,750 fathoms to the south of San Cristoval Island, Solomon group, lat. 11½° S., the other at 2,583 fathoms, to the south-west of the Union group, lat. 11° S.

It will be observed that these high readings also occur at widely separated localities, but it is curious to note that the majority are recorded in the same locality as the lowest readings, viz., in the north-eastern part of the region under consideration in the neighbourhood of the Union and Samoan groups. The highest readings recorded at these depths as well as several slightly lower, were observed in

the deep basin to the north of New Zealand. Some of these observations are much higher than the neighbouring readings at similar depths, for instance, the readings of 37.8° at 2,360 fathoms, 37.0° at 2,295 fathoms, and 36.8° at 2,327 fathoms are surrounded by readings of 35.2 to 35.8°. Two of the readings (36.9° and 37.0°) are recorded in the neighbourhood of the great deeps in close proximity to readings two to three degrees lower ; for instance the reading of 37.0° at 3,350 fathoms is in the neighbourhood of two much lower readings at lesser depths, viz., 34.1° at 2,420 fathoms and 35.0° at 1,975 fathoms. The reading of 37° at 2,373 fathoms in the Coral Sea, west of the Indispensable Reefs, is not far from a reading of 35.8° at 1,552 fathoms. The high reading of 37° at 2,298 fathoms off Funafuti is in accordance with the other two observations recorded in the same locality, viz., 39.6° at 1,768 fathoms and 39.0° at 1,348 fathoms, which are all very high when compared with the general run of the observations at similar depths.

An interesting illustration of the distribution of temperature as affected by the contour of the bottom is recorded within the basin between New Zealand and Fiji :—On the 16th May, 1895, while running a line of soundings between New Zealand and Fiji, the " Waterwitch " came across a rise with 1,260 fathoms on it, apparently surrounded on all sides by water over 2,200 fathoms in depth. The temperature obtained on the summit of the rise, in 1,260 fathoms, was 36.2° ; in 2,410 fathoms to the south of the bank the temperature was 35.4°, in 2,280 fathoms to the west of the bank the temperature was 35.6°, in 2,260 fathoms to the east of the bank the temperature was 35.8, *but* in 2,270 fathoms to the *north* of the bank the temperature was found to be 36.3°, or 0.1° higher than was observed on the summit of the bank 1,000 fathoms nearer the surface. It seems probable from these observations that the water was flowing in a northerly direction, and that before reaching the deep water to the north it must have flowed over the summit of the rise, where it acquired a slightly higher temperature.

In the preceding discussion we have included all observations in depths exceeding 2,000 fathoms down to the greatest depths. There are twenty-one observations recorded in depths between 3,000 and 4,000 fathoms, ranging from 33.5° to 37.0°, with a mean of 34.8°, and three observations in depths exceeding 4,000 fathoms, ranging from 33.7° to 34.5°, with a mean of 34.1°. The lowest reading beyond 3,000 fathoms is 33.5° at 3,006 fathoms, in the neighbourhood of the great deeps to the south of the Friendly Islands, and the highest readings are 37.0° at 3,350 fathoms and 36.9° at 3,220 fathoms, farther to the south in the same neighbourhood. These two high readings are

about 1½° higher than any other observation at these depths. The greatest depth at which the bottom temperature is recorded is 4,762 fathoms, east of Tongatabu, Friendly Islands, the temperature being 34.5°.

From the observations given in this paper it seems impossible to trace any relation, in deep water beyond 2,000 fathoms, between the temperature of the bottom water and the depth; the general rule which applies to the intermediate waters, of decrease of temperature with increase of depth, does not appear to hold good with reference to these deep water bottom temperatures. Considering that the extreme range of temperature shown by all the bottom observations in depths greater than 2,000 fathoms does not exceed 6° F., it is perhaps not surprising that the slight variations do not apparently follow any definite direction with relation to the depth.

III. Marine Deposits of the South-West Pacific.

During the cruise of H.M.S. "Penguin" at the end of 1895 and beginning of 1896 a few very deep soundings were obtained, the depth exceeding anything previously known. We have had the opportunity of examining the deposits taken at these great depths, through the kindness of the late Admiral Sir W. J. L. Wharton, Hydrographer of the Admiralty, as well as many hundreds of other deposits from this region, including over 40 samples collected by H.M.S. "Challenger" in 1874, over 60 samples by U.S.S. "Tuscarora" in 1875 and 1876; about 20 samples by H.M.S. "Myrmidon" in 1887; about 420 samples by H.M.S. "Egeria" in 1888, 1889, and 1890; about 200 samples by H.M.S. "Penguin" in 1894, 1895, and 1896; and about 50 samples by H.M.S. "Waterwitch" in 1895.

The number of samples examined may be tabulated, according to depth, as follows:—

From shallow water under 100 fathoms	.. .. ..	77 samples
depths between 100 and 500 fathoms	.. .. ..	133 „
„ „ „ 500 and 1000 „	.. .. ..	150 „
„ „ „ 1000 and 1500 „	.. .. ..	161 „
„ „ „ 1500 and 2000 „	.. .. ..	118 „
„ „ „ 2000 and 2500 „	.. .. ..	67 „
„ „ „ 2500 and 3000 „	.. .. ..	43 „
„ „ „ 3000 and 3500 „	.. .. ..	18 „
„ „ „ 3500 and 4000 „	.. .. ..	3 „
„ „ „ 4000 and 4500 „	.. .. ..	1 „
„ „ „ 4500 and 5000 „	.. .. ..	0 „
„ „ over 5000 fathoms	.. .. ..	2 „
	Total ..	773 „

In addition, we have made use of the descriptions of the deposits collected by the German ship "Gazelle," of which over twenty samples fall within the scope of this paper.

This mass of material has enabled us to prepare a map of the region (see Map IV.) showing approximately the distribution of the various kinds of deposits, but in the northern parts of the region the information available is very meagre; in fact we have no deposits from the area south of the equator lying between the Solomon, Santa Cruz, and northern portion of the New Hebrides groups across to the Ellice and Gilbert Groups and onwards to the Phœnix group.

All the principal varieties of deep-sea deposits are represented in the region under consideration, with the exception of Diatom Ooze, which occurs farther to the south, forming apparently a continuous band of varying width around the world in the south polar regions northwards of the zone of Blue Mud bordering the Antarctic Continent. We may also remark that the local variety of terrigenous deposits called Red Mud, hitherto known only from the coast of Brazil and the Yellow Sea, appears also to be absent from this region. In the appendix we give detailed descriptions, on the plan adopted in the Challenger Report on Deep-Sea Deposits, of a series of samples from various parts of the region. In these descriptions the percentages placed within parentheses ( ) are the results of chemical analyses, while those placed within brackets [ ] are the results of approximate evaluations.

From an examination of Map IV. it will be observed that the bottom over by far the greater part of the region is covered by Globigerina Ooze and Red Clay in nearly equal proportions, the Globigerina Ooze probably predominating to a slight extent. The Red Clay occupies all the deepest parts of the region, except for a small patch of Radiolarian Ooze, extending southwards from the equator for about 13° of lat. on the meridian of 170° W. The Globigerina Ooze covers the sea-floor in medium depths (1,000 to 2,300 fathoms), with a few scattered patches of the closely-related Pteropod Ooze in lesser depths, mostly under 1,000 fathoms. Coral Mud occurs along the Great Barrier Reef of Australia and around all the reefs and islands of coral formation. In the neighbourhood of volcanic islands, and near some banks recently investigated, Volcanic Mud is found, and, further, some of the deposits from the very deep water extending from Samoa southwards as far as about lat. 33° S., which have been classed as Red Clays, might with equal propriety have been called Volcanic Muds, for the abundance of volcanic debris in these deposits is a marked peculiarity, making up in some cases as much as 50 per cent. of the whole deposit. Blue Mud and Green Mud occur around the coasts of Australia, New Zealand, Chatham Islands and other larger islands not of volcanic origin.

The following table shows the approximate area covered by each variety of deposit in square geographical and English miles, and the percentage of the total water-surface—which, as stated in the Introduction, is estimated at about 11,000,000 square English miles.

