XXI. *Tables of Temperatures of the Sea at different Depths beneath the Surface, reduced and collated from the various observations made between the years* 1749 *and* 1868, *discussed. With Map and Sections.* *By* JOSEPH PRESTWICH, *M.A., F.R.S., F.G.S.*

Received May 14,—Read June 18, 1874.

CONTENTS.

§ I. *Introduction.*

THIS communication, the result of an inquiry having originally reference to the bearing of the subject on certain geological questions, was commenced more than twenty years ago, but abandoned for a time, partly owing to the pressure of other engagements, and partly waiting more accurate information of the range of life at depths*. The great impulse given to these questions by the more recent expeditions of the 'Lightning'

* A few of the geological questions were, however, noticed, and some of the early deep-sea temperature-observations given, in the author's Anniversary Address to the Geological Society of February 1871, Quart. Journ. Geol. Soc. vol. xxvii. pp. xliii–lxxv.

and 'Porcupine,' culminating in that of the 'Challenger,' has not only again directed attention to the subject of deep-sea temperatures, but has led to such improved methods of observation, that it may now seem late to bring forward the less accurate experiments of former observers. It might therefore seem almost a work of supererogation, now that the subject in connexion with these later voyages has been so ably and zealously taken up by my friend Dr. CARPENTER, to introduce these more variable older elements into the discussion. Still the older observations, though restricted to comparatively limited depths, have a wide range; and in the case of the Arctic voyages they were obtained under conditions of so much difficulty and danger, that it may be long before similar experiments are repeated; while many of the original opinions evidently deserve great consideration. It was, moreover, always my intention to complete the task I had begun when time and opportunity offered; and as Dr. CARPENTER'S work commences with the observations made by him on board the 'Lightning' in 1868, it may not be out of place to have a record of all that was done in temperature-soundings* up to that time, even as supplementary to the more exact work of later voyages.

I may also notice that, notwithstanding the superiority of the more recent observations and the inaccuracy of many of the older ones, there are a certain number of the latter which were made with great care, and which may vie with recent experiments in exactness; while with respect to the others, the errors are such as may in most cases be computed and allowed for; or merely taking the old observations as they are, the *comparative* temperatures recorded at *corresponding* depths with the same or similar instruments have their own special value. The older observations are also so scattered through various narratives of voyages and in scientific periodicals, that no one can, without much difficulty of search, form an idea of their number and interest, or of the progress which the subject had made at the hands of the eminent men who had from time to time engaged in the inquiry on the Continent. I purpose, therefore, to show the state of the question at the time of the 'Lightning' expedition. For all that has been done since, I would refer to the exhaustive papers of Dr. CARPENTER†.

In former voyages the temperatures are variously noted in degrees of RÉAUMUR,

* The few old observations of life at depths will not now require notice.

† "Preliminary Report," by Dr. WILLIAM B. CARPENTER, V.P.R.S., "of Dredging Operations in the Seas to the North of the British Islands, carried on in Her Majesty's Steam-vessel 'Lightning,' by Dr. CARPENTER and Dr. WYVILLE THOMSON, Professor of Natural History in Queen's College, Belfast." Proc. Roy. Soc. vol. xvii. p. 168; Appendix, p. 197, 1868–69.

"On the Rhizopodal Fauna of the Deep Sea," by W. B. CARPENTER, M.D., V.P.R.S. *Ibid.* vol. xviii. p. 59.

"Preliminary Report of the Scientific Exploration of the Deep Sea in H.M. Surveying-vessel 'Porcupine,' during the Summer of 1869, conducted by Dr. CARPENTER, V.P.R.S., Mr. J. GWYN JEFFREYS, F.R.S., and Prof. WYVILLE THOMSON, LL.D., F.R.S." *Ibid.* vol. xviii. p. 397.

"Report on Deep-sea Researches carried on during the Months of July, August, and September 1870, in H.M. Surveying-ship 'Porcupine,'" by W. B. CARPENTER, M.D., F.R.S., and J. GWYN JEFFREYS, F.R.S. *Ibid.* vol. xix. p. 146.

"Report on Scientific Researches carried on during the Months of August, September, and October, 1871, in H.M. Surveying-ship 'Shearwater,'" by WILLIAM B. CARPENTER, LL.D., M.D., F.R.S. *Ibid.* vol. xx. p. 535.

FAHRENHEIT, and Centigrade, and the depths are recorded in feet, fathoms, the 'old French foot,' 'toise'*, 'brasse,' 'mètre,' and the 'yaden,' while the longitude is sometimes that of Greenwich, at others that of Paris. I have reduced these various measures to a common scale, adopting for temperatures that of FAHRENHEIT; for length, the English foot; and for longitude, the meridian of Greenwich. As in these reductions some errors may have crept in, references are given to all the original readings.

In the Lists of Observations (pp. 639–70) the degrees of temperature at depths stand as they are recorded by the several observers, without the correction adopted for the Sections. The place of each observation is laid down on a recent Admiralty Chart of the world (Plate 65), in accordance with the longitude and latitude given by each observer, without any attempt at correction, which, in some of the early observations, may possibly be necessary.

The observations thus reduced are tabulated in three groups. Table I. gives the deep-sea temperatures in the Northern Hemisphere from the Equator to the Polar Circle, and in the same way Table II. gives those in the Southern Hemisphere. The observations in inland seas are given in a separate Table, No. III.

A list of temperature-soundings, made up to date, was given by PÉRON in 1816. It was limited to 4 of his own, and to 16 of FORSTER'S and IRVING'S†. In 1832 D'URVILLE‡ gave a greatly extended list, embracing as many as 421 observations, which he arranged according to zones of depth; and in 1837 GEHLER§ published a list of 226 observations arranged according to latitude. These, I believe, constitute all the general lists that have been published. The number of observations recorded in the present Tables amount to 1356.

In the following pages I have given:—first, a notice of the many voyages on which soundings for deep-sea temperatures were taken, with an account, when possible, of the mode in which the observations were made; secondly, a summary of the opinions founded on these data; and thirdly, a statement of the results obtained and of the conclusions to be formed thereon.

Besides the error due to pressure, which, as so many of the older soundings were made at small depths, is frequently unimportant, there is that arising from the angle of the line from the vertical caused by currents, and another due to the tension of the rope by strain and wet, which is sometimes not inconsiderable. I have, however, in drawing the sections, given the depths without correction for these causes, so as to place all the observations on the same footing, as it is but rarely, although there are exceptions, that these particular sources of error were noticed or mentioned ‖.

* The Old Foot=12·79 inches; the Toise=76·68 inches; the Brasse=63·93 inches.

† Voyage de découverte aux Terres Australes, vol. ii. p. 327.

‡ Voyage de l'Astrolabe, vol. x. Chap. III. Physique.

§ GEHLER'S Physikalisches Wörterbuch. Sechster Band, Dritte Abtheilung, Mc–Mj, pp. 1676–82.

‖ The older deep-sea soundings have been found to be liable to serious error, arising from the difficulty in actual fixing the depth of sounding; but in these Tables there are few of that depth to involve this particular error; still some of the deeper ones must be looked upon with doubt.

Owing to the want of a reliable self-registering thermometer, three plans were resorted to by the earlier observers to ascertain the temperature of the sea at depths below the surface. The first and more common plan was to bring up water from a determined depth in sufficient quantity and with sufficient speed to prevent any material change of temperature, and then to try it with an ordinary thermometer, although sometimes the thermometer was suspended in and descended with the water-bucket. In the second place, the thermometer was surrounded with a non-conducting substance, and left down a length of time sufficient to acquire the temperature of the surrounding medium and then brought rapidly to the surface. In the third place, the temperature was taken by means of mud or silt brought up from the bottom. On a few occasions metallic thermometers have been tried, but not with satisfactory results. These several plans continued in use from time to time up to a comparatively late period, until gradually superseded by self-registering thermometers.

As the error due to pressure in the use of the latter instrument has now been determined with sufficient accuracy, most of the older observations can readily be subjected to correction. Such correction has been applied to all the observations that have been used in constructing the Sections, Plates 66–68; but, as in the Tables themselves the original readings are given without correction, in order to obtain in any case, with a few exceptions named, an approximately true reading, the correction given at p. 612 must be applied. Where, from the use of proper precautions, the original readings are presumed to be correct, they are distinguished by being placed between brackets in the Sections.

§ II. *Historical Narrative of Deep-sea Observations*, 1749–1868.

In this chapter I have enumerated in chronological order the various voyages on which I have found any record of deep-sea temperatures—stating generally the course gone over, the number of observations made, the depths attained, the methods employed. At the end the correction for the errors attendant on these methods is determined. The particulars of the observations taken on each voyage will be found in the Tables by reference to Column VIII., under which is given the name of the officer in command, or of the scientific observer accompanying the expedition. The conclusions formed by them on these data are reserved to the next chapter.

It was about the middle of the last century that the subject of deep-sea temperatures first began to attract attention. In 1749 Captain Ellis, on the occasion of a voyage to the north-west coast of Africa, made two experiments at depths of 3900 and 5346 feet in lat. 25° 13′ N.*, with an instrument devised by Dr. Hales, and described by him in a paper to the Royal Society†. It consisted of a bucket about the size of an ordinary pail, with valves at top and bottom, which remained open as the apparatus descended, and closed as it ascended. He obtained in both cases readings of 53°; and he rightly attributed this uniformity to the greater depth of water through which, in the deeper experiment, the instrument had to be hauled, and which caused a larger gain of heat.

* Phil. Trans. for 1751–1752, vol. xlvii. p. 214. † *Ibid.* p. 213.

No further attempts of the kind seem to have been made until 1772, when COOK* went, with FORSTER† as naturalist, on his first voyage round the world. They each separately record three experiments made, at depths of 600 feet, between the equator and 64° South latitude, and they both recognized the decrease, within certain latitudes, of the temperature with depth. From some unexplained cause, the experiments were soon discontinued. No mention is made either in COOK's or FORSTER's narrative of the instruments used, except that the latter alludes (p. 45) to the use of thermometers, while PÉRON speaks (p. 318) of FORSTER's "cylindre à double soupape;" so it may be presumed that he used HALE's apparatus with an ordinary thermometer enclosed in it. The apparatus was left at the bottom from 15 to 30 minutes.

In 1773, on the occasion of Captain PHIPPS's‡ voyage to Spitzbergen, he was furnished by the Royal Society with instructions how "to direct his inquiries." Sailing past Shetland and the Faroe Islands, to the west and north coasts of Spitzbergen, he reached 80° 48′ N. latitude. Dr. IRVING, who accompanied the expedition, made nine observations at depths varying from 192 to 4098 feet, and extending from the German Ocean to the north of Spitzbergen. They first of all used thermometers contrived by Lord CHARLES CAVENDISH§ in 1757. They were on the principle of overflow thermometers, which registered the temperature by subtracting from a column of mercury of given length the portion which passed over into an attached receiving bulb, and comparing the instrument before and after with a standard thermometer; but, owing to its delicacy, difficulties of manipulation, and errors by compression, this instrument was soon abandoned. IRVING then devised a water-bottle with a coating of wool 3 inches thick, and shutting inside with a cone of lead when at the bottom. The temperature was taken when brought to the surface. For moderate depths the results, which are recorded in the Tables, seem to have been tolerably correct. Those obtained with CAVENDISH's thermometer are, on the contrary, so discordant‖ that I have not included

* Voyage towards the South Pole, 1772–1775. By Capt. COOK. 2nd edit. London, 1777, pp. 25, 29, 39.

† Voyage round the World, 1772–1775, in H.M.S. 'Resolution.' By GEORGE FORSTER, F.R.S. London, 1787, vol. i. pp. 48, 50, 51.

‡ A voyage towards the North Pole, undertaken by His Majesty's commands in 1773. London, 1774. Appendix, pp. 141–7.

§ Phil. Trans. vol. l. p. 308, and vol. liv. p. 261.