	Approximate area in square *Geographical* miles.	Approximate area in square *English* miles.	Percentage.
Globigerina Ooze	3,983,800	5,280,600	48.0
Red Clay	3,644,900	4,831,500	44.0
Blue and Green Muds	353,400	468,400	4.3
Volcanic Mud	134,300	178,100	1.6
Coral Mud	131,400	174,200	1.6
Pteropod Ooze	29,200	38,700	0.4
Radiolarian Ooze	11,700	15,500	0.1
TOTAL	8,288,700	10,987,000	100.0

I. Globigerina Ooze.

This is the predominant form of deposit in this region, covering as it does about 48 per cent. of the sea-floor. It ranges in depth from 610 to 2,835 fathoms, but the great majority of the samples are from depths between 1,000 and 2,000 fathoms, showing that it is a deposit characteristic of medium depths; indeed the extreme depths mentioned above are exceptions due to special circumstances. The deposit from 610 fathoms, off the reefs at Kandavu, Fiji, is on the boundary line between Globigerina Ooze and Coral Mud, and has been included among the Globigerina Oozes because of the abundance of shells of pelagic Foraminifera, which make up half of the carbonate of lime present. Another Globigerina Ooze from a similar depth, 630 fathoms, situated to the south of lat. 35° S., illustrates the effect of latitude on the distribution of pelagic organisms, for at such depths within the tropics some distance from land the deposit is usually a Pteropod Ooze, whereas in this case the shells of pelagic Foraminifera make up the mass of the carbonate of lime present. The deposit from 2,835 fathoms, between Birnie and Enderbury Islands of the Phœnix group, might almost have been called a Radiolarian Ooze, so numerous are the remains of these siliceous organisms, but it contains 42 per cent. of carbonate of lime, an exceptionally high percentage for such a great depth, which remark applies also to a sample from 2,800 fathoms off the east coast of New South Wales, lat. 33° S., where the percentage of carbonate of lime is over 45, the calcareous matter being mostly in an amorphous condition and the pelagic Foraminifera shells fragmentary, while there is a great admixture of amorphous clayey matter.

But it is in depths of 1,500 to 2,000 fathoms that we find this kind of deposit in its most typical form, though the species of pelagic Foraminifera predominating, or even represented, in different samples,

vary considerably according to latitude. For the sake of comparison we give here a table showing the species of pelagic Foraminifera observed in five Globigerina Oozes within the region under consideration, arranged according to latitude from the equator southwards to 45° S. :—

	I. lat. 0° 42′ S. North of the Admiralty Is. 1,100 fms.	II. lat. 15° 58′ S. Coral Sea, 2,325 fms.	III. lat. 19° 2′ S. near Fiji Is., 1,350 fms.	IV. lat. 37° 53′ S. between New Zealand and Australia, 1,975 fms.	V. lat. 45° 11′ S. South of Chatham Is. 1,381 fms.
Orbulina universa.. ..	†	†	†	†	†
Globigerina bulloides ..	†		†	†	†
„ rubra ..	†		†		
„ conglobata ..	†	†	†		
„ æquilateralis..	†	†	†	†	
„ dubia ..	†	†	†	†	†
„ inflata ..	†	†	†	†	†
„ sacculifera ..	†	†	†		
„ digitata ..	†	†			
Hastigerina pelagica ..			†		
Sphæroidina dehiscens ..	†	†	†	†	
Pullenia obliquiloculata ..	†	†	†	†*	
Candeina nitida	†		†		
Pulvinulina menardü ..	†	†	†		
„ tumida ..	†	†	†		
„ canariensis ..	†		†	†	
„ micheliniana	†*	†	†	†	†
„ crassa ..		†	†	†	†

*Single specimen only observed.

This list includes all the species of Foraminifera known to have a pelagic habitat, with three exceptions, viz., (1) *Globigerina cretacea*,* a very doubtful species apparently closely related to *Globigerina dubia* ; (2) *Globigerina dutertrei*,† a form characteristic of the colder waters of the globe and related to *Globigerina inflata* ; (3) *Cymbalopora bulloides*,‡ a fragile tropical form abundant in some coral-reef regions, the shells of which are seldom, if ever, found at the bottom in depths over 1,000 fathoms ; *Hastigerina pelagica*‖ was observed in one of the deposits from these five stations and young examples were present,

*" *Globigerina cretacea* resembles *Globigerina dubia* . . . . I have never met with recent specimens either among surface organisms or in bottom-ooze which presented exactly the same characters as the typical Cretaceous variety ; though shells similar in general conformation, and more nearly related to *Globigerina cretacea* than to any other recognised modification of the genus, are not uncommon in certain localities " (H. B. Brady, Zool. Chall. Exp., part 22, pp. 593-7, 1884).

†" *Globigerina dutertrei* is a starved variety which to some extent takes the place of the typical *Globigerina bulloides* in the Antarctic seas, just as *Globigerina pachyderma* represents the type in Arctic latitudes " (Brady, *op. cit.*, p. 601).

‡" *Cymbalopora bulloides* has long been known as a bottom Foraminifer . . . . but on the Challenger cruise it was frequently taken in the tow-nets at the surface of the sea, always in shallow areas and in the mmediate neighbourhood of coral-reefs . . . . . Bottom specimens have been collected off the Admiralty Islands, the New Hebrides, around the Fiji group, &c." (Brady, *op. cit.*, pp. 639-40).

‖" A few of the thicker shelled specimens [of *Hastigerina pelagica*] are found from time to time in bottom dredgings, but they are by no means common, and are seldom even approximately complete. The spines are invariably broken off, and when the shells are not otherwise fractured the surfaces are worn and the texture rotten" (Brady, *op. cit.*, p. 614).

in a few other bottoms, but the full-grown specimens of this species have very fragile shells, which offer but a feeble resistance to the processes of disintegration, and usually reach the bottom in moderate depths only in a fragmentary condition.

It will be observed from the table that of the eighteen species enumerated four are common to the five stations, viz., *Orbulina universa*, *Globigerina dubia* and *inflata*, and *Pulvinulina micheliniana*. The absence of *Globigerina bulloides*, a common and widely-distributed form, from station No. II. may be accidental or may perhaps be due to the great depth, which would also account for the absence of *Globigerina rubra*, *Candeina nitida*, and *Pulvinulina canariensis*. Of *Pulvinulina micheliniana* only a single example was observed in the equatorial station (No. I.), and it appears to be characteristic rather of subtropical than tropical regions ; the same remark applies to *Pulvinulina crassa* (probably a variety of *Pulvinulina micheliniana*), the only species of *Pulvinulina* unrepresented at the equatorial station (No. I.).

The station which practically includes all the species is No. III., near the Fiji Islands, the only absentee being *Globigerina digitata*, a species of very limited distribution and a mere variety of *Globigerina sacculifera*. The two most southerly stations (Nos. IV. and V.) contain fewer species than the other three stations within the tropics, and at the same time the examples are of smaller size ; this is especially noticeable in No. V., where the Foraminifera are all of a nearly uniform small size, the bulk of the material being made up of specimens of *Globigerina dubia* and *inflata*, the remaining four species being few in number.

On the other hand, it is those species with large massive shells that are specially characteristic and abundant in the tropical stations, such, for instance, as *Globigerina conglobata* and *sacculifera*, *Pullenia obliquiloculata*, *Pulvinulina menardii* and *tumida*, which were all unrepresented in the most southerly station (No. V.), and were represented in lat. 38° S. (No. IV.) only by a single specimen of *Pullenia obliquiloculata* and by three examples of *Sphæroidina dehiscens*.

Of the calcareous remains of organisms other than Foraminifera in the Globigerina Oozes coccoliths are the most common, having been found in nearly every sample examined from the region under consideration. Sometimes they are not numerous and are very minute, at other times they are very abundant and often of large size. It is in the southern parts of the region that the coccoliths attain their greatest development ; between lat. 35° and 46° S. extremely large coccoliths were observed in some of the deposits. It was only in these same southern

latitudes (between Australia and New Zealand and near Chatham Islands, lat. 37° to 45° S.) that coccospheres were present in the deposits, whereas rhabdospheres were not observed in any of the samples, being apparently broken up into their component parts (the rhabdoliths). Rhabdoliths were usually observed in the samples from the tropical areas in company with coccoliths, though seldom so abundant and in some cases very difficult of detection.