‖ I annex them here, for the purpose of record, with the correction for compression and unequal expansion of spirits afterwards introduced by CAVENDISH and applied by PHIPPS.

	North Latitude.	East Longitude.	Depth in feet.	Temperature in degrees of Fahr.		
				By therm.	Corrected.	Air.
1773, June 20	67° 5′	0° 46′	4680	15°	26°	48° 5′
„ „ 30 A.M. ..	70 8	10 55	708	30	31	40 5
„ „ 30 P.M. ..	70 8	10 ?	690	33	33[1]	44 75
„ Aug. 31	69 0	0 18	4038	22	32	59 5

[1] In this experiment the water brought up in IRVING's water-bottle gave a reading of 38°·5.

them in the Tables. The general conclusion PHIPPS and IRVING drew was that, except in Arctic seas, the temperature decreased with the depth.

In 1780 SAUSSURE made the two first observations on the temperature of the Mediterranean*—one off Genoa at a depth of 944 feet, and the other off Nice at a depth of 1918 feet. Both the thermometers marked 55°·8, or, allowing his correction, about 55°·5, a singularly close approach to the more recent observations of AIMÉ and others. SAUSSURE used a spirit-thermometer of RÉAUMUR'S with a large ball, which he surrounded with a mixture of wax, resin, and oil 3 inches thick; and the whole was then placed in an iron-wire cage. In both cases he sunk the thermometers at 7 o'clock in the evening, and left them down until 7 in the morning, so that they might acquire precisely the temperature of the surrounding water. The one sunk 1918 feet deep took twenty-four minutes to haul in, and he inferred that this would give the true temperature within a fraction (one fifth) of a degree. The thermometer was specially made and graduated for the experiment; and he had previously ascertained that after lowering it to a temperature of 2°·3 R., and arranging so that by constant moving it traversed 1000 feet of water at 14° R. in ten minutes' time, the instrument had only risen one tenth of a degree, or to 2°·4.

In 1800–4 a voyage of circumnavigation was undertaken by command of the Emperor Napoleon. Monsieur F. PÉRON† accompanied it as naturalist and physicist; but, owing to the indifference of the officers and ill-will of the men, he was unable to make more than 4 uncertain experiments, all in the tropical seas, and at depths only of from 320 to 2270 feet, the lowest temperature recorded being 45°·5 in lat. 4° N. M. PÉRON, not satisfied with former methods, employed a mercurial REAUMUR'S thermometer, placed in a glass cylinder, with cotton-wool to protect it. This was enclosed in a wooden cylinder sufficiently large to allow of a packing between the two of powdered charcoal, and then put in a tin case, which was wrapped round with oil-cloth. The value of the results to be obtained by such protected instruments necessarily depends, as in the case of SAUSSURE'S experiments, upon leaving the thermometer down for some hours; but in one case only was M. PÉRON allowed to leave his apparatus down 1 hour 50 minutes, and once he had to haul it up after five minutes' submergence. PÉRON refers to and tabulates the experiments of his predecessors, and remarks on the same law of the temperature decreasing from the surface downwards.

In 1803 the 'Neva' sailed on a voyage of circumnavigation, under the command of Captain KRUSENSTERN. Touching at Falmouth, he passed round Cape Horn to the Sandwich Islands, Kamtschatka, Japan, and back by the Cape of Good Hope. KRUSENSTERN took out with him an apparatus made in St. Petersburg on the model of HALES'S; but this was abandoned for SIX'S self-registering thermometer, which, although invented in 1782, was now for the first time employed at sea. Some thirty experiments were made by

* Voyages dans les Alpes. Neufchâtel, 1796, vol. iii. pp. 153 & 196.

† Voyage de Découvertes aux Terres Australes en 1800–4, rédigé par M. F. PÉRON, Nat. de l'Expéd. Paris, 1816, pp. 334–37.

him and Dr. HORNER in the tropical regions of the Pacific* and the Sea of Okhotsh. We have no description of his water-bucket, and are therefore without means of judging of the exact value of the results. The more numerous experiments made, on the other hand, by Dr. HORNER† with SIX'S thermometer admit of correction.

A subject of so much interest did not escape the attention of SCORESBY; and he gives a Table of the twenty-four observations made by him in the seas around Spitzbergen, during his several voyages to the Arctic Ocean between 1810 and 1822, at depths varying from 78 to 4566 feet‡. He made use of an apparatus (no doubt based on that of HALES) consisting "of a cask capable of holding 10 gallons of water, composed of 2 inches of fir plank, as being a bad conductor of heat." Each end of the cask was furnished with a valve; these were connected with a wire so as to move simultaneously. They opened in descending and closed in ascending. The cask was allowed to remain down half an hour, and was hauled up briskly. A common thermometer was then used to ascertain the temperature of the water so brought up. This machine soon, however, got out of order, and he had one cast in brass, 14 inches in length by $5\frac{1}{2}$ inches in diameter, which he called a marine diver. This he employed in all his experiments on and after the 1st May, 1811. A SIX'S thermometer was enclosed, which could be read off through two glass sides in the "diver" on coming to the surface. The weight of the machine was 23 lbs. He recognized in these seas a uniform though slight increase of temperature from the surface to the greatest depth he attained, the temperature at the surface being generally 28° to 29°, and increasing in descending to 36° and even 38° (uncorrected). In a subsequent voyage he gives, however, an experiment made 7° or 8° further south, and off the coast of Greenland, in which the reverse held good; the surface-temperature being 34°, and at a depth of 678 feet 29° §.

Objections have been raised to SCORESBY'S experiments, on the ground that they do not accord with those of MARTINS and BRAVAIS, which were made with more exact modern instruments. But these observers themselves accept SCORESBY'S observations as true, subject to small corrections. The differences between them are, in fact, more apparent than real, and arise chiefly from the circumstance that their observations were made in the months of July and August, when the temperature of the air averaged from 35° to 45°, and that of the surface-water from 38° to 42°, whereas SCORESBY experimented in April and May, when these had temperatures respectively of 20° to 34° and of 28° to 30°, so that the relative differences between the surface and the deep waters are necessarily very different in the two cases. In the experiments at depths below 2000 feet there is little discordance after applying the corrections employed by MARTINS and BRAVAIS. The latter, however, took no depth exceeding 2854 feet, while SCORESBY gives

* Voyage round the World in the years 1803–6. English translation. London, 1813, vol. i. pp. 187 & 203.

† HORNER'S observations are recorded by GEHLER (note, p. 589). They are given under his name, and not that of KRUSENSTERN, in the Tables. See also the original work of KRUSENSTERN.

‡ Account of the Arctic Regions. Edinburgh, 1820, p. 187.

§ Journal of a Voyage to the Northern Whale Fishery in the year 1822. Edinburgh, 1823, p. 237.

two exceeding 4000 feet; and these were made at some distance from those of the French observers, who experimented chiefly between Norway and lat. 76° N., whereas SCORESBY'S observations were mostly north of that latitude, and in the sea west of Spitzbergen as far as 80° north.

It is easy to determine the depth at which, in inland seas like the Mediterranean, the effect of the diurnal variation of temperature ceases, but it is a much more difficult problem in Arctic seas. Exposed to the low temperatures of an Arctic climate, the surface-waters may continue to sink until their temperature is reduced to 25°·4, the point at which they attain their maximum of density. This, however, can only happen in a state of perfect calm or with waters of unusual saltness, as sea-water of the usual specific gravity freezes under ordinary conditions at 27°·4 F., though it has been shown that in a state of perfect rest it may be reduced to 20°, or even lower before freezing.

Under these conditions, and with the complicated action of warm currents from the south and of cold currents from the north, we must expect to find considerable variation in the temperature of the Arctic Ocean, down, at all events, to the depths hitherto reached of 4600 feet. Judging from the conditions prevailing in the Antarctic seas and the sea of Baffin Bay, it seems probable that more uniform readings will be obtained at greater depths, and that the anomalous readings in the upper strata are caused by the warmer waters which flow in from the south tending to take at and near the surface the temperature of the air at different seasons, while the deeper part of this mass of warm water remains unaffected; and in the deeper channels there may be, flowing from the north, the more permanent body of cold water produced by the winter refrigeration of the polar seas of still higher latitudes.

Subject to the corrections for the causes before named, SCORESBY'S experiments command confidence. The effect of the corrections will be to reduce his readings where SIX'S thermometer was used, while where the water-bucket alone was used a small addition may be generally needed.

In the mean time (1815–18) another Russian voyage of circumnavigation *, under the command of OTTO VON KOTZEBUE, was undertaken for scientific purposes. One hundred and sixteen carefully conducted experiments (often taken from day to day) were made in both the great oceans and amongst the islands of the Eastern Archipelago. These observations, many of them serial, taken at depths of from 24 to 2448 feet, were tabulated in the order of date. On this voyage KOTZEBUE used English-made (JONES) SIX'S thermometers. They were protected by a wooden case closed with "wire grating," but not in any other way, and they were fastened on the sounding-line about 6 feet above the weight. KOTZEBUE considered that "seven or eight minutes suffice to give it the temperature of the surrounding water, and a quick or a slow pulling up has no effect on the observation" (vol. i. p. 89).

* Entdeckungs-Reise in die Süd-See und nach der Berings-Strasse zur Erforschung einer nordöstlichen Durchfahrt auf dem Schiffe Rurick (Weimar, 1821), dritter Band, von dem Naturforscher der Expedition Dr. CHAMISSO, Tables, p. 230; and Dr. HORNER'S Report thereon, p. 233.

In 1816 Captain WAUCHOPE made two observations in the Atlantic, a few degrees north and south of the equator, at depths of 2880 and 6060 feet, and records temperatures at those depths of 51° and 42° *. The apparatus he used consisted of "a series of cases, one within the other, having valves opening up so as to allow the water to pass through in descending, but which closed in hauling the instrument up. The thermometer was enclosed in a glass tube in the centre of it." Elsewhere he mentions that the cases were $\frac{1}{4}$ of an inch apart, except the outer one, which was $\frac{1}{2}$ an inch, and that one was filled with tallow. This was enclosed in a case of wood 1 inch thick. The machine was 2 feet high by 10 inches in diameter. The time it took to haul up was from twenty minutes to one hour and twenty minutes. After all, as SIX'S thermometer was used, the correction to be applied is rather that due to pressure than to the change of medium. In measuring the depth, Captain WAUCHOPE allowed for the angle of the rope from the vertical.

In 1817, on the occasion of the voyage of the 'Alceste' to China, a few experiments were made by CLARKE ABEL† in the shallow waters of the Yellow Sea. No particulars of the methods he adopted are given.

In 1818 attention was again directed in this country to the Arctic seas, and the 'Isabella' and 'Alexander' were despatched to Baffin Bay, under the command of ROSS‡ and PARRY; and the 'Dorothea' and 'Trent' to Spitzbergen, under BUCHAN and FRANKLIN§. As many as 72 valuable observations on deep-sea temperatures and soundings were made by the several commanders, assisted by SIR EDWARD SABINE, who accompanied Ross, and by BEECHEY and FISHER, who accompanied FRANKLIN. Some of these are recorded in the narratives of the several voyages, and the others are given by Dr. MARCET in his well-known paper "On the Specific Gravity and Temperature of Sea Waters" published in 1819||.

Sir JOHN ROSS adopted the plan of taking the temperature of a mass of mud or silt brought up from the bottom. For this purpose he contrived what he called a deep-sea clamm. It consisted of "a cast iron parallellogram" 18 inches high by 6 inches wide on the outside; inside 5×4 in. It weighed 1 cwt., and would bring up about 6 lbs. of mud. By this means, a bottom-temperature generally of 29°·5, and in one case, at the depth of 6000 feet, as low as 28°·75, was determined in Baffin Bay. This degree of cold was generally corroborated by a SIX'S thermometer, both instruments apparently giving the same or nearly the same reading. It was on this occasion that the

* Mem. Wernerian Nat. Hist. Soc. vol. iv. p. 163.

† THOMSON'S Annals of Philosophy for 1819, vol. xiii. p. 314.