The colour of the Globigerina Ooze varies strikingly with latitude within this region of the South-West Pacific, those samples from the southerly parts of the region being of a pure or cream white colour, while nearer the equator the deposit assumes a fawn or light brown colour, deepening in many cases into a dark brown, sometimes almost chocolate colour, due to the greater or less abundance of the peroxides of manganese and iron. At its deep margin the Globigerina Ooze passes gradually into the Red Clay, while at its shallow margin it may becomea Coral Mud in the vicinity of coral reefs, or a Volcanic Mud near volcanic centres, or a Blue Mud or Green Mud on approaching the continents and continental islands, or a Pteropod Ooze within tropical areas removed from coral reefs and volcanic centres.

II. Pteropod Ooze.

This deposit is closely related to the Globigerina Ooze, for the name is applied to those deposits which differ from the Globigerina Ooze simply in the comparative abundance of the shells of pelagic Molluscs, and as these shells are apparently more quickly removed by the solvent action of sea-water than the smaller but thicker Foraminiferous shells, it follows that it is found in lesser depths than the Globigerina Ooze, passing gradually at its deeper margin into the latter deposit. It is usually found in depths between 500 and 1,000 fathoms, the shallowest sample within this region being from 305 fathoms, and the deepest 1,102 fathoms. It is limited to tropical and subtropical waters, the most southerly latitude at which it has been observed in this area being 30° S. on the meridian of 180°. It occurs in the Coral Sea in those places where the bottom rises into banks or plateaus less than 1,000 fathoms below the surface, but beyond the range of coral reefs, and in this locality it is found in closer proximity to a continental shore than in any other part of the world. This may be explained by the facts that no large rivers enter the sea and the coast is guarded by the Great Barrier Reef, the seaward face of which is bathed by pelagic waters, so that within two hundred miles from the shore a Pteropod Ooze may be found.

III. Red Clay.

As will be seen from the Table, this deposit is inferior in extent in the region under consideration only to the Globigerina Ooze, cover-

ing the bottom as it does over about 44 per cent. of the total water surface.

The Red Clay occupies all the deepest parts of the region, covering the bottom to the east of about 175° W. longitude, where the depth exceeds at some points 5,000 fathoms, representing the south-western boundary of the great Red Clay area of the Pacific; a second area occurs in the deep water lying between New Zealand and the Fiji Islands (including a small patch of Globigerina Ooze where the bottom rises to 1,260 fathoms, surrounded on all sides by water over 2,200 fathoms in depth); a third area occurs to the east of Australia (the northern prolongation of a large tract occupying the sea between Australia and New Zealand), and, like the second area, includes a patch of Globigerina Ooze in comparatively deep water, viz., 2,370 and 2,800 fathoms; a fourth area—or rather two areas joined together by a narrow neck between Rennell and Bellona Islands and the Solomon group—occurs in the Coral Sea and in the sea lying between the New Hebrides group and the Loyalty Islands and New Caledonia; there are indications of a fifth area of Red Clay extending on both sides of the equator in long. 157° to 174° E.

The depth at which the Red Clay was found varies from 2,180 to 5,155 fathoms, and the percentage of carbonate of lime ranges from 20 per cent. in 2,180 fathoms to 0 in the greater depths. The calcareous organisms observed consisted of pelagic and bottom-living Foraminifera, fishes' teeth, Echini spines, and coccoliths; the last-named were only present in the shallowest sample, 2,180 fathoms.

The mineral particles ranged from 1 to 50 per cent.; those samples with a high percentage always contained a large amount of pumice and other volcanic material and might be designated Volcanic Muds. The minerals consisted of pumice, magnetite, augite, hornblende, felspars, palagonite, manganese grains, glassy particles, volcanic rock fragments, and quartz, which last was noticed only in two bottoms situated to the south-east of Chatham Islands, in 2,793 and 2,881 fathoms.

The siliceous organisms ranged from 0 to 10 per cent., consisting of Radiolaria (including Challengeridæ in some cases), Sponge spicules, arenaceous Foraminifera, and Diatoms.

The "fine washings" ranged from 35 to 96 per cent., but where the percentage was less than 70 the samples contained a high percentage of minerals (principally pumice) and might be called Volcanic Muds. The fine washings were made up in all cases of amorphous clayey matter with minute mineral particles less than 0.05 mm. in diameter (chiefly pumice).

IV. Radiolarian Ooze.

This deposit, which may be looked upon as a variety of the Red Clay differing only in the comparative abundance of the skeletons of Radiolaria, covers a small area in this region. Up till 1900 only three samples had passed through our hands, taken by the U.S.S. "Tuscarora" in 1875, and the amount of material available was insufficient for detailed examination and description; they were situated just under the equator on the meridian of 170° W. southwards towards the Phœnix Islands, in depths of 3,020, 3,015, and 2,865 fathoms. A little farther south, among the Phœnix Islands, two samples from 2,835 and 3,000 fathoms contained a large proportion of Radiolaria, but have been classed among other deposits: the first among the Globigerina Oozes, as it contains 42 per cent. of carbonate of lime due principally to pelagic Foraminifera, and the second among the Red Clays. Subsequently, however, the examination of several series of recent soundings has shown that Radiolarian Ooze covers a pretty extensive area in this locality, as indicated on Map IV.

V. Volcanic Mud.

Volcanic material plays a very important part in the deposits of the region under consideration, being present in less or greater abundance in every sample examined, principally in the form of pumice and volcanic glass. As already stated, some of the Red Clays from deep water might equally well be called Volcanic Muds so abundant are the fragments of volcanic origin. But it is around and between the various groups of volcanic islands, such as the Kermadecs, Friendly Islands, Samoan Islands, Fijis, New Hebrides, Santa Cruz Island, and some of the Solomon Islands, that we find Volcanic Mud in its most characteristic form.

The samples ranged in depth from 302 to 2,427 fathoms, while from a depth of 2,835 fathoms, to the south-west of Samoa, the sounding tube brought up some fragments of volcanic rock and volcanic glass, the largest 5 mm. in diameter, mostly converted into palagonite and coated with manganese.

The percentage of carbonate of lime ranged from 5 to 40 per cent., due to pelagic and bottom-living Foraminifera, fragments of Pteropods and Lamellibranchs, Echini spines, Ostracodes, otoliths of fishes, Coral fragments, coccoliths, rhabdoliths, and Tunicate spicules.

The mineral particles ranged from 10 to 60 per cent., and consisted of pumice, volcanic glass and rock fragments, palagonite, manganese grains, olivine, mica, felspar, obsidian.

The siliceous organisms made up 1 to 5 per cent., consisting of Sponge spicules, Radiolaria, arenaceous Foraminifera, Diatoms, and imperfect casts of calcareous organisms.

The fine washings ranged from 18 to over 60 per cent., being usually minute splinters of pumice and other volcanic materials along with amorphous clayey matter.

VI. Blue Muds and Green Muds.

These deposits occur chiefly around New Zealand and Chatham Island and off the southern coasts of Australia. They are very largely made up of detrital matter washed down from the land and carried into the ocean by rivers. The Blue Muds occur especially close to the embouchures of large rivers, where the deposit is formed at a relatively rapid rate. At a considerable distance from the coast they may have a large number of pelagic shells, and in some positions the deposit may gradually pass into a Globigerina Ooze.

At other parts of the coast the Blue Muds pass into Green Muds, characterised by the presence of glauconite. This deposit is evidently formed less rapidly than the Blue Mud. It contains less detrital matter than the Blue Mud and pelagic conditions approach nearer to the shore where Green Muds are found than in other places. Green Muds are also found in their greatest development in those regions where warm currents occupy the surface at one time of the year and cold currents at another. Such an area is found off the coasts of New South Wales, where the warm Australian current from the north mingles with the Antarctic drift from the south. Here the "Challenger" found much glauconite in the deposits, the Foraminifera being largely filled with the most perfect casts of glauconite, and there were also phosphatic concretions in the deposit.