‡ Ross's Voyage of Discovery to Baffin's Bay in 1818. 2nd edition. London, 1819. Appendix, xi. pp. 234–236. Appendix, xiii. p. 250.

§ For a Table of the temperature of the Sea at various depths, taken during Capt. FRANKLIN'S Voyage to Spitzbergen with Captain BUCHAN, see Edinburgh Phil. Journal for 1825, vol. xii. p. 233.

|| Phil. Trans. for 1819, p. 161; FRANKLIN, table vi. p. 203; BEECHEY, table vii. p. 203; FISHER, table viii. p. 203; PARRY, table x. p. 205; SABINE, table xi. p. 205. These are marked 'M' in the Tables.

remarkable low temperature of 25°·75 F. was recorded, at a depth of 4080 feet in Davis Straits, by Sir JOHN ROSS and Sir EDWARD SABINE*.

BUCHAN and FRANKLIN employed, on the suggestion of Mr. FISHER, a leaden box with two valves, which remained open in descending, and were closed in the ascent. No other particulars are given, but there is every probability that it was constructed on the model of those of HALES and SCORESBY. Their observations, with one or two exceptions, are, allowing for the difference of season (June and July), in tolerable agreement with those of SCORESBY; but they seem less carefully made, and to require, I suspect, a larger correction.

In 1819–20 PARRY went out in command of the 'Hecla' and 'Griper'†, and penetrated the Arctic seas of North America as far as 113° W. long. He took several deep-sea temperatures on board the 'Hecla,' whilst Sir E. SABINE, on board the 'Griper,' made another series of observations. Mr. FISHER, who published an account‡ of the voyage, also notes some of those on board the 'Hecla.'

About this time Sir HUMPHRY DAVY suggested another contrivance for bringing up water from depths, which seems to have been used occasionally by ROSS and PARRY; but the observations with it are not specified. On the occasion of PARRY'S voyage in 1819, Dr. MARCET contrived his water-bottle, which PARRY appears to have occasionally employed, especially in 1821–23 (p. xvi), "in consequence of the failure of the thermometer when exposed to sudden changes," although elsewhere he says (p. xiii) that the temperature was taken, unless otherwise noticed, by SIX'S thermometer. Owing to the very small size (half a pint) of DAVY'S and MARCET'S water-bottles, and their being of metal, they were valueless for temperature-experiments§, although useful for obtaining small samples of deep-sea water; and they were consequently, with this exception, but little used for the former purpose.

In PARRY'S second voyage of 1821–23‖ he records a series of twenty-three experiments made in one of the inland seas of Arctic America, at depths of from 600 to 1200 feet. These show a temperature of from 29° to 31°·7 on the surface, and a like temperature,

* On reference to Sir E. SABINE he informs me, from a note made at the time, that on bringing up the thermometer the index marked 25¾°, and that never having known it lower than 28°, he was very careful in examining the instrument; that both he and Captain Ross were on the spot, and that Captain Ross remarked, in drawing it out of the tin case, which was full of water, that the mercury was close up to the index. It fell instantly and rapidly; but Sir EDWARD had the same belief, that when he first looked it was close up to the index. (See also Dr. CARPENTER in Proc. Roy. Soc. vol. xvii. p. 187.)

† Voyage for the Discovery of a North-west Passage, 1819–20, in the 'Hecla' and 'Griper.' By Captain PARRY, 2nd edit. 1821, pp. 4, 5, 6, 7, 45, 115, 261, 271, 272, 273, 289, 291, 292, 293, 294, 295, 307.

‡ Journal of a Voyage of Discovery in the Arctic Regions in H.M.S. 'Hecla' and 'Griper' in the years 1819–20. By A. FISHER, Surgeon. 3rd edit. London, 1821.

§ FISHER, *op. cit.* p. 17.

‖ Journal of a Second Voyage for the discovery of a North-west Passage from the Atlantic to the Pacific, performed in the years 1821–23 in H.M.S. 'Fury' and 'Hecla,' under the orders of Captain W. E. PARRY. London, 1824, p. 483.

or one only 0°·5 less, at the bottom. As, however, there is little doubt that all these observations in Lyons Inlet were made with MARCET'S bottle, no reliance is to be placed on them*. In his third and last voyage of 1827†, PARRY made as many as forty-five observations in the seas west and north of Spitzbergen, but none exceeded 700 feet in depth. With few exceptions, they show a lower reading than those of SCORESBY. On this occasion he reverted to the use of SIX'S thermometers.

From PARRY'S observing on his first voyage that his soundings were made with "SIX'S self-registering thermometer confined in iron cases"‡, and again, on his second voyage, "that he took out eight SIX thermometers with iron cases"§, I was led, in consequence of the low readings, to think that these cases might have been used for protection against pressure; but Sir EDWARD SABINE, who was with ROSS in 1818 and with PARRY in 1819, being in the latter expedition on board Captain CLAVERING'S ship, the 'Griper,' informs me that all the observations were there made in concert between him and Captain CLAVERING, and that he had with him "half a dozen thermometers on SIX'S construction, made expressly for him by the elder JONES, each of which fitted into (and was retained by an apparatus at top and bottom) a *tinned iron cylinder* pierced with holes in the top and bottom, through which the sea-water percolated freely. . . . . The holes in the top and bottom of the cylinder were rather less in diameter than a seven-shilling piece, admitting a free current. A weight attached to the rope at some little distance below the thermometer, caused the line to run out freely, and prevented the occurrence of 'kinks'"||.

It is therefore to be presumed that the iron cases referred to by PARRY were merely to guard the instruments against accident, and not against pressure; and on comparing the observations made by him on board the 'Hecla,' often on the same day and nearly on the same spot, with those of Sir EDWARD SABINE in the 'Griper,' I find them in such close agreement as to satisfy me that such was doubtlessly the case. At the same time

* Of the 23 readings recorded, ten give precisely the same temperature at depths of 600 to 1200 feet as was found on the surface, while the others in no instance show a difference of more than 1°, and generally of not more than 0°·5; whereas an inland sea in those latitudes might be expected to show extremely low temperatures at depths.

† Narrative of an attempt to reach the North Pole in the 'Hecla' in the year 1827. By Captain W. E. PARRY. London, 1828, Appendix vii.

‡ *Op. cit.* Introd. p. xiii. § *Op. cit.* Introd. p. xvi.

|| Sir EDWARD SABINE thus describes the mode of proceeding in making the temperature-soundings:—"The cylinder, having the thermometer enclosed, was attached to the sounding-line, and was dropped into the sea from the extremity of a spar run out from the side of the ship, the line to which it was attached passing round a pulley near the end of the spar. In a similar way the cylinder when coming up from the bottom was waited for by a boat near the end of the spar, the cylinder released, and conveyed carefully by hand in an upright position to Capt. CLAVERING or myself at the gangway (or by ourselves), by whom the degree recorded by the index was immediately noted. The record by the thermometer was then written down on the spot antecedently to any discussion or comment, the record being made either by Capt. CLAVERING or myself. The spar from the end of which the thermometer case was dropt into the sea was always several feet distant from the side of the ship."

there is reason to believe that thermometers of stronger make than usual, and so better adapted to resist pressure, were used by Ross and PARRY in their voyages of 1818–19*. The usual correction, therefore, cannot be applied to their observations of that date. Little or none may be needed.

In 1822 Sir EDWARD SABINE made an observation on the temperature of the Caribbean Sea at a depth of 6000 feet (the actual length of rope was 7380 feet, but of this 1380 feet were allowed for slack and drift), and a reading of 45°·5 F. was obtained†. On another occasion on this voyage, Sir EDWARD used a solid iron case to protect the thermometer against pressure, but it did not prove sufficiently close to exclude water.

In 1823–26 KOTZEBUE commanded another voyage of circumnavigation‡, and on this occasion he was accompanied by EMIL. VON LENZ, who subsequently published several important memoirs on the deep-sea temperatures and on the specific gravity of sea-water taken on this occasion§. His observations are remarkable from their being made at greater depths and their recording lower temperatures than any others made up to that time, or, in fact, until long subsequently, in tropical seas. One observation, in the Pacific, 21°·14 north latitude, indicated at a depth of 5835 feet, by his corrected reading, a temperature of 36°·4 F., and another, 6476 feet deep, in the Atlantic, 32°·20 north latitude, gave 35°·8 F.

Although only fifteen observations were made, they were mostly at considerable depths, and they were all taken with various precautions and subjected to careful corrections‖.

On his first voyage KOTZEBUE experienced so much trouble with the self-registering thermometer, owing to the mercury passing over the index and to the shifting of the index from jolts or shaking, that on this second voyage LENZ reverted to HALES'S mode of taking deep-sea temperatures, using an improved apparatus arranged by PARROT, the Russian Academician¶. The apparatus, which he termed a bathometer, was 16 inches high by 11 inches in diameter, and held 27·49 kil. (six gallons) of water. It had valves at top and bottom opening upwards, and connected by a rod, to which was attached a mercurial thermometer made specially to bear pressure, with a ball 5 lines thick. The apparatus was covered over with four alternating layers of sheet iron and canvas, saturated with a mixture of boiling tallow and wax, and the whole enveloped in a cloth painted over several times. It was calculated to bear a pressure of 3000 toises (19,150 feet), and the practice was to leave it at the bottom 15 minutes. It was

* See also 'Depths of the Sea,' p. 300.

† Phil. Trans. for 1823, p. 206. See also his 'Pendulum and other Experiments.' London, 1825.

‡ Voyage round the World. English translation. London, 1830.

§ Annalen der Physik und Chemie, Band xx. 1830, pp. 73–131; Edinb. Journ. of Science, vol. vi. 1832, pp. 341–45; and St. Petersburg Ac. Sc. Bull. v. 1847, col. 65–74.

‖ Physikalische Beobachtungen angestellt auf einer Reise um die Welt unter dem Commando des Capitains von KOTZEBUE in den Jahren 1823–26. St. Petersburgh Acad. Sci. Mém. i. 1831, pp. 221–334.

¶ There are but few observations given in the English Translation of the Voyage (vol. i. pp. 24 & 29, and vol. ii. p. 4), and it is not stated whether or not they are corrected. To these the name of KOTZEBUE is attached in the Tables; the others made on this voyage are on the authority and in the name of LENZ.

found to leak slightly; but it was considered that the expansion of the water in coming to the surface would compensate for this loss.

This instrument was placed in water at 67° F. (19°·4 C.) until it acquired its temperature. It was then replaced with other water at 32°. Left in it for two hours, the temperature of the water in the bathometer fell to 52°·7, showing a difference, in that time, of 14°·3, which difference LENZ further estimated would have amounted only to 7° had the apparatus passed through water ranging from 32° to 67°, instead of being exposed to a constant temperature of 32°. Taking this as the rate of refrigeration at given temperatures and in given time, LENZ then employed BIOT'S formula for ascertaining the gain or loss of heat of a body placed in a medium possessing a higher or lower temperature than itself, as the basis for calculating the correction required in each particular observation. Corrections were also made for the depths, by allowing on the one hand for the angle of the rope from the vertical, and on the other for the gain in length by tension under water*.

LENZ gives a Table of his observations as originally taken, and again repeats the Table with the corrected temperatures and depths. These two are combined in the following Table, in which it is shown that, even with uncorrected readings, LENZ obtained on three occasions a temperature below 4° C., while six corrected readings indicate a temperature below 3° Cent., or of from 36° to 37° Fahr.