IV. Distribution of Carbonate of Lime ($Ca\ CO_3$) over the Floor of the Ocean.

By far the larger part of the carbonate of lime which is found in the marine deposits now covering the floor of the ocean has been derived from sea-water through the action of organisms. The carbonate of lime derived from minerals may for the present be wholly neglected, for in no case does it amount to one per cent. in any of the varieties of marine deposits referred to in this paper. The carbonate of lime found in marine deposits is made up of the fragments of Fish bones, Mollusc shells, Corals, spicules of Tunicates and Sponges, shells of Foraminifera, remains of calcareous Algæ, and indeed of remains of all the calcareous structures secreted by marine organisms. A very important division may be made in these calcareous remains into two classes:—viz., those which have been secreted by organisms

which live habitually in the surface and subsurface waters of the ocean, such as pelagic Molluscs, pelagic Foraminifera, and calcareous Algæ, viz., Pteropods, *Globigerina*, *Pulvinulina*, *Orbulina* and several other genera of Foraminifera, and coccospheres and rhabdospheres. The remains of all these pelagic (plankton) organisms are especially abundant in the deposits far from land. Near the land their presence is masked by detrital matters. In great depths they disappear, being dissolved by the action of sea-water either while falling to the bottom or soon after they reach the bottom. In depths of 1,000 fathoms far from land they may make up fully 95 per cent. of the deposit.

The organisms which live on the bottom of the ocean (benthos), viz., Corals, Molluscs, Foraminifera (of very different species from those of a pelagic habitat), calcareous Algæ, are very poorly represented in deep water, but in shallow water their remains may make up nearly the whole of the deposit now in process of formation. This is especially the case around coral islands.

In Map V. we have represented the result of a very large number of analyses of the amount of carbonate of lime in the samples of deposits which have passed through our hands from this region of the ocean. The map is specially interesting when compared with the other maps showing depth, temperature and deposits. It will be observed that the dark shades of blue, which represent the high percentages of carbonate of lime, correspond to the shallower depths of the ocean in the depth Map (II.) and to the shore regions where coral reefs prevail. Away from the coasts the deep shades correspond with the distribution of the Globigerina and Pteropod Oozes on the deposit Map (IV.). Again, the faintest shades of blue on the map correspond with the deep water on the depth map, and with the Red Clays in the deposit map. It is well known that carbonate of lime is very sparingly secreted in the cold water either of the polar regions or of the deep sea, while it is very abundantly secreted in warm seas where there is a nearly uniform temperature throughout the year. In warm water the lime is secreted in the form of aragonite, while in the cold water it appears in the form of calcite. In this connection it may be remarked that in the deposits now forming on the floor of the ocean the remains of organisms may be found which during their lives existed always in a temperature of 35° F., mixed up with the remains of organisms which always lived in a temperature of about 80° F. This shows how difficult it may be to unravel the geological records of the past, for the remains of organisms which lived under wholly different conditions may be mixed up in the same strata.

In the collection of the data for this paper, and in the preparation

of the manuscript and maps I have been largely assisted by Mr. James Chumley, Mr. Robert Dykes, Mr. C. E. Wragge, and Mr. Fred. Pearcey, assistants in the Challenger Office, Edinburgh.

APPENDIX I.

Detailed Descriptions of Typical Deposits from the South-West Pacific.

H.M.S. "Egeria," Sounding 8, 30 April, 1889, lat. 34° 00½′ S., long. 166° 21½′ E., 1,656 fathoms.

GLOBIGERINA OOZE, creamy white when dry, grey when wet, chalky.

CALCIUM CARBONATE (85.3%), principally pelagic Foraminifera (Globigerinidæ, Pulvinulina), coccoliths and rhabdoliths.

RESIDUE (14.7%)

Minerals [2%], m.di. 0.2 mm., pumice chiefly; one piece of quartz 0.4 mm. in diameter observed.

Siliceous Organisms [5%], Radiolaria, Sponge spicules, Diatoms.

Fine Washings [7.7%], amorphous clayey matter.

U.S.S. "Tuscarora," 25 December, 1875, lat. 3° 21′ S., long. 171° 23′ W., 2,835 fathoms.

GLOBIGERINA OOZE (with many Radiolaria), fawn colour, fine grained.

CALCIUM CARBONATE (42.09%), pelagic Foraminifera, mostly in a fragmentary condition, numerous coccoliths (some very large), Tunicate spicules, and much crystalline and amorphous calcareous matter.

RESIDUE (57.91%)

Minerals [1%], a few manganese grains, palagonitic and glassy particles.

Siliceous Organisms [25%], Radiolaria, Diatoms, Sponge spicules, and one or two small arenaceous Foraminifera.

Fine Washings [31.91%], amorphous clayey matter.

H.M.S. "Penguin," Sounding 263, 10 August, 1895, lat. 16° 23′ S., long. 178° 2′ 45″ W., 1,497 fathoms.

GLOBIGERINA OOZE, fawn colour.

CALCIUM CARBONATE [80%], pelagic Foraminifera (many young), one or two bottom-living Foraminifera, coccoliths, rhabdoliths.

RESIDUE [20%]

Minerals [5%], pumice, magnetite.

Siliceous Organisms [1%], Radiolaria (including Challengeridæ), Sponge spicules.

Fine Washings [14%], amorphous clayey matter and minute mineral particles.

H.M.S. "Penguin," Sounding 118, 17 August, 1894, lat. 23° 2.3′ S., long. 156° 36.2′ E., 1,085 fathoms.

GLOBIGERINA OOZE, cream colour when wet, white when dry.

CALCIUM CARBONATE [80 %], pelagic and bottom-living Foraminifera (with many young forms), Ostracodes, Echini spines, coccoliths, rhabdoliths.

RESIDUE [20%]

Minerals [1%], pumice (one piece about 2 mm. in diameter observed).

Siliceous Organisms [3%], Sponge spicules, Radiolaria, Diatoms, a few brown casts and arenaceous Foraminifera.

Fine Washings [16%], amorphous clayey matter and minute fragments of minerals and siliceous organisms.

H.M.S. "Penguin," Sounding 120, 18 August, 1894, lat. 24° 23.2′ S., long. 155° 46.7′ E., 2,400 fathoms.

GLOBIGERINA OOZE, fawn colour when wet, creamy white when dry.

CALCIUM CARBONATE (52.0%), pelagic and bottom-living Foraminifera (mostly fragmentary or of small size), coccoliths, rhabdoliths.

RESIDUE (48.0%)

Minerals [5%], m.di. 0·09mm., quartz, felspar, olivine, magnetite.

Siliceous Organisms [1%], Sponge spicules.

Fine Washings [42%], morphous clayey matter and small mine al particles.

H.M.S. "Penguin," Sounding 73, 8 August, 1894, lat. 22° 49·9′ S., long. 155° 17.6′ E., 1,760 fathoms.

GLOBIGERINA OOZE, of a pale fawn colour.

CALCIUM CARBONATE [80%], pelagic and bottom-living Foraminifera, otoliths, Echini spines, coccoliths, rhabdoliths, and a few Tunicate spicules.

RESIDUE [20%]

Minerals [3%], volcanic particles, quartz.

Siliceous Organisms [1%], Sponge spicules.

Fine Washings [16%], amorphous clayey matter and minute mineral particles.

H.M.S. "Penguin," Sounding 68, 21 June, 1894, lat. 35° 41.2′ S., long. 151° 15.5′ E., 2,666 fathoms.

GLOBIGERINA OOZE, of a greenish grey colour.

CALCIUM CARBONATE [40%], pelagic and bottom-living Foraminifera, a few Pteropod fragments, Echini spines, coccoliths (very large), and many Tunicate spicules.

RESIDUE [60%]

Minerals [10%], quartz, volcanic glass and other volcanic particles, mica, felspar, glauconite, black spherules (manganese ?).

Siliceous Organisms [5%], Sponge spicules.

Fine Washings [45%], amorphous clayey matter and minute mineral particles.

H.M.S. "Penguin," Sounding 251, 8 August, 1895, lat. 18° 18.5′ S., long. 179° 19.5′ E., 1,500 fathoms.

GLOBIGERINA OOZE, of a light brown colour.

CALCIUM CARBONATE [80%], pelagic and bottom-living Foraminifera (with many young forms), coccoliths, rhabdoliths, and a few Tunicate spicules.

RESIDUE [20%]

Minerals [3%], pumice fragments, some showing signs of alteration.

Siliceous Organisms [2%], Sponge spicules and arenaceous Foraminifera.

Fine Washings [15%], amorphous clayey matter and minute particles of pumice.

H.M.S. "Penguin," Sounding 258, 9 August, 1895, lat. 17° 9.6′ S., long. 179° 50.6′ W., 1,047 fathoms.

GLOBIGERINA OOZE, fawn colour.

CALCIUM CARBONATE [75%], pelagic Foraminifera (including many young forms), a few Pteropods, Ostracodes, coccoliths, rhabdoliths, and Tunicate spicules.

RESIDUE [25%]

Minerals [8%], volcanic glass, pumice, olivine ; one piece of pumice 4.5mm. in diameter observed.

Siliceous Organisms [3%], Sponge spicules, Radiolaria, and Diatoms.

Fine Washings [14%], amorphous clayey matter and minute mineral particles.

H.M.S. "Penguin," Sounding 256, 9 August, 1895, lat. 17° 31.6′ S., long. 179° 54.7′ W., 1,374 fathoms.

GLOBIGERINA OOZE, fawn colour

CALCIUM CARBONATE [80%], pelagic and bottom-living Foraminifera, Pteropods, coccoliths, rhabdoliths, many Tunicate spicules (making up probably 2 per cent. of the whole deposit).

RESIDUE [20%]

Minerals [3%], pumice and other volcanic particles.

Siliceous Organisms [3%], Sponge spicules, Radiolaria, and Diatoms.

Fine Washings [14%], amorphous clayey matter and minute mineral particles.

H.M.S. "Penguin." Sounding 228, 1 August 1895, lat. 18° 22′ 54″ S., long. 177° 8′ 8″ W., 1,211 fathoms.

GLOBIGERINA OOZE, of a brown colour.

CALCIUM CARBONATE [60%], pelagic and bottom-living Foraminifera with a large proportion of young forms, otoliths, coccoliths, rhabdoliths, and amorphous calcareous matter.

RESIDUE [40%], dark brown.

Minerals [10%], pumice and other volcanic material.

Siliceous Organisms [5%], Sponge spicules, Radiolaria, Diatoms.

Fine Washings [25%], minute mineral particles and amorphous matter.

H.M.S. "Waterwitch," Sounding 147, 29 May, 1895, lat. 17° 13′ S., long 179° 57′ W., 1,065 fathoms.

GLOBIGERINA OOZE, light brown in colour.

CALCIUM CARBONATE [70%], pelagic and bottom-living Foraminifera (with many young forms), Pteropod fragments, Ostracodes, Echini spines, coccoliths, rhabdoliths, Tunicate spicules. Some of the shells covered with manganese.

RESIDUE [30%]

Minerals [10%], volcanic glass, pumice, palagonite, manganese grains.

Siliceous Organisms [2%], Sponge spicules, Radiolaria, arenaceous Foraminifera.

Fine Washings [18%], amorphous clayey matter and small mineral particles.

H.M.S. "Penguin," Sounding 230, 2 August, 1895, lat. 17° 25′ 49″ S., long. 177° 57′ 10″ W., 1,445 fathoms.

GLOBIGERINA OOZE, of a brown colour.

CALCIUM CARBONATE (62.7%), pelagic and bottom-living Foraminifera with many young forms, coccoliths, rhabdoliths.

RESIDUE (37.3%), chocolate colour

Minerals [7%], principally pumice and associated minerals.

Siliceous Organisms [1%], Radiolaria, Sponge spicules, Diatoms.

Fine Washings [29.3%], amorphous clayey matter and minute mineral particles.

H.M.S. "Waterwitch," Sounding 106, 13 May, 1895, lat. 33° 10′ 18″ S., long. 173° 58′ 42″ E., 1,724 fathoms.

GLOBIGERINA OOZE, light grey in colour.

CALCIUM CARBONATE [75%], pelagic and bottom-living Foraminifera, coccoliths, rhabdoliths.

RESIDUE [25%], dark brown.

Minerals [1%], pumice, blown particles of quartz, augite.

Siliceous Organisms [2%], Sponge spicules, Radiolaria, Diatoms, arenaceous Foraminifera.

Fine Washings [22%], amorphous clayey matter and small mineral particles

H.M.S. "Egeria," Sounding 6, 28 April, 1889, lat. 33° 36′ S., long. 161° 25½′ E., 946 fathoms.

GLOBIGERINA OOZE, grey when wet, nearly white when dry.

CALCIUM CARBONATE [75%], pelagic and bottom-living Foraminifera, Echini spines, coccoliths, rhabdoliths.

RESIDUE [25%], dark brown.

Minerals [4%], volcanic glass, pumice, palagonite, wind-blown quartz crystals covered with limonite.

Siliceous Organisms [4%], Sponge spicules, Radiolaria, Diatoms, arenaceous Foraminifera.

Fine Washings [17%], amorphous clayey matter and minute mineral particles.

H.M.S. "Waterwitch," Sounding 133, 20 May, 1895, lat. 18° 48′ 34″ S., long. 178° 0′ 30″ E., 1,180 fathoms.

GLOBIGERINA OOZE, brown.

CALCIUM CARBONATE [35%], pelagic and bottom-living Foraminifera, Pteropod fragments, Ostracodes, Echini spines, coccoliths, rhabdoliths, Tunicate spicules.

RESIDUE [65%]

Minerals [7%], volcanic glass, pumice, magnetite.

Siliceous Organisms [3%], Sponge spicules, arenaceous Foraminifera.

Fine Washings [55%], amorphous clayey matter and minute mineral particles.

H.M.S. "Penguin," Sounding 260, 9 August, 1895, lat. 16° 54.5′ S., long. 179° 32′ W., 779 fathoms.

GLOBIGERINA OOZE, of a light brown colour.

CALCIUM CARBONATE [75%], pelagic and bottom-living Foraminifera, otoliths, Echini spines, coccoliths, rhabdoliths, Tunicate spicules. Only one doubtful Pteropod fragment observed.

RESIDUE [25%], dark brown.

Minerals [5%], pumice (including a few large pieces) and other volcanic particles.

Siliceous Organisms [3%], Sponge spicules, Radiolaria, Diatoms, arenaceous Foraminifera.

Fine Washings [17%], amorphous matter and small mineral particles.

A sounding taken by H.M.S. "Waterwitch" near this position and at a similar depth (lat. 16° 56′ 10″ S., long. 179° 32′ 30″ W., 776 fathoms) differed from this deposit in the presence of numerous Pteropod shells and fragments, so that it would be called a Pteropod Ooze.

U.S.S. "Enterprise," lat. 45° 2′ S., 178° 21 'W., 996 fathoms.

GLOBIGERINA OOZE, white, with bluish tinge when wet.

CALCIUM CARBONATE [80%], pelagic and bottom-living Foraminifera, Echini spines, coccospheres, coccoliths (abundant and very large).

RESIDUE [20%]

Minerals [2%], quartz, manganese, glauconite, pumice.

Siliceous Organisms [3%], Sponge spicules, Diatoms, arenaceous Foraminifera.

Fine Washings [15%], minute fragments of minerals and amorphous clayey matter.

U.S.S. "Enterprise," lat. 45° 11′ S., long. 177° 53′ W., 1,381 fathoms.

GLOBIGERINA OOZE, light grey (nearly white), fine grained.

CALCIUM CARBONATE [70%], pelagic and bottom-living Foraminifera, Echini spines, coccoliths.

RESIDUE [30%]

Minerals [2%], pumice and glassy particles.

Siliceous Organisms [1%], Sponge spicules.

Fine Washings [27%], amorphous matter and small mineral particles.

H.M.S. "Egeria," Sounding 4, 26 April, 1889, lat. 33° 44′ S., long. 156°0½′ E., 2,800 fathoms.

GLOBIGERINA OOZE, greenish white, homogeneous, clayey, of a very fine texture.

CALCIUM CARBONATE (45.3%), fragments and young specimens of pelagic Foraminifera, coccoliths, rhabdoliths, Tunicate spicules, amorphous calcareous matter.

RESIDUE (54.7%), dark grey.

Minerals [2%], angular and rounded, m.di. 0.07mm.; principally pumice, augite, volcanic glass, one or two grains of quartz; some crystals covered with limonite.

Siliceous Organisms [1%], Sponge spicules, Diatoms.

Fine Washings [51.7%], amorphous clayey matter and minute mineral particles.

H.M.S. "Egeria," Sounding 2, 20 June, 1890, lat. 33° 1′ S., long. 170° 5.7′ E., 2,258 fathoms.