Date.	Lat.	Long.	Depth in toises.	Angle of rope.	Temperature.		Time employed in hauling up the instrument.	Time of its remaining at the bottom.	Corrected observations.	
					At surface.	At depth.			Depth.	Temp.
							min.	min.	toises.	
1823. Oct. 10 ...	7° 20′ N.	21° 59′ W.	500	0° 0′	25°·8 C.	5° C.	30	15	539	2°·20 C.†
1824. May 18 ...	21 14 „	196 1 „	139	10 0	26·4	16·7	6	15	140	16·36
„ „	„ „	„ „	399	0 0	„	5·1	17	10	413	3·18
„ „	„ „	„ „	649	10 0	„	4·9	32	10	665·1	2·92
„ „	„ „	„ „	979	25 0	„	4·6	56	15	914·9	2·44
1825. Feb. 8	25 6 „	156 58 „	179	25 0	21·5	14	3	2	167	14·00
1825. Aug. 31 ...	32 6 „	136 48 „	89	10 0	21·45	13·54	4	15	89·8	13·35
„ „	„ „	„ „	229	25 0	„	7·06	8	15	214	6·51
„ „	„ „	„ „	479	25 0	„	4·75	15	15	450·2	3·75
„ „	„ „	„ „	579	10 0	„	3·56	19	15	592·6	2·21
1826. Mar. 6.....	32 20 „	42 30 „	969	5 10	20·86	3·92	50	15	1014·8	2·24
1825. Aug. 24 ...	41 12 „	141 58 „	199	10 0	19·2	5·9	10	15	205	5·16
„ „	„ „	„ „	525	20 0	„	3·4	25	15	512·1	2·14
1826. Mar. 24 ...	45 53 „	15 17 „	192	0 0	14·64	10·56	9	15	197·7	10·36
„ „	„ „	„ „	383	0 0	„	10·26	13	8	396·4	9·95

† This should probably be 3°·20.

* POGGENDORFF'S Annalen der Physik und Chemie, vol. xx. 1830, pp. 78, 90, 106; and 'Bulletin Universel' for 1831, vol. i. p. 275.

In 1825 an important expedition*, under the command of Captain BEECHEY, was despatched by the Government round Cape Horn to the Pacific Ocean and Behring Strait. Aided by Mr. COLLIE, the Surgeon, a large and valuable series of meteorological observations were made, including ninety-seven single and serial experiments on deep-sea temperatures in the North and South Atlantic and North and South Pacific, ranging from lat. 56° S. to 70° N., and at depths from 30 to 5124 feet. These were arranged in Tables according to latitude for each ocean. No very low temperatures are recorded, but the decrease with the depth is persistent, SIX'S thermometers were used, but no particulars are given of how they were used †.

The great voyage of Admiral FITZROY from 1826 to 1836, productive as it was of such valuable results in other branches of science, added little to our knowledge of deep-sea physics. Only two sets of observations, both serial, were made in the Indian Ocean at depths of from 30 to 2500 feet‡. SIX'S thermometers are mentioned, but without any other particulars.

In 1826–29 also another important surveying and exploring expedition § proceeded from France under the command of Captain DUMONT D'URVILLE, aided by a staff of scientific officers. He was instructed by ARAGO to pay particular attention to deep-sea soundings and temperatures, and informed of the precautions essential in making such observations. D'URVILLE proceeded from Toulon through the Straits of Gibraltar to Teneriffe, across the Indian Ocean to Australia, New Zealand, the Eastern Archipelago, and back by the Mauritius, the Cape, and Ascension, making observations in all the seas he traversed, at depths varying from 50 to 6160 feet, and to the number altogether of 66, the lowest temperature recorded being 40°. These he tabulated according to zones of depth; and he incorporated also in his Tables the experiments of all preceding observers, beginning with COOK and FORSTER. D'URVILLE concluded from his observations that in the open ocean the temperature at and below 3198 feet (600 brasses) *is nearly constant between* 39° *and* 41°—*that it might be perhaps* 40° FAHR. He also supposed that *a belt of this uniform temperature* existed between the latitudes of 40° and 60°. D'URVILLE was evidently led to this hypothesis of a zone of uniform temperature from assuming the greatest density of sea-water to be, as with fresh water, between 39° and 40°. His observations in the Mediterranean confirmed those of SAUSSURE, viz. that the waters of that sea, below the depth of 1000 feet, had a uniform temperature of about 55°.

In 1828 GRAAH made a few observations in the North Atlantic ‖, but no particulars are given of the instruments he used.

* Narrative of a Voyage to the Pacific and Behring Strait in H.M.S. 'Blossom' in 1825–28. London, 1831. Appendix, Table X. p. 731.

† Sir EDWARD BELCHER, however, tells me that Captain BEECHEY'S thermometers "were enclosed in copper cases with tow above and below," and that no protection against pressure was employed.

‡ Narrative of the Surveying Voyage of H.M.S. 'Adventure' and 'Beagle.' Appendix to vol. ii. p. 301.

§ Voyage de l'Astrolabe, vol. v. of Météorologie, Physique, et Hydrographie. Paris, 1833. Chapter III. Physique, pp. 51*–85*.

‖ Narrative of an Expedition to the East Coast of Greenland. London, 1837, p. 21.

Bérard, in 1831–32*, made another series of observations in the Mediterranean, and ascertained that the temperature of about 55°, noted by Saussure and D'Urville at depths of from 1000 to 3000, prevailed to the depth of 6400 feet.

I cannot ascertain precisely when protection against pressure on the thermometer was first used. Parrot and Lenz† made experiments on the effects of compression on thermometers in 1832, and found that in ordinary instruments they were excessive; but this did not apply to Six's self-registering thermometer, which from its form of construction offers much greater resistance to compression.

It seems to me, however, that some form of protection must have been adopted by the French several years earlier. It is true that D'Urville merely says that he was provided with two of Bunten's instruments, and makes no mention of the mode in which they were used; but on comparing his observations in the Mediterranean, where the bathymetrical isotherms are at nearly constant levels, I find his results in such close agreement with those of Aimé, obtained with protected instruments, and so free from variation dependent on depth alone, that I can only conclude that D'Urville's thermometers were likewise protected. In the same way I infer that Bérard also used similar instruments‡. Thus their respective readings give:—

	1826. D'Urville.	1831. Bérard.	1840. Aimé.
Soundings in the Mediterranean.	1062 ft. 54°·2 Fahr.	3189 ft. 55°·4 Fahr.	1148 ft. 54°·6 Fahr.
	1594 „ 54°·7 „	3829 „ 55°·7 „	
	3189 „ 54°·7 „	6377 „ 55°·4 „	

For this reason I think it not improbable that the ocean observations of D'Urville were made with the same precautions, and need little or no correction.

In 1839 Captain Wauchope§ recorded two more experiments made by him in 1836 in tropical regions at depths of 1800 and 3918 feet, showing respectively temperatures of 52° and 43°. He also surmised that at a certain depth there might be a uniform temperature of about 40° in all seas.

But the most remarkable voyage‖ of the period was that of Captain Abel Du Petit-Thouars between 1836 and 1839. This expedition sailed from Brest in December 1836, touched at Teneriffe, Rio Janeiro, sailed round Cape Horn along the South-American coast, thence to the Sandwich Islands, and back by New Zealand, Bourbon, and the Cape. Fifty-nine observations were made; but eleven failed owing to accidents with

* Bérard's observations are taken from Aimé's paper quoted further on.

† Expériences de forte compression sur divers corps. Mém. Acad. Sci. St. Pétersbourg, vol. ii. p. 595. F. Marcet and De la Rive (Bibl. Univ. xxii. 1823, p. 265) had before this shown the influence of atmospheric pressure on the bulb of thermometers.

‡ On the 'Porcupine' expedition of 1869 a uniform temperature was noted of 54°·7 to 55°·5 in this area of the Mediterranean at and below a depth of 1000 to 1100 feet. (Proc. Roy. Soc. 1870, vol. xix. p. 221.)

§ Edinburgh New Phil. Journ. vol. xxvi. 1838-39, p. 399.

‖ Voyage autour du Monde sur la Frégate 'La Vénus,' Capitaine Du Petit-Thouars. Paris, 1844. Physique, par M. de Tessan, vol. ix. Tables, p. 385.

the instruments, and twenty gave wrong readings owing to the great pressure forcing water into the cylinder. Amongst the successful observations, two at a depth of 6600 feet in the Pacific, and of 6000 feet off the Cape, recorded temperatures of 36°·1 and 37°·4; a third in the North Atlantic, lat. 4°·23 and 6406 feet deep, gave 37°·8 F.; while another, at a depth of 12,271 feet near the equator in the Pacific (on which occasion the cylinder was crushed by the pressure and the instrument broken, and the index jammed and fixed), gave a reading of 34°·8 or 35° Fahr.

This was the first voyage in which precautions against pressure were systematically and professedly taken; instruments of special construction were provided. The form adopted was Six's thermometer, modified by Bunten, of Paris. They were enclosed in strong brass cylinders* to protect them from pressure, and they were always left down for half an hour. After the return of the expedition the thermometers were tried with a standard instrument, and found to have a reading only $\frac{2}{10}$ to $\frac{3}{10}$ of a degree Cent. higher than on starting. It was found, however, that the cylinder would not bear a pressure of more than about 12,000 feet; and that at all depths it was occasionally filled with water. In these latter cases Du Petit-Thouars used a correction of which we shall speak presently, and gives the corrected with the uncorrected reading. Corrections were also made for the angle the rope took with the vertical. There is therefore every reason to suppose that the deep-sea temperatures obtained on this voyage may be accepted as perfectly reliable.

The 'Bonite,' under the command of Captain Vaillant†, was also despatched from France in 1836 to the Indian Ocean, Chinese seas, and the Pacific. Sixteen observations in the Atlantic and Indian Oceans are recorded at depths of from 244 to 8838 feet. The 'Bonite' was likewise provided with Bunten's thermometers. They were wrapped in wool and placed in a glass tube, which again was enclosed in a copper cylinder closed by a screw at each end, and left down 18 to 20 minutes. In the first deep sounding (700 brasses) recorded the cylinder is stated to have come up full of water. This throws doubt on all the subsequent experiments; and as no reference at all is made to the state of the cylinder in the other soundings, and the readings are more concordant with the "full cylinder" ones of Du Petit-Thouars, I think a correction should be applied to all his deeper observations. A large number of surface-temperatures were taken, and it was remarked again that in the Pacific the sea is more frequently warmer than the air, *except* under the equator.

Another voyage‡ of research was undertaken by France in 1838 to the Arctic seas,

* Du Petit-Thouars gives no particulars of the construction of his instruments; but Arago, in his report of the results obtained on this voyage, speaks of the "thermométrographe de M. Bunten enfermé dans un étui cylindrique en laiton de 33·4 mill. de diamètre intérieur et de 15·6 mill. d'épaisseur," which I presume refers to Du Petit-Thouars's instruments.—Comptes Rendus, 1840, vol. xi. p. 311.

† Voyage autour du Monde sur la Corvette 'La Bonite,' Capitaine Vaillant. Géol. et Minér. par M. Chevalier, pp. 232, 390–1; and Physique, par. M. Darondeau, 'Observations Météorologiques.'

‡ Voyage en Scandinavie et au Spitzberg de la Corvette 'La Recherche.' Géographie et Physique, vol. ii. p. 279.

and a series of twenty-three interesting experiments were made by MM. MARTINS* and BRAVAIS between the North Cape and Spitzbergen, and off the west coast of that island, in depths of from 200 to 2460 feet.

The principle of overflow differential thermometers had been revived by WALFERDIN† in 1836—a maximum one for the purpose of taking the higher temperatures of deep wells and mines, and a minimum one for deep-sea soundings. These instruments were free from the inconveniences of CAVENDISH's, were of easy manipulation, and could bear jerks without affecting the registering column of mercury. To protect them against pressure they were enclosed in a tube of glass, of thickness proportional to the pressure to which it would be exposed, and hermetically sealed at both ends. M. WALFERDIN claimed for these thermometers greater accuracy and certainty than the ordinary self-registering thermometers‡.