GLOBIGERINA OOZE, white, chalky, exceedingly fine in texture, most of the calcareous matter in an amorphous condition, very few of the Foraminifera shells being perfect.

CALCIUM CARBONATE [75%], pelagic Foraminifera, coccoliths.

RESIDUE [25%], brown.

Minerals [10%], angular and rounded pumice (one fragment of augitic pumice 5mm. in diameter), quartz, augite, hornblende, felspars.

Siliceous Organisms [5%], Sponge spicules, Radiolaria.

Fine Washings [10%], amorphous clayey matter, minute minerals, peroxides of iron and manganese.

H.M.S. "Penguin," Sounding 239, 3 August, 1895, lat. 17° 18′ S., long. 179° 56.2′ W., 491 fathoms.

PTEROPOD OOZE, fawn colour when wet, cream colour when dry. This sounding seems to indicate a rise surrounded on all sides by deeper water.

CALCIUM CARBONATE [80%], Pteropods, pelagic and bottom-living Foraminifera (with many young forms), otoliths, Ostracodes, Echini spines, Gasteropods, coccoliths, rhabdoliths, Tunicate spicules. Some of the shells covered with manganese.

RESIDUE [20%]

Minerals [5%], pumice, volcanic glass, palagonite, manganese grains.

Siliceous Organisms [2%], Sponge spicules, Radiolaria, arenaceous Foraminifera.

Fine Washings [13%], amorphous clayey matter and small mineral particles.

H.M.S. "Penguin," Sounding 243, 3 August, 1895, lat. 17° 51.8′ S., long. 179° 12.7′ E., 650 fathoms.

PTEROPOD OOZE, fawn colour. The deposit was formed into lumps in the bottle.

CALCIUM CARBONATE [80%], Pteropods, pelagic and bottom-living Foraminifera, otoliths, Ostracodes, Echini spines, coccoliths, rhabdoliths, Tunicate spicules.

RESIDUE [20%]

Minerals [3%], pumice and other volcanic particles.

Siliceous Organisms [3%], Sponge spicules, Radiolaria, Diatoms, arenaceous Foraminifera.

Fine Washings [14%], amorphous clayey matter and minute mineral particles.

H.M.S. "Penguin," Sounding 69, 7 August, 1894, lat. 23° 30.3′ S., long. 153° 52.7′ E., 660 fathoms.

PTEROPOD OOZE, containing about 65 per cent. of carbonate of lime.

This deposit was received in two bottles marked respectively upper stratum and lower stratum. The upper stratum is darker in colour than the lower, being brownish grey, while the lower stratum in the bottle showed two layers (the lower quite bluish grey the upper light grey). The upper stratum contained many arenaceous Foraminifera (which were not observed in the lower stratum), and the Foraminiferous shells were coloured brown by managanese (of which there was no trace n the lower stratum).

H.M.S. "Penguin," Sounding 329, 20 August, 1895, lat. 14° 4.1′ S., long. 171° 49.5′ W., 1,027 fathoms.

PTEROPOD OOZE,

CALCIUM CARBONATE (70.3%), Pteropod fragments, pelagic and bottom-living Foraminifera, otoliths, amorphous calcareous matter.

RESIDUE (29.7%)

Minerals [2%], pumice and other volcanic particles.

Siliceous Organisms [10%], Sponge spicules, Radiolaria.

Fine Washings [17.7%], amorphous matter and minute mineral particles.

H.M.S. "Waterwitch," Sounding 131, 20 May, 1895, lat. 19° 9′ S., long. 77.° 52′ 40″ E., 1,102 fathoms.

PTEROPOD OOZE, of a light brown colour.

CALCIUM CARBONATE [40%], Pteropods, pelagic and bottom-living Foraminifera, Ostracodes, Echini spines, coccoliths, rhabdoliths, Tunicate spicules.

RESIDUE [60%], dark brown.

Minerals [20%], pumice, volcanic glass, mica.

Siliceous Organisms [3%], Sponge spicules, Radiolaria, arenaceous Foraminifera.

Fine Washings [37%], amorphous matter and minute mineral particles.

H.M.S. "Penguin," Sounding 236, 3 August, 1895, lat. 16° 45.5′ S., long. 179° 14.2′ W., 771 fathoms.

PTEROPOD OOZE, of a fawn colour.

CALCIUM CARBONATE [90%], Pteropods, pelagic and bottom-living Foraminifera, Ostracodes, Echini spines, Polyzoa, coccoliths, rhabdoliths, Tunicate spicules.

RESIDUE [10%], brown.

Minerals [1%], volcanic glass, pumice.

Siliceous Organisms [2%], Sponge spicules, Radiolaria, arenaceous Foraminifera.

Fine Washings [7%], amorphous matter and minute mineral particles.

H.M.S. "Penguin," Sounding 381, 30 December, 1895, lat. 28° 44.4′ S., long. 176° 4′ W., 5,147 fathoms.

RED CLAY (or Volcanic Mud), grey-brown, homogeneous, containing no carbonate of lime.

Minerals [40%], m.di. 0.08mm.; principally disintegrated pumice (the largest fragments 2mm. in diameter), much magnetite and palagonite, along with augite, hornblende, felspars.

Siliceous Organisms [1%], Radiolaria, arenaceous Foraminifera.

Fine Washings [59%], amorphous clayey matter with enormous numbers of minute particles of pumice and other unrecognisable minerals.

The upper layer of this deposit was examined separately, but no differences were observed that would alter the above determinations.

H.M.S. " Penguin," Sounding 383, 31 December, 1895, lat. 30° 27.7′ S., long. 176° 39′ W., 5,155 fathoms.

RED CLAY (or Volcanic Mud), light grey, containing a few gritty particles of pumice and of a greenish rock, the largest about 5mm. in diameter. No calcareous organisms, nor siliceous organisms, observed.

Minerals [40%], m.di. 0.1mm ; principally fragments of felspathic pumice, with a few fragments of augitic pumice, felspars, augite, hornblende (?), much magnetite, small fragments of a greenish coloured rock, and a few palagonitic particles.

Fine Washings [60%], amorphous clayey matter with minute indeterminable particles of minerals as enumerated above.

H.M.S. " Penguin," Sounding 377, 27 December, 1895, lat. 24° 5.8′ S., long. 174° 17.4′ W., 3,185 fathoms.

RED CLAY (or Volcanic Mud), uniform brown colour when wet, grey when dry, containing a few macroscopic pieces of pumice, the largest 2 to 3mm. in diameter. There was no effervescence when treated with dilute acid, but a fragment of a calcareous Foraminifera and a fragment of a fish's tooth were noticed among the washings.

Minerals [40%], m.di. 0.07mm. (excluding the larger fragments of pumice), angular and rounded ; principally grey felspathic pumice, augite, hornblende, much magnetite, palagonite.

Siliceous Organisms [4%], arenaceous Foraminifera, Sponge spicules, Radiolaria.

Fine Washings [56%], amorphous clayey matter with minute particles of pumice.

H.M.S. " Penguin," Sounding 379, 28 December, 1895, lat. 26° 43.2′ S., long. 175° 13.7′ W., 3,350 fathoms.

RED CLAY, grey-brown, homogeneous, containing no carbonate of lime ; showed dark lines, when the bottle was shaken, due to minute grains of magnetite about 0.02mm. in diameter.

Minerals [12%], m.di. 0.07mm., angular and rounded ; principally fragments of felspathic pumice, the largest about 1mm. in diameter, with many small fragments of magnetite.

Siliceous Organisms [2%], Radiolaria, Sponge spicules.

Fine Washings [86%], amorphous clayey matter and minute splinters of pumice.

H.M.S. " Penguin," Sounding 391, 3 January, 1896, lat. 33° 50′ S., long. 178° 49·5′ W., 3,037 fathoms.

RED CLAY, grey-brown, homogeneous, principally composed of comminuted fragments of pumice.

CALCIUM CARBONATE [1%], minute fragments of pelagic Foraminifera.

RESIDUE [99%],

Minerals [7%], m.di. 0.07mm., mostly elongated splinters of felspathic pumice.

Siliceous Organisms [10%], Radiolaria, Diatoms, arenaceous Foraminifera.

Fine Washings [82%], amorphous clayey matter with angular fragments of pumice.

H.M.S. " Penguin," Sounding 390, 3 January, 1896, lat. 32° 59.7′ S., long. 178° 11.9′ W., 3,071 fathoms.

RED CLAY, grey-brown, homogeneous, composed of broken-down pumice, the largest piece about 3mm. in diameter ; a macroscopic grain of manganese, about 2.5mm. in diameter, was also noticed.

CALCIUM CARBONATE [3%], pelagic Foraminifera, Echini spines.

RESIDUE [97%].

Minerals [10%], m.di. 0.08mm., angular and rounded ; felspathic pumice, much magnetite, palagonite.

Siliceous Organisms [3%], principally arenaceous Foraminifera, Radiolaria, Sponge spicules, Diatoms.

Fine Washings [84%], minute comminuted fragments of pumice and amorphous clayey matter.

H.M.S. " Penguin," Sounding 384, 1 January 1896, lat. 31° 15.3′ S., long. 177° 18.4′ W., 3,715 fathoms.

RED CLAY (or Volcanic Mud), light brown or fawn when wet, light grey when dry ; containing no carbonate of lime ; with many rounded fragments of pumice, the largest over 1cm. in diameter, having many crystals of felspars, augite and magnetite projecting from their surfaces.

Minerals [50%], m.di. 0.07mm. (excluding the larger fragments of pumice), angular and rounded ; principally grey felspathic pumice, much magnetite, augite, hornblende, palagonite.

Siliceous Organisms [2%], Radiolaria, Sponge spicules, and arenaceous Foraminifera.

Fine Washings [48%], much amorphous clayey matter, with minute fragments of pumice less than 0.05mm. in diameter, the greater part less than 0.02mm. in diameter.

H.M.S. " Egeria," Sounding 47, 10 August, 1889, lat. 7° 52′ S., long. 171° 1½′ W., 2,766 fathoms.

RED CLAY, dark brown or chocolate colour ; slightly gritty due to pumice fragments and grains of manganese, the largest about 2mm. in diameter. There was no effervescence with dilute acid, but a few frag-

ments of pelagic Foraminifera and of fishes teeth were noticed.

Minerals [20%], m.di. 0.1mm., rounded; principally pumice fragments and manganese grains.

Siliceous Organisms [3%], Sponge spicules, Radiolaria, Diatoms.

Fine Washings [77%], amorphous clayey matter, with minute mineral particles and manganese grains.

U.S.S. "Enterprise," lat 47° 8′ S., long. 168°W., 2,972 fathoms.

RED CLAY, of a grey colour, containing no carbonate of lime.

Minerals [3%], pumice, glassy particles, manganese.

Siliceous Organisms [2%], Sponge spicules, Radiolaria, Diatoms.

Fine Washings [95%], amorphous clayey matter and minute mineral particles.

Other two soundings in the same neighbourhood, viz., lat. 46° 36′ S., long. 172° 34′ W., 2,782 fathoms, and lat. 48° 16′ S., long. 160° 17′ W., 2,533 fathoms, were similar in composition to the foregoing.

U.S.S. "Enterprise," lat. 45° 45′ S., long. 176° 37′ W., 2,180 fathoms.

RED CLAY, light grey when dry, dark grey when wet.

Calcium carbonate [20%], pelagic and bottom-living Foraminifera (mostly fragmentary), coccoliths.

Residue (80%]

Minerals [1%], pumice and glassy particles.

Siliceous Organisms [2%], Radiolaria, Sponge spicules.

Fine Washings [77%], minute mineral particles and amorphous clayey matter.

U.S.S. "Enterprise," lat. 47° 22′ S., long. 164° 34′ W., 2,793 fathoms.

RED CLAY, brownish grey, containing no carbonate of lime.

Minerals [20%], pumice, rounded grains of quartz, manganese grains, greenish and yellowish minerals; piece of dark brown rock 0.5cm. in diameter.

Siliceous Organisms [1%], Sponge spicules.

Fine Washings [79%], minute mineral particles and amorphous clayey matter.

Another sounding (lat. 47° 54′ S., long. 162° 22′ W.), 2,750 fathoms, was quite similar to the above, but with apparently fewer mineral particles (probably about 10 per cent.).

U.S.S. "Enterprise," lat. 48° 52′ S., long. 166° 46′ W., 2,881 fathoms.

RED CLAY, brownish grey, containing the merest trace of carbonate of lime due to a few minute fragments of pelagic Foraminifera.

Minerals [3%], pumice (half-a-dozen particles 0.5 to 0.8mm. in diameter), and a few quartz grains.

Siliceous Organisms [1%], Spicules of Radiolaria and Sponges.

Fine Washings [96%], disintegrated pumice and amorphous clayey matter.

H.M.S. "Penguin," Sounding 331, 20 August, 1895, lat. 14° 49.4′ S, long. 171° 51.9′ W., 2,532 fathoms.

RED CLAY (or Volcanic Mud), of a brown colour.

Calcium carbonate [5%], small pelagic Foraminifera.

Residue [95%], brown.

Minerals [50%], principally small particles of pumice.

Siliceous Organisms [10%], Radiolaria (including Challengeridæ), Sponge spicules, Diatoms.

Fine Washings [35%], amorphous matter and minute mineral particles.

H.M.S. "Penguin," Sounding 330, 20 August, 1895, lat. 14° 32′ 21″ S., long. 172° 2′ 42″ W., 2,622 fathoms.

RED CLAY, brown in colour, with only a trace of carbonate of lime.

Minerals [10%], m.di. 0.08mm., minute particles of pumice and other volcanic minerals, some altered, palagonite.

Siliceous Organisms [5%], Sponge spicules, Radiolaria (including Challengeridæ), Diatoms.

Fine Washings [85%], amorphous clayey matter and minute mineral particles.

H.M.S. "Penguin," Sounding 333, 21 August, 1895, lat. 15° 32′ 28″ S., long. 172° 3′ 32″ W., 3,532 fathoms.

RED CLAY (or Volcanic Mud), brown in colour, containing no carbonate of lime. Some of the deposit was coagulated into a lump.

Minerals [30%], small particles of pumice and other volcanic material.

Siliceous Organisms [3%], Sponge spicules, Radiolaria, Diatoms.

Fine Washings [67%], amorphous clayey matter and minute mineral particles.

H.M.S. "Penguin," Sounding 326, 19 August, 1895, lat. 14° 44.8′ S., long. 173° 37.1′ W., 2,634 fathoms.

VOLCANIC MUD (or Red Clay), containing no carbonate of lime.

Minerals [80%], volcanic rock fragments (max. diameter 0.7mm.) and augitic pumice (maximum diameter 1mm.) in abundance.

Siliceous Organisms [1%], Sponge spicules.

Fine Washings [19%], amorphous matter and fine mineral particles.

H.M.S. "Waterwitch," Sounding 134, 21 May, 1895, lat. 18° 27′ 10″ S., long. 178° 27′ E., 1,130, fathoms.

VOLCANIC MUD, brown, clayey.

CALCIUM CARBONATE [40%], pelagic and bottom-living Foraminifera, Pteropod fragments, Echini spines, otoliths, Coral fragments, coccoliths, rhabdoliths, Tunicate spicules.

RESIDUE [60%]

Minerals [20%], olivine, mica, pumice, manganese grains, volcanic glass.

Siliceous Organisms [2%], Sponge spicules, arenaceous Foraminifera, imperfect casts.

Fine Washings [38%], amorphous clayey matter and minute mineral particles.

H.M.S. "Waterwitch," Sounding 135, 21 May, 1895, lat. 18° 18′ 50″ S., long. 178° 24′ 45″ E. 795 fathoms.

VOLCANIC MUD, brown, clayey.

CALCIUM CARBONATE [25%], pelagic and bottom living Foraminifera, Pteropod fragments, otoliths, Ostracodes, coccoliths, rhabdoliths, Tunicate spicules. Some of the shells coloured brown or black by manganese.

RESIDUE [75%]

Minerals [10%], pumice, mica, olivine.

Siliceous Organisms [5%], Sponge spicules, Radiolaria, arenaceous Foraminifera, imperfect casts.

Fine Washings [60%], amorphous clayey matter and small mineral particles.

H.M.S. "Penguin," Sounding 336, 22 August, 1895, lat. 16° 28.8′ S., long. 173° 1.4′ W., 1,611 fathoms.

VOLCANIC MUD, grey-brown in colour.