These thermometers, termed "thermomètres à déversement," were used by MARTINS and BRAVAIS on their voyage to Spitzbergen, in conjunction with SIX's thermometers (thermométrographes) modified by BUNTEN, of Paris. The former were enclosed in glass tubes exhausted as much as possible, and the latter in copper tubes, evidently not strong enough, as they "almost always came up full of water." To ensure accuracy, they employed in all these observations two instruments of each sort, and in some cases as many as four, and took the mean of each set. When sunk to the bottom they were raised 1 mètre from it, and left there for an hour. Sometimes the thermometrographs were not protected; and in that case, or when the tubes were full of water, a correction was applied, of which we shall speak further on. A correction was also used for the angle of the rope with the vertical. M. MARTINS states that he had much more confidence in WALFERDIN's thermometers than in BUNTEN's. I find, however, that, taking the 18 observations made with sets of the former, the average variation for each set amounted to 0°·45 Cent., or, averaging the variation of each of the 52 instruments employed, to 0°·16 C., while the 10 observations with 23 instruments of the latter give respectively 0°·18 C. and 0°·08 C.; but M. MARTINS shows that while the mean of the differences is 0°·19 C. at depths not exceeding 131 metres, it is reduced to 0°·06 C. at depths of 640 to 870 metres. The readings, on the whole, of WALFERDIN's instruments are very slightly lower than those of BUNTEN's; as they were more relied on by the observers, I have given them in the Tables in preference to the others.

But notwithstanding the successful use of WALFERDIN's instruments on this voyage,

* Voyage de 'La Recherche,' Géogr. et Phys. vol. ii. (Mémoire sur les Températures de la Mer Glaciale à la surface, à des grandes profondeurs, et dans le voisinage des glaciers du Spitzberg, par M. CHARLES MARTINS) pp. 342–5. Tableau IV.

† Bull. Soc. Géol. de France for 1836, vol. vii. pp. 193 & 354.

‡ He instances a case of a well at Saint-André where, at a depth of 830 feet, two of his instruments gave 17°·96 C. and 17°·93 C. respectively; whereas two self-registering instruments gave 19°·2 C. and 16°·8. The latter were affected both from water getting into the case and from lowering of the index by shaking. In another case, two of his instruments both registered 23°·5 C., and two thermometrographs 23°·45 and 23°·50, while another of the latter had its index displaced by the shaking of the line.—Ibid. vol. ix. p. 255, vol. xii. p. 166, and vol. xiii. p. 113.

and the mention of them approvingly by POUILLET* and ARAGO†, I cannot find that they were again used, although a modified form contrived by M. AIMÉ was employed by him in his researches in the Mediterranean in 1840–44.

In 1838 a few observations were made in the Indian Ocean by the Rev. J. H. PRATT‡.

An American expedition made the round of the world in 1839–42 under the command of Captain WILKES, who gives twenty-eight § deep-sea temperatures at depths of from 60 to 5100 feet in the South Pacific and Southern Oceans, in one case recording a temperature of 27°·5 at a depth of 1420 feet in the latter sea. The subject was afterwards || further discussed by Captain WILKES in a separate paper, in which he expressed an opinion that there existed a zone of the uniform mean temperature of 39°·5 FAHR. It would appear that SIX's thermometers without protection were used.

In the same year (1839) a very important expedition was despatched from this country to the Antarctic seas under the command of Captain Sir JAMES C. ROSS. A special code of instructions was drawn up by a Committee of the Royal Society. Numerous results of great value were obtained, especially those relating to the soundings and sea-bed of the Antarctic Ocean. As many as 161 deep-sea temperature-observations are recorded, chiefly in the Southern and Antarctic Oceans, with a few in the Atlantic and Indian Oceans¶. They vary in depth from 12 to 7200 feet; some of the soundings were much deeper.

These temperature-soundings claim particular notice in consequence of the undue weight which has been attached to them. In starting Sir JAMES ROSS took with him a supply of SIX's thermometers; but he gives no description of how they were used, or what precautions were adopted**. The observations also are not tabulated, but are scattered through the work without plan or order; and it is at times difficult to fix on their exact position, date, &c. It would appear that, owing to want of protection and the great depths at which they were used, all the instruments he took with him from England were broken by the time he reached the Southern Ocean.

* Éléments de Physique, 5th edit. vol. ii. p. 653. † Œuvres complètes, vol. viii. p. 626.

‡ London and Edinb. Phil. Mag. 1840, vol. xvi. p. 176.

§ United States Exploring Expedition, 1839–42. London, 1845, vol. i. pp. 137, 139, 230, 309, 310; vol. ii. pp. 290, 293, 299, 332; and vol. iii. Appendix I.

|| "On the Depth and Saltness of the Ocean," American Journal of Science and Arts for January 1848, p. 41.

¶ A Voyage of Discovery and Research in the Southern and Antarctic Regions. London, 1847, vol. i. pp. 34, 130, 166, 167, 168, 170, 180, 200, 222, 231, 267, 280, 306, 309, 313, 317, 321; and vol. ii. pp. 35, 52, 53, 55, 133, 138, 140, 141, 147, 156, 193, 195, 200, 214, 216, 227, 228, 282, 322, 351, 356, 358, 363, 369, 374, 379, 382, 384.

** Dr. HOOKER, who accompanied the expedition, informs me that no precautions were taken against pressure, but that to prevent breakage "the thermometers were enclosed in a copper cylinder. Sometimes two thermometers were placed at different points of the same line (say 500 and 1000 fathoms), at others the line was drawn up and sunk again to a greater or less depth. The first fathoms of the line were spun yarn, the next of 3 plies of the same, the rest whole line." It was hauled in by the whole ship's company. Dr. HOOKER also says "that the average length of time, speaking entirely from memory, during which the thermometers were left at the depths reached was a quarter of an hour."

He then wrote to England for stronger registering thermometers, which were sent to him in Australia, but of which he gives no particulars further than stating that they were stronger. Before receiving these, he apparently renewed his observations with instruments obtained in Australia. Consequently it is probable that each of these sets of instruments were of different construction, and may require a different correction—those used during the first part of the voyage a larger correction than those used during the latter period. In the absence of sufficient information this cannot be attempted; and the general formula given further on has been applied to the correction of all his observations I have had occasion to use in the construction of the sections.

With regard to the observations themselves, they may be also sometimes open to objection in consequence of the great difficulties under which they were so constantly taken. The severe cold, the inclemency of the weather, and the tediousness of the operation are all elements of possible error to be taken into account. The one cause may have led at times to the shifting of the index, and the other to some want of accuracy in the reading; for I cannot conceive it possible for any set of thermometers to have recorded, in the innumerable cases mentioned, the same one and uniform temperature of 39°·5 at and beyond a certain depth. Even supposing a uniform temperature of that exact degree did exist at certain determined depths, it is in the highest degree improbable that any instruments would give the exact same record. There is not only the risk of shifting of the index, but there is the certainty that the ordinary imperfection and variation of the instruments would most certainly prevent it. With the greatest care and with standard instruments especially selected, MM. Martins and Bravais, out of ten sets of observations each made with two, three, or four thermometers, only give one instance in which the readings of two of them agree. In the other cases they differ from 0°·1 to 1° Fahr.

Nevertheless, apart from this point, and supposing them to be approximately correct, the observations of Sir James Ross are, from their number, depth, and position, very valuable, and, subject to correction, they furnish fairly available results, although, from the cause before mentioned, it may not be certain whether the correction applied gives the true reading in all cases within one, two degrees, or in some cases possibly more. Owing also to this use of unprotected instruments Ross came to the same conclusion as D'Urville with respect to the existence of a zone of a uniform surface-temperature in given latitudes, and likewise with respect to the persistence of the same uniform temperature of 39°·5 Fahr. at given depths in the great oceans. In this opinion he seems to have been biassed, similarly with his predecessors, by the belief that the density of sea-water was, like that of fresh water, greatest at that temperature.

In 1840–44 M. Aimé made a series of important observations on the temperature of the air and sea between Marseilles and Algiers*. The experiments, which were carried on for a series of years, proved that the diurnal variations of temperature in the Medi-

* "Mémoire sur la température de la Méditerranée," Annales de Chimie et de Physique, 1845, 3me sér. vol. xv. p. 1; and Comptes Rendus for Sept. 1844.

terranean ceased at a depth of 60 feet, and the annual variations at a depth of from 1150 to 1300 feet. At this point AIMÉ found a uniform temperature of 54°·7, and was of opinion, from the observations of BÉRARD, that no increase took place at greater depths. This degree he showed to be the average of the mean temperature between Toulon and Algiers, of the months of January, February, and March.

In order to determine whether the decrease of temperature was gradual, or whether the instrument passed through warmer strata, AIMÉ also used a thermometer which was let down upright and reversed at the bottom of the soundings. This he termed a "thermomètre à retournement." Besides these, AIMÉ employed the ordinary self-registering thermometer with an enlargement in one part of the tube to remedy the inconvenience of the quicksilver passing over the index. These several instruments were enclosed in copper cylinders strong enough to resist the pressure to which they were subjected. For moderate depths he preferred a glass tube hermetically sealed *.

In 1845 Captain (now Admiral) SPRATT made 15 observations † from the surface to a depth of 1260 feet, in the Grecian archipelago, and obtained results in perfect accordance with those of SAUSSURE and AIMÉ in the Western Mediterranean. He afterwards made a more extended series of observations (34 in all) and to greater depths (7440 feet) in the eastern basin of the Mediterranean from Malta to Egypt ‡. Admiral SPRATT at first used SIX'S thermometer; but finding that the index often moved, he resorted, in shallow seas of the archipelago, to the plan of taking the temperature of the mud brought up from the bottom by means of a sound formed of iron tubing. This plan, Admiral SPRATT considered, gave more reliable results than the other. In every case in FORBES'S VII.th zone, or between 1080 and 1200 feet, the mud indicated a temperature of 55°·5; and he concluded that there was no reason to suppose the temperature to be lower than 55° at any depth under 1800 feet. In the deeper waters he reverted to the use of SIX'S thermometer.

Captain (now Admiral Sir EDWARD) BELCHER gives a series of eight observations he made in mid-Atlantic when crossing the equator in 1843, at depths of from 1800 to 6000 feet §. Sir EDWARD informs me that a much larger number were made, but that they were not published at the time and have been unfortunately lost, with the exception of the few others recorded by Sir JAMES ROSS ||. Sir EDWARD BELCHER also mentions that he had a water-bottle of great strength, with two enclosed thermometers specially made by CAREY, and that these instruments "were tested continuously between 1835 and 1846, and never found to vary from each other or from the standard which I [Sir E. B.] now possess, and which belonged to the Old Board of Longitude. They

* For a description of his instruments see *op. cit.* Ann. Chim. et Phys. pp. 6–12.

† Phil. Mag. for 1848, p. 169.

‡ The Nautical Magazine for 1862, p. 9. Admiral SPRATT has also obligingly communicated to me the twenty-two unpublished observations to which is attached "*u*" in the Tables.

§ Narrative of the Voyage of H.M.S. 'Samarang' during the years 1843–46. London, 1848, vol. i. p. 9.

|| Antarctic Voyage, vol. ii. p. 53.

were out in 1852–54, exposed to all the Arctic variations of temperature, and are still perfect. They were made to go inside the water-bottle, and not subjected to jerks of the line, which we found often moved the indices"*.

In 1845–51 Captain KELLETT, in his voyage† to the Pacific and Behring Strait, made 38 observations to depths of 3000 feet, several of them serial, some in mid-Atlantic, others in the Pacific, ranging from near the Equator to Behring Straits, and seven in the Arctic Ocean beyond. SIX's thermometers without protection were used.

Lieutenant (afterwards Commander) DAYMAN, who served on the surveying-ship 'Rattlesnake,' made a series of one hundred and ten observations in the Atlantic, Indian, and Southern Oceans, at depths generally of from 1000 to 2000 feet‡.

While the readings given by other observers who used unprotected self-registering thermometers agree fairly well among themselves, those recorded by DAYMAN are much higher in proportion. But as he gives no particulars of his instruments, or of the mode in which they were used, it is not possible to say how the difference arises or what the error may be; it seems uniformly too high by 1° or 2°. There are also anomalies in the lists, which leads me to suppose that the readings of the lesser and greater depths have sometimes been transposed. The readings, however, have a certain independent value *inter se* as furnishing comparative temperatures at corresponding depths.