CALCIUM CARBONATE [10%], pelagic and bottom living Foraminifera (with many young forms), coccoliths.

RESIDUE [90%]

Minerals [60%], principally pumice particles, the largest 3.5mm. in diameter.

Siliceous Organisms [3%], Sponge spicules, Radiolaria, and Diatoms.

Fine Washings [27%], amorphous clayey matter and minute mineral particles.

H.M S. "Penguin," Sounding 335, 21 August, 1895, lat. 15° 52′ 54″ S., long. 172° 36′ 49″ W., 2,427 fathoms.

VOLCANIC MUD, brown, containing grey clayey lumps.

CALCIUM CARBONATE [15%], pelagic Foraminifera, coccoliths (numerous and large), and minute Tunicate spicules.

RESIDUE [85%]

Minerals [40%], volcanic material ranging from pieces of volcanic rock (mostly unaltered) 2 to 3mm. in diameter down to the merest pumice fragments.

Siliceous Organisms [3%], Radiolaria (including Challengeridæ), Sponge spicules.

Fine Washings [42%], amorphous matter and small mineral particles.

The clayey lumps in this deposit were lighter in colour, chalky and white when dry, containing probably 10 to 20 per cent. more carbonate of lime than the looser matrix, the constituent particles being on the whole smaller, the largest mineral particles not exceeding 0.5mm. in diameter; otherwise no distinction can be drawn between the deposit itself and the enclosed aggregations.

H.M.S. "Penguin," Sounding 226, 1 August, 1895, lat. 19°24′ 14″ S., long. 176° 19′ 19″ W., 1,275 fathoms.

This position is about 80 miles N.W. of Falcon Island and the deposit might equally well be called Volcanic Mud or Globigerina Ooze.

GLOBIGERINA OOZE (or Volcanic Mud), brown in colour.

CALCIUM CARBONATE (33.5%), pelagic and bottom-living Foraminifera with many young forms, Echini spines, coccoliths, rhabdoliths, and amorphous calcareous matter.

RESIDUE (66.5%), dark brown.

Minerals [7%], principally pumice, the largest fragments about 3mm. in diameter.

Siliceous Organisms [2%], Sponge spicules, Radiolaria, Diatoms.

Fine Washings [57.5%], minute pumice particles and amorphous clayey matter.

H.M.S. "Penguin," Sounding 225, 1 August, 1895, lat. 19° 51.9′ S., long. 175 55.1′ W., 1,397 fathoms.

This position is about 40 miles N.W. of Falcon Island, and the deposit is largely composed of pumice and other volcanic material derived probably from the disintegration of that island.

VOLCANIC MUD, dark brown in colour.

CALCIUM CARBONATE [5%], pelagic Foraminifera mostly young forms, coccoliths, rhabdoliths.

RESIDUE [95%], dark brown.

Minerals [60%], m.di 0.1mm., chiefly pumice (both felspathic and augitic), the largest fragments about 1.5mm. in diameter, obsidian, palagonite, felspar.

Siliceous Organisms [1%], Sponge spicules, Radiolaria.

Fine Washings [34%], minute mineral particles and amorphous matter.

H.M.S. "Waterwitch," Sounding 126, 21 May, 1895, lat. 18° 12′ 40″ S., long. 178° 24′ 30″ E., 302 fathoms.

VOLCANIC MUD, of a greenish colour. There were indications of two layers in the bottle, the upper of a brown colour.

CALCIUM CARBONATE [35%], pelagic and bottom-living Foraminifera, Pteropod fragments,

small Lamellibranch shells, Echini spines, Ostracodes, coccoliths, rhabdoliths, Tunicate spicules.

Residue [65%]

Mineral [10%], m.di. 0.07mm., pumice and other volcanic particles. One piece of pumice 2mm. in diameter observed, but the minerals are mostly of small size.

Siliceous Organisms [3%], Sponge spicules, arenaceous Foraminifera.

Fine Washings [52%], many minute mineral particles and amorphous matter.

H.M.S. " Penguin," Sounding 266, 11 August, 1895, lat. 15° 55′ 13″ S., long. 177° 35′ 41″ W., 1,432 fathoms.

GLOBIGERINA OOZE, of a dark brown colour.

Calcium carbonate (51.8%), principally pelagic Foraminifera with a very large proportion of young forms.

Residue (48.2%), black-brown.

Minerals [3%], principally pumice (one piece 2mm. in diameter observed), manganese grains.

Siliceous Organisms [3%], Radiolaria (including young Challengeria), Sponge spicules, and Diatoms.

Fine Washings [42·2%], principally pumice in a state of fine division, with minute grains of manganese and amorphous matter.

H.M.S. " Penguin," Sounding 325, 18 August, 1895, lat. 15° 5.6′ S., long. 174° 20′ W., 1,362 fathoms.

VOLCANIC MUD, of a brown colour.

Calcium carbonate [20%], pelagic and bottom-living Foraminifera with many young forms, coccoliths, rhabdoliths.

Residue [80%]

Minerals [30%], fragments of pumice, the largest 2 to 3mm. in diameter.

Siliceous Organisms [3%], Sponge spicules, Radiolaria, Diatoms.

Fine Washings [47%], amorphous matter and minute particles of pumice.

H.M.S. " Penguin," Sounding 327, 19 August, 1895, lat. 14° 28′ 24″ S., long. 172° 48′ 22″ W., 2,835 fathoms.

Fragments of volcanic rock and volcanic glass largely converted into palagonite and coated with manganese: some of the fragments 0.5cm. in diameter.

H.M.S. " Penguin," Sounding 328, 20 August, 1895, lat. 14° 12.2′ S., long. 172° 11.1′ W., 2,128 fathoms.

VOLCANIC MUD,

Calcium carbonate [30%], pelagic Foraminifera, Coral fragments, coccoliths, rhabdoliths.

Residue [70%]

Minerals [30%], principally pumice.

Siliceous Organisms [3%], Sponge spicules, Radiolaria.

Fine Washings [37%], minute mineral particles and amorphous matter.

H.M.S. " Penguin," Sounding 342, 23 August, 1895, lat. 18° 22·7′ S., long. 173° 50.3′ W., 1,141 fathoms.

VOLCANIC MUD, brownish grey colour.

Calcium carbonate [20%], pelagic and bottom-living Foraminifera (many young), Ostracodes, coccoliths, rhabdoliths, Tunicate spicules.

Residue [80%],

Minerals [60%], m.di. 0.2mm., principally black volcanic glass and pumice, the largest particles 3.5mm. in diameter, palagonite.

Siliceous Organisms [2%], Sponge spicules, Radiolaria.

Fine Washings [18%], amorphous clayey matter and minute fragments of pumice.

U.S.S. " Enterprise," lat. 44° 41′ S., long. 178° 53′ W., 751 fathoms.

GREEN SAND (or Green Mud), light grey in colour, fine grained.

Calcium carbonate [25%], pelagic and bottom-living Foraminifera, Echini spines, coccoliths (some very large), and small Holothurian spicules.

Residue [75%]

Minerals [40%], pumice, glassy particles, quartz, glauconite, mica.

Siliceous Organisms [1%], Sponge spicules.

Fine Washings [34%], amorphous matter and fine mineral particles.

Another sounding by the " Enterprise," near Chatham Is. (lat. 44° 8′ S., long. 178° 57′ W.), 184 fathoms, indicated a Green Sand, but the very small quantity of material had the appearance of having been washed; the carbonate of lime did not apparently exceed 10 per cent., the remainder being principally mineral particles (glauconite, glauconitic casts, quartz, &c.)

U.S.S. " Enterprise," lat. 42° 27′ S., long. 175° 34′ E., 1,192 fathoms.

BLUE MUD, of a greenish colour, fine grained.

Calcium carbonate [15%], pelagic and bottom-living Foraminifera, Echini spines, coccoliths (some very large).

Residue [85%]

Minerals [10%], quartz, glauconite, glassy particles.

Siliceous Organisms [1%], Sponge spicules, Diatoms.

Fine Washings [74%], amorphous matter and fine mineral particles.

Another sounding by the " Enterprise," about midway between New Zealand and Chatham Is. (lat. 42° 7′ S., long. 178° 19′ E.), 1,320 fathoms, was similar to the foregoing, but appeared to have fewer mineral particles (probably about 5%).