Sir A. ARMSTRONG§, who was with Captain M'CLURE on his memorable voyage along the coast of Arctic America, records three observations made on the voyage out round Cape Horn, and three in the Arctic Ocean after passing Behring Strait. No mention is made of the thermometers, except that they were SIX'S "self-registering."

In the series‖ of "Reports" to the Government of the United States much valuable information is given with respect to the temperature of the seas off the North-American coast, and especially of the Gulf-stream at various depths. As the original observations are, however, not recorded, but only the diagrams founded on them, I am unable, with two or three exceptions, to give any tabulated details, and must refer to the "Reports" themselves for fuller information. Owing to the depth of the Gulf-stream off the American coast, the lines of bathymetrical isotherms lie at very variable depths. The

* With respect to the mode of conducting the observations, Sir EDWARD BELCHER says, "The deep-sea temperatures were observed only in calms. The thermometers were all handled by *myself*, and eased overboard with the greatest care. The hauling-in was not subject to jerks, as it was done by the aid of a boat astern, the ship drifting by currents, sometimes one to two hundred fathoms from the boat, and great caution observed in getting them detached (by myself) and read off instantly."

† Voyage of the 'Herald,' Captain KELLETT. By BERTHOLD SEEMAN. London, 1853, vol. i. pp. 7, 92, 94, vol. ii. p. 107.

‡ Narrative of the Voyage of H.M.S. 'Rattlesnake,' Captain STANLEY, 1846–50. By JOHN MACGILLIVRAY. London, 1852. Appendix I. vol. i.; and Edinb. New Phil. Journ. for 1852, vol. lii. p. 267.

§ A Personal Narrative of the Discovery of the North-West Passage, by ALEXANDER ARMSTRONG, M.D., R.N., H.M.S. 'Investigator,' Captain M'CLURE, 1850–54. London, pp. 19, 43, 65, 150, 216.

‖ See Report of the Superintendent of the United States Coast Survey for 1854, by Professor BACHE. Also those for succeeding years.

stream forms, as is well known, a trough of warm water, from below which the cold water rises up as a wall in approaching the coast.

Captain MAURY has given* incidentally a few deep-sea temperatures made by the U. S. Coast Survey (DUNSTERVILLE, BROOKE, and RODGERS) during the few years previous to the publication of his work; but it is a subject which he does not treat so fully as other points of ocean physics. It is not stated what instruments were employed.

On the voyage of H.M.S. 'Cyclops' in 1857, forty-one important observations were made by Captain PULLEN in the North and South Atlantic, Indian Ocean, and Red Sea, at depths of from 2400 to about 16,000 feet†. It was on this voyage that the first regular precautions against pressure were taken in this country. Captain PULLEN was furnished, by order of the late Admiral FITZROY, with some instruments constructed purposely for deep-sea observations, the object of which was explained in the following memorandum, communicated to me by Captain PULLEN:—

"In SIX'S self-registering thermometer, the long bulb, filled with spirits of wine, is so delicate, that under a great pressure of ocean it is more or less compressed, and drives the spirit against the mercury, which is thus acted on not only by temperature, but by the mechanical pressure of sea-water.

"With a view to obviate this failing, Messrs. NEGRETTI and ZAMBRA undertook to make a case for a weak bulb, which should transmit temperature, but resist pressure.

"Accordingly a tube of thick glass is sealed outside of the delicate bulb, between which and the casing is a space all round, which is *nearly* filled with mercury.

"The *small* space not so filled is a vacuum, into which the mercury can be expanded, or forced, by heat or mechanical compression, without doing injury to, or even compressing, the inner and much more delicate bulb.

"This provision is meant to guard against possible compression of even the *outer* glass, strong as it is.

"One may ask, Why not strengthen the inner tube, the bulb, at once, so as to be equal in power of resistance to the outer casing? Mr. GLAISHER and the makers say no; the bulb will yield a little, on account of its length, be it even as strong as the outer case. (Signed) "ROBERT FITZROY, Admiral.

"May 19th, 1857."

With these instruments Captain PULLEN made a series of observations, and was the first in this country to confirm the observations of the continental observers that so low a temperature as 35° existed in the depths of intertropical seas. In reply to my inquiries, Captain PULLEN informs me that, after comparing the deep-sea thermometers with standards kept on deck and setting the indices, "they were placed in copper cylinders,

* The Physical Geography of the Sea. By M. T. MAURY, LL.D., U.S.N., 11th edit. London, 1857, pp. 53, 261, 263, and Appendix, p. 351. The last edition of 1874 gives no new facts.

† Twelve of these are given in Proc. Roy. Soc. vol. ix. p. 189, and the others are abstracts from Captain PULLEN'S MS. Journal, of which he has kindly given me the particulars; to these latter "*u*" is attached in the Tables.

with a valve at each end both opening upwards, so that on going down a column of water passed through. On arriving at the depth, and you commence hauling in, these valves close, thus cutting off a portion of water at that depth, which was brought up and tested for density and its then temperature. Indices read off both from maximum and minimum scale and noted. But I have often found that the maximum index shifted, showing a different reading from what it stood at when started. Now whether this would affect the minimum side is a question."

Captain PULLEN thinks not. But there are inequalities in some cases so apparent that they can hardly be accounted for, except by a shifting of the index. In one instance, in fact, while the thermometer at 7890 feet indicated 41°*, the index, owing to rough weather, had shifted to 67° at a depth of 11760 feet. Captain PULLEN speaks also of some of the instruments being more regular in their indications than others. After, however, eliminating those readings, which are evidently too high (marked with a ? in Tables), the value of the other observations remains unaffected.

The Austrian Expedition of the 'Novara' in 1857–60 †, under the command of Admiral Von WÜLLERSTORF, made an extraordinary number of daily meteorological observations, from which it is difficult to extract the few scattered notices respecting the temperature at depths. Although they amount to 33 in number, they are mostly at depths under 1000 feet, and none exceed 1500 feet. They embrace eleven observations in the Mediterranean to depths of not more than 760 feet.

It was apparently on this occasion that the water-bucket was last used. All that is said on the subject is that "for these observations a wooden cylinder furnished with valves was generally employed; but an English apparatus has also frequently been made use of, which consists of a similarly constructed copper cylinder, with an easily affected maximum and minimum thermometer, so that by it water was not only brought up from a depth, but also the highest and lowest temperatures of the layers of water through which the sounding was made were ascertained." No other particulars are given, and no mention is made in the several observations of which instrument was used. WULLERSTORF'S observations, as I read them, differ so greatly from those of other observers, that I can only attribute it to some undetected source of error. The readings seem much too high and out of proportion with the others; but still they have a certain value in their comparative temperatures.

In 1859 Captain KÜNDSON‡ made four temperature-soundings between Iceland and Greenland, at depths of 1200 to 1800 feet; and in 1861 Dr. ED. LENZ§ records a

* In two other cases also the bottom-temperature is recorded as higher than those at lesser depths.

† Reise der österreichischer Fregatten 'Novara' um die Erde in 1857–59. Wien, 1862. Naturw.-physikalischer Theil, 139–449.

‡ "Voyage of the War Brig 'Queen' from Iceland to Greenland," in the Papers translated for the Hydrographic Office, Washington, 1871.

§ Meteorologische Beobachtungen auf den Atlantischen und Grossen Ocean an den Jahren 1847–49. Angestellt von dem Dr. ED. LENZ, berechnet von E. LENZ. Nov. 1861. Bulletin de l'Académie Imp. des Sciences de St. Pétersbourg, tom. v. p. 129 (1863).

series of observations made in the North and South Atlantic, at a uniform depth of 360 feet, the importance of which consists in showing, as HORNER and KOTZEBUE had previously done, that near the equator the water at and beneath the surface is colder than a few degrees further north and south. SIX'S self-registering thermometers were used. No protection mentioned.

Dr. WALLICH* gives, in 1862, one temperature-observation at a depth of 600 feet, on the well-known occasion of the deep-sea soundings between England and America.

Between 1860 and 1868 the several other expeditions undertaken to obtain deep-sea soundings in different parts of the world for telegraphic purposes afforded favourable opportunities for temperature-observations. Such were those obtained in 1868 by Capt. SHORTLAND† between Bombay and Aden, which are recorded in a series of means. They extend in one case to the depth of 13,020 feet, and give a reading of 33°·5, and in another, more westward, to 7800 feet, with a reading of 36°. These readings have, I presume, been corrected from the original observations.

Again, in 1868 Commander CHIMMO‡ made a series of observations on the American side of the North Atlantic, at depths extending to 12,000 feet, and recording temperatures of 42°. It is merely stated that the experiments were made with "new and delicate thermometers," which were without protection, and the readings are uncorrected.

In August 1868 the 'Lightning' sailed on the first of that series of deep-sea researches which, conducted under the combined superintendence of Dr. CARPENTER and Professor WYVILLE THOMSON, with the addition afterwards of Mr. GWYN JEFFREYS, and followed up systematically in subsequent voyages, have already yielded such valuable and important information on the natural history and physics of the depths of the sea.

Regarding the relative merits of the several methods employed by the early observers, a few words may be said. The water-bucket, when properly constructed, of sufficient size, and when well handled, was not badly contrived to determine the temperature at moderate depths. It was free from the errors of pressure and index to which thermometers are liable. The errors depend upon the size of the apparatus, the proper closing of the valves, the rapidity of hauling in, and the difference of temperature between the bottom- and surface-waters. When the latter is not great the error can be but small; and such is the case in those Arctic seas where it has been chiefly used. As so considerable a number of observations were made with this apparatus by SCORESBY and FRANKLIN, it might be desirable to determine by experiment the amount of correction required to adjust the error of this particular apparatus.

In the case of LENZ'S bathometer, he made a series of experiments to determine

* The North-Atlantic Sea-Bed, 1862, p. 145.

† Admiral SHERARD OSBORN, "On the Geography of the Bed of the Atlantic and Indian Oceans and Mediterranean Sea," Journ. Roy. Geogr. Soc. 1871, vol. xli. p. 58.

‡ Proc. Roy. Geogr. Soc. 1869, vol. xiii. p. 92.

the corrections necessary for his several observations. He showed that a variety of considerations have to be taken into account with HALES'S water-bucket or any similar apparatus, and that the scale of corrections must vary with the latitude and the depth. Thus in lat. 21° 14′ N., with a surface-temperature of 79°·5 F. and at a depth of 2635 feet, his corrections amounted to 4° F., while in lat. 45° 53′, with a surface-temperature of 58°·3 and at a depth of 2524 feet, they amounted only to 0°·6 F., and, again, for the lesser depths of 898 and 1252 feet in the same latitude respectively to 0°·4 F. and to 0°·6 F. The same corrections cannot, however, be applied to the observations of ELLIS, COOK, FORSTER, IRVING, SCORESBY, FRANKLIN, and WAUCHOPE; for in the case of the first three and of FRANKLIN the apparatus was not protected by any other non-conducting substances; in the case of WAUCHOPE'S and SCORESBY'S later experiments the correction must be applied to the enclosed SIX thermometer; and in IRVING'S the small size of the apparatus, although protected, necessitates a larger correction. It is, nevertheless, satisfactory to note, from the regular decrease in the value of the corrections from the equator to the pole, that in the higher latitudes, where HALES'S apparatus has been most used, the special corrections needed for that apparatus diminish to their minimum, and are so small that probably 0°·5 to 1° would cover all the errors of observation made by the foregoing explorers. The main error for correction is that due to pressure in those instances where a SIX'S thermometer has been used in conjunction with HALES'S apparatus.

The second plan, that of sinking an ordinary thermometer, protected and surrounded by some substances which are bad conductors, has been but little used, as it requires so much time. Independently of this, and for moderate depths, it is trustworthy and useful, and some of the results, as those of SAUSSURE, may be accepted as closely accurate.

The third plan, that of taking the temperature of mud or silt brought up from the bottom, has the advantage that it secures the possession of a body having the exact bottom-temperature; but it has the disadvantage of small bulk, and therefore of being more influenced by the temperature of the water through which it has to pass. For moderate depths, however, the error can only be small.

The first and last of these methods, whatever their inconveniences, had but one main source of error—causing a gain where the surface-temperature is higher, and a loss where lower, than that at depths. Only in one instance, however, was the necessary correction accurately estimated. But with the introduction of the self-registering thermometer two sources of error (the one occasional and uncertain in amount, arising from shifting of the indices; and the other fixed and definite, resulting from pressure) were introduced. Owing also to the want of standard instruments, the observations made on the several voyages have had in themselves different degrees of value, dependent on the care with which the instruments were made, and on the precautions with which they were used. As such precautions were, it is evident, usually enforced, and Admiralty instruments were generally used, a considerable uniformity of result has been nevertheless maintained; and the readings on the different voyages agree sufficiently

well amongst themselves to allow, with reasonable success, of the application of the same correction to all, excepting those of DAYMAN, and perhaps one or two others, which require larger corrections, and WÜLLERSTORF'S, which are uncertain.

With these few exceptions, and admitting slight qualifications for each particular case, the larger number of the early observations may, subject to a correction for pressure, be accepted as approximately accurate. The need of this correction for pressure was, as I have before observed, noted so early as 1823; but it was not until the voyage of 'La Vénus' that the necessary precautions were professedly taken against it, and that experiments were made to estimate its amount. Such estimates were then made by DU PETIT-THOUARS in tropical seas, subsequently by MARTINS and BRAVAIS in arctic seas, and afterwards by AIMÉ in an inland sea. The results of the several calculations are as follows:—

DU PETIT-THOUARS made experiments with a protected and an unprotected thermometer at a depth of 1000 brasses or 1620 mètres, which is equal to a pressure of 162 atmospheres, and he was led to adopt a coefficient of 0°·01 Cent. per atmosphere as the measure of correction needed for unprotected thermometers. This gives 1° C. per 100 atmospheres, or of 1°·8 F. per 3200 feet, or 1° FAHR.=1780 feet.

CH. MARTINS concluded from his experiments, which were on a more limited depth, that a coefficient of 0°·13 Cent. per 100 mètres, or of 1°·30 C. per 1000 mètres* (equal to 2°·3 FAHR. per 3280 feet, or 1° for every 1426 feet), was required.

AIMÉ, again, from experiments in the Mediterranean with his special thermometrographs, came to the same conclusion as DU PETIT-THOUARS, viz. that for the pressure of every 100 atmospheres the instrument required a correction of about 1° Cent.

These conclusions agree very closely with the more recent researches of Dr. CARPENTER and the late Dr. MILLER. The latter showed† that under a pressure of $2\frac{1}{2}$ tons (or 374 atmospheres) per square inch, SIX'S unprotected self-registering thermometers of three different constructions gave readings from 7°·5 to 10° FAHR. too high. Excluding the effects of the small amount of heat evolved from the water by compression (or some undetermined cause), which was found equal to 0°·9, the mean error of the three was 8°·6 F.−0°·9=7°·7; and, taking the pressure of one ton as equivalent to a depth of 800 fathoms, this would be equal to a rise of 1° F. for every 1560 feet. But in those experiments one instrument (SIX'S, with a spherical bulb) gave a variation of 2° in excess of the one with cylindrical bulb and of the Admiralty instrument. Now, as the two latter are of the forms almost always used, and BUNTEN'S instruments had also a cylindrical bulb, it is a question whether the one with spherical bulb should not be excluded. In that case the reading of the other two gives a mean of 8° F.−0°·9=7°·1 as the error for pressure of $2\frac{1}{2}$ tons, or equal to 1° FAHR. for every 1690 feet.

It is true that considerable variation was found to exist in the effects of pressure on

* M. MARTINS took the differences between each of the protected and unprotected "thermométrographes," and these he diminished in each case by 0°·1,—"quantité égale à la poussée de l'index."

† Proc. Roy. Soc. for 1869, vol. xvii. p. 485: see also Proc. Roy. Soc. for 1870, vol. xviii. p. 409; and Commander DAVIS, R.N., *ibid.* p. 347.

some other instruments; but with the care taken in the construction of our best thermometers, and of those of BUNTEN, which were generally employed, the chances of greater variation than that here indicated are reduced to a minimum*.

The foregoing estimates show that with good instruments the effect of pressure equals an increase of about 1° F. for every 1400 to 1800 feet of depth; and in adopting a coefficient of 1° F. for every 1700 feet as the necessary correction of all the observations in the Tables, excepting those made with protected instruments or corrected by the original observer, and excepting also those before named as requiring larger corrections in consequence of using unfit or unsuitable instruments or instruments of a different class, I feel that I am below rather than above the true measure of allowance.

§ III. *Summary of the preceding Observations.*

Although the early observers noted the decrease of temperature with the increase of depth, it was not until 1823–26 that LENZ proved that this decrease held good to the greater depths of temperate and tropical seas, and that the water at depths in the open oceans was but little above the zero of Centigrade.

The substitution of the self-registering thermometer for the older methods led for a time, owing to the neglected error of pressure, to a retrograde course; for the voyages of BEECHEY, KELLETT, and others which followed between 1826 and 1836, while they added largely to the number of observations at greater depths, gave, in so doing, increased importance to the error, from the circumstance that the pressure on the instrument not only counterbalanced the effect of the greater cold at increased depths, but often gave readings (uncorrected) somewhat higher at those depths than at lesser ones. From this cause, and from inattention to the different properties of sea- and fresh water, an erroneous conclusion was drawn from observations otherwise valuable, which for a time greatly retarded the progress of ocean physics.

The first to fall into this error was D'URVILLE, who, misled by the coincidence of temperature obtained by him in some of his deepest soundings, and of the nearly like minimum temperature (4° to 5° C.) so frequently recorded (with his unprotected thermometers) by BEECHEY and others at greater depths, concluded, in ignorance apparently of LENZ's observations, that this uniformity of temperature was the result of a general

* With respect to these variations, Dr. CARPENTER, after speaking of the results obtained on the 'Porcupine' expedition with the MILLER-CASELLA instrument, observes:—"With these results, obtained with thermometers upon which complete reliance can be placed, those obtained last year with the best ordinary thermometers are found to be in close accordance, when the proper correction for pressure is applied to them." He then instances two cases in which experiments were made on both expeditions at nearly the same places and in nearly similar depths. In one case, at a depth of 550 fathoms, the difference exceeded the estimate by about 1°, in the other, at a depth of 550 fathoms, it amounted to 2°·2 F., or was "exactly equivalent to the correction for pressure at that depth in the unprotected thermometers." Dr. CARPENTER concludes:—"This very near accordance gave us, of course, a feeling of great satisfaction in our last year's work; and it fully justified our conclusion that, whatever might be the pressure-correction required by the instruments then employed, it would not affect the *differences* obtained at nearly approximating depths." (Proc. Roy. Soc. vol. xviii. p. 455.)

law dependent on the maximum density of water, which he supposed to be alike in fresh and salt water; and he consequently assumed that a temperature of about 4°·4 C. (40° F.) prevailed below a certain depth in open seas*, and that in both hemispheres there was in certain latitudes a zone from the surface downwards of like uniform temperature†.

On the other hand, we have seen that in 1836–39 Du Petit-Thouars fully confirmed the observations of Lenz, that a temperature of from 35° to 37° existed at depths in both the great oceans. Arago, in commenting on these results, testifies to their accuracy and importance, and remarks that "the observations collected by the 'Vénus' will occupy a distinguished place, on account of their number and exactness, and of the great depths at which they were taken." He also observes that, low as some of the readings are, yet all errors must be positive, and that they place on reliable grounds the great fact of the prevalence of the same low temperatures at depths in the Pacific as well as in the Atlantic, and in the equatorial regions of both oceans; and he especially dwells on the circumstance that they tend effectually to disprove the hypothesis which had been advanced, that at great depths there existed a uniform and common temperature of 40° F. ‡

It appears, nevertheless, that so little was known of what had already been done and written, that Sir James Ross fell into the very same errors as D'Urville had made thirteen years before. Unfortunately in this case his conclusions were accepted without examination by distinguished writers in two popular works on Physical Geography, and obtained a currency for which it is difficult to account §. Although Sir James Ross's experiments were in themselves valuable, they required both detail and corroboration, and his conclusions were evidently based on an assumption for which there was no warrant. And yet, while his important and positive facts as to the persistence of life to great depths failed to receive the attention they deserved, his physical fallacies were received almost without a question. As with his predecessor, D'Urville, Sir James found in his more numerous and deeper observations that the unprotected thermometer commonly marked a temperature of and about 39° to 40°; and taking the maximum density of fresh water to be 39°·5, he applied the same reasoning to the open seas as had already been applied to freshwater lakes, and assumed, exactly as D'Urville had done, that a uniform temperature of about 39°·5 prevailed at depths varying with the latitude, and that a belt of water of that temperature, extending from the surface downwards, encircles the globe between the 50th and 60th degrees of south latitude, or, as he more definitely fixes it, in a mean latitude of about 56° 26′ S. ‖

* Voyage, p. 62. † *Ibid.* p. 59.

‡ "Il faut donc espérer que le fameux nombre +4°·4 si étourdiment emprunté aux observations à la surface et au fond des lacs *d'eau douce* de Suisse cessera de paraître dans les dissertations *ex professo*, comme la limite au-dessous de laquelle la température du fond des mers ne saurait jamais descendre." (Voyage de 'La Vénus,' Physique, vol. v. p. 22; and 'Œuvres Complètes,' vol. ix. p. 254.)

§ I may, however, remark that their mention of the subject is incidental, and confined merely to giving the facts on Ross's authority.

‖ "It is therefore evident that about this parallel of latitude there is a belt or circle round the earth,

WILKES, who also explored the Antarctic seas in 1838–42, took the same view, and for the same reasons as D'URVILLE, WAUCHOPE, and ROSS, of the existence of a deep-sea and of a belt of water of the uniform temperature of 39°·5 F.

Commenting on the general results of this great American expedition, BIOT discusses* the question of deep-sea temperatures. He remarks that serial observations should in all cases be made, "that the instruments ought to be protected against pressure by surroundings of great strength and resistance," and that they should be left a considerable time at the bottom. Comparing the observations of ROSS with those of DU PETIT-THOUARS, SCORESBY, PARRY, and MARTINS, he shows their want of agreement. He says that the experiments of ROSS depend entirely on his instruments, "of which he had no means of knowing and judging (*aucun moyen d'appreciez*)," while he knew those of DU PETIT-THOUARS and MARTINS to have been prepared with every care. For ROSS, he remarks, "the uniformity of temperature at the bottom of the sea is a necessity;" and he trusts that some steps may be taken to verify his observations, for between them and those of other observers there is, he remarks, "a complete incompatibility."

With respect to the freezing-point and point of greatest density of sea-water, these properties were first more particularly investigated by Dr. MARCET in his well-known paper on the subject published in 1819†. Dr. MARCET ascertained that he could lower the temperature of sea-water (at 1·027 sp. gr.) to 27°, and even, when in large vessels and kept perfectly still, to 18° or 19° F., before freezing, but that when it froze it always rose to 28°; and he states that his experiments "uniformly led him to the conclusion that the law of greatest specific density at 40° did not apply to sea-water, but that, on the

---

where the mean temperature of the sea obtains throughout its entire depth, forming a boundary, or kind of neutral ground, between the two great thermic basins of the oceans. To the north of this circle the sea has become warmer than its mean temperature, by reason of the sun's heat which it has absorbed, elevating its temperature at various depths in different latitudes. So that the line of mean temperature of 39°·5 in latitude 45° S. has descended to the depth of 600 fathoms; and at the equatorial and tropical regions this mark of the limit of the sun's influence is found at the depth of about 1200 fathoms, beneath which the ocean maintains its unvarying mean temperature of 39°·5, whilst that of the surface is about 78°.

"So likewise, to the south of the circle of mean temperature, we find that, in the absence of an equal solar supply, the radiation of the heat of the ocean into space occasions the sea to be of a colder temperature as we advance to the south; and near the 70th degree of latitude we find the line of mean temperature has descended to the depth of 750 fathoms, beneath which again, to the greatest depths, the temperature of 39°·5 obtains, whilst that of the surface is 30°.

"The experiments which our limited time and means admitted of our making serve to show that the mean temperature of the ocean at present is about 39°·5, or $7\frac{1}{2}$ degrees above the freezing-point of pure water, and as nearly as possible the point of its greatest density. But it would be indispensable that this temperature should be ascertained to the tenth part of a degree; and as we now know where we may send any number of thermometers down to the greatest fathomable depths without an alteration of temperature, even to that small amount, this desideratum might be very easily obtained." (Ross's 'Voyage to the Antarctic Regions,' vol. ii. p. 375.)

* Journal des Savans, 1849, p. 69.

† "On the Specific Gravity and Temperature of Sea-water," Phil. Trans. for 1819, p. 161.

contrary, sea-water gradually increased in weight down to the freezing-point, until it actually congealed." Other experiments led him to fix this point of greatest density at 22° F.

ERMAN* in 1828 fixed the maximum density of sea-water of 1·027 specific gravity at 25° F., and found likewise that it did not reach its maximum before congelation. Still more conclusive were the more elaborate experiments of DESPRETZ† in 1837. Taking distilled water at a temperature of 20° C. and sea-water of the specific gravity of 1·027 at 20° C., he successfully determined the following important points:—

	Cent.	Fahr.
Maximum density of fresh water	+4°	=39°·2
,, sea-water	−3·67	=25·4
Point of congelation of sea-water	−2·55	=27·4
Temperature of sea-water during congelation . . .	−1·88	=28·6

He also showed that the freezing-point and the point of maximum density were proportionate to the quantity of saline matter in the water, and that both therefore varied with the degree of salinity of the sea.

The effects of pressure and the properties of fresh and salt water were therefore perfectly well understood previous to the date of Ross's voyage. How, then, the unsupported opinion of one who, though a most able and enterprising navigator, had not any pretensions to an exact knowledge of physical science could have been accepted by scientific writers of so much eminence is a singular fact. I can only account for it by the circumstance that the subject had not been made in this country one of special investigation, and therefore the results of Ross's work had not been questioned by any competent special authority. In fact they had never been discussed.

The observations of LENZ, DU PETIT-THOUARS, and others, combined with the researches of physicists, had sufficiently established the law of the decrease of temperature with the depth to 2° to 3° above the zero of Centigrade in the temperate and tropical zones of both the great oceans; and their conclusions could hardly be considered as seriously affected by the unsupported though ingenious hypothesis of D'URVILLE and ROSS. LENZ had obtained, by means of his bathometer, with corrections for change of medium, the low readings given at p. 599; and subsequently DU PETIT-THOUARS by means of protected thermometers had obtained directly, without correction‡, amongst a number of others at lesser depths, the following deep-sea temperatures:—

* "Nouvelles Recherches sur le maximum de densité de l'eau salée," Annales de Chimie, xxxviii. p. 287.

† "Recherches sur le maximum de densite de l'eau pure et des dissolutions aqueuses," *ibid.* lxx. p. 5.

‡ Others of his observations were corrected. On his return his thermometers were found to give too high a reading by $\frac{2}{10}$ to $\frac{3}{10}$ of a degree Centigrade, so that his observations may require a further slight deduction to this extent.

	Lat.	Long. of Paris.	Depth. Mètres.	Temperature at depth.	Temperature at surface.
North Atlantic . .	4° 23′ N.	28° 26′ W.	1950	3°·2 C.	27° C.
South Atlantic . .	25 10 S.	5 39 E.	1620	3	19·6
	39 51 S.	41 57 E.	1620	3·2	25·6
North Pacific . . .	4 32 N.	136 54 W.	3740	1·7	27·2
	51 34 N.	159 21 E.	1790	2·5	11·7
South Pacific and Indian Ocean . .	0 55 S.	99 27 W.	1790	3	26·5
	27 47 S.	98 0 E.	1620	2·8	23·8
	37 42 S.	112 38 E.	1620	3	16·7
	43 47 S.	81 26 W.	810	4·1	13·2
	,, ,,	,, ,,	1790	2·3	,,

The rate of decrease recorded by the observations of Du Petit-Thouars was confirmed within certain limits for lesser depths by those of Kotzebue, Beechey, D'Urville, Vaillant, and others, and for greater depths by some of the later observations of Captain Pullen, who obtained in the

	Lat.	Long.	Depth. fathoms.	Temperature at depth.	Temperature at surface.
Indian Ocean . . .	5° 31′ S.	61° 31′ E.	2330	35° F.	84° F.
South Atlantic . .	26 46 S.	23 52 W.	2700	35	75
	30 6	20 14	400	43·5	74·5
	,, ,,	,, ,,	1200	38·2	,,

These various submarine temperature observations in the several great Oceans, taken in conjunction with the corrected readings for others adopted by Du Petit-Thouars and De Tessan, showed that, whether in temperate or tropical regions, approximately:—

The temperature at surface being according to latitude .	60° to 80° Fahr.	
At from 1000 to 2000 feet it was from	40 to 60	,,
,, 2000 to 5000 ,, ,, ...	37 to 40	,,
,, 5000 to 12000 ,, ,, ...	35 to 37	,, (or less)

Other corrected readings give equally low or still lower temperatures.

On the other hand, in the Arctic seas, the observations of Scoresby and of Martins and Bravais showed that the temperature of the upper strata, down to a depth of 200 to 300 feet, varies greatly with the season, ranging from 8 to 10 degrees above to 3 or 4 degrees under 32° F., and that with increasing depth a more uniform higher temperature prevailed. Scoresby, whose experiments were conducted further northward and westward, found this latter temperature to be generally 3° or 4° above the freezing-point of fresh water, or 7° to 8° above that of sea-water. His two deepest experiments (to the N.W. of Spitzbergen) give the following results:—

Lat.	Long.	Depth.	Temperature. Uncorrected.	Corrected.
79° 4′ N.	5° 38′ E.	4380 feet.	37° Fahr.	34°·5?
78 2 N.	0 10 W.	4566 feet.	38 „	35·4?

M. Martins's chief experiments were, on the other hand, between the North Cape and Spitzbergen, from 71° to 76° N. lat. The deepest temperature sounding was in 73° 36′ N. and 20° 53′ E., in which instance Walferdin's thermometer registered at 2854 feet 32°·2 F., and Six's thermometer, corrected for pressure, gave 31°·6. This latter is the only recorded instance in the open sea where his reading was below zero of Centigrade. His most northern observations, viz. in 76° 13′ N. and 12° 48′ E., at 1296 feet, and another in the same place in 2103 feet, gave respectively 33°·4 and 32°·3; while one of Scoresby's, in 79° N. and 5° 40′ E., at 2400 feet gives, corrected, 34°·6 F., and another in 76° 16′ N., 9° E., at 1380 feet, not far from Martins's position, gives, without allowance for pressure (for in this case Six's thermometer does not appear to have been used), a temperature of 33°·3.

Martins, however, states that on approaching the land in Magdalena Bay, instead of a submarine temperature above zero, he found that in depths of from 110 to 136 mètres the temperature of the water was always below zero; that these bottom-waters there had, in fact, a temperature of −1°·75 C. to −1°·91 C. (28°·6 F.), that of the surface being 0°·1 to 1°·2 Cent.*

The results obtained in another section of the North Atlantic are very different and of much interest. The observations in Davis Strait and Baffin Bay by John Ross and Sabine indicate that, after passing the point where the diurnal and annual variation cease, there is a gradual decrease of the temperature with the depth to a point approaching in places to that of the maximum density of sea-water. Even taking the readings without correction†, they show:—

From 1000 to 2000 feet, a temperature of	. . . . .	32° to 29°·5 Fahr.	
„ 2000 to 3000 „	„	. . . . .	30 to 29 „
„ 3000 to 4000 „	„	. . . . .	29 Fahr.
„ 5000 to 6000 „	„	. . . . .	$28\frac{3}{4}$ „

Besides these, Parry noted, in 68°·29 N. lat. and 63°·43 W. long., at a depth of 4854 feet, a temperature of 27°, and, as before mentioned, Ross and Sabine have recorded‡, in 66° 50′ N., 61° W., at a depth of 4080 feet, a temperature of $25\frac{3}{4}$°§.

In the Antarctic seas the observations of Cook, James Ross, and Wilkes show that the temperature from the surface down to 600 or 1000 feet varies from 28° to 32°. At greater depths there are, with few exceptions, only the experiments of Ross; and these cannot,

* *Op. cit.* p. 332.

‡ Marcet, Phil. Trans. 1819, pp. 169 & 205.

† Probably but very little is needed, *antè*, pp. 597 and 598.

§ This may be rather doubtful (see, however, note, *antè*, p. 596).

for reasons before given, be accepted without reserve. Still they are available after correction for pressure; and the readings then indicate thermal conditions very similar to those which obtain in Arctic seas. To take one of the most southern series of observations, at a spot in the Antarctic Ocean where no soundings were obtained, at a reputed depth of 24,000 feet:—

Lat.	Long.	Depth.	Temperature. Uncorrected.	Temperature. Corrected for pressure.
68° 32′ S.	12° 49′ W.	Surface (March)	30°·8 Fahr.	30°·8 Fahr.
		900 feet.	33	32·4
		1800 „	35·5	34·4
		3600 „	38·7	36·5
		4500 „	39·4	36·6
		5400 „	39	35·8
		6300 „	39·5	35·8

Again, another nearer the South Polar land, and in soundings:—

63 49 S.	51 7 W.	Surface (Feb.).	32 F.	32 F.
		600 feet.	32·2	32
		900 „	33·2	32·6
		1800 „	35·5	35·6
		2700 „	36·4	35
		3600 „	37·3	35·2
		7200 „	39·5	35·2

Still further and closer to another part of the Antarctic continent we have:—

77 49 S.	162 36 W.	Surface (Feb.).	28·5 F.	28·5 F.
		1740 feet.	30·8	29·8

There is only one observation of Du Petit-Thouars in the Southern Ocean for comparison with those of Ross. As the cylinder came up full, I give the reading with the correction:—

59 48 S.	79 56 W.	Surface (March).	42·9 F.	42·9 F.
		2657 feet.	39	37·5

The conditions, therefore, prevailing in the open Arctic and Antarctic seas are apparently closely analogous,—the temperature at a distance from land increasing with the depth until it rises to 35° to 36° F. at 2000 to 3000 feet, below which it seems to remain nearly stationary at about the same temperature; while closer to the land and at less depths it falls nearer to the freezing-point of sea-water (see note, *postea*, p. 635).

The temperatures at depths in inland seas were found at an early period to be very different to those of open seas; and it is singular that the very first observations made

in the Mediterranean by SAUSSURE in 1780, of 55°·8 F. at 944 feet, and 55°·5 at 1918 feet, remain substantially correct to the present day. It was, however, D'URVILLE'S more extended observations in 1826 that made better known the fact that the temperature decreased from the surface down to 200 brasses (1066 feet), below which it remained constant at about 13° C., or between 54° and 55° F. Still his greatest depth did not exceed 3189 feet; but BÉRARD in 1831 extended the observations to a depth of 6377 feet, and still found the same degree of temperature.

AIMÉ further showed, from a series of soundings made during 1840–44 in the western basin of the Mediterranean, between Marseilles and Algiers, that the diurnal variation of temperature ceases to be sensible at 16 to 18 mètres, and the annual variation at 300 to 400 mètres. The mean of his series of observations gave the following results:—

Mean Annual Temperature of the Mediterranean at different depths.

Depth.	Temperature.	Extreme monthly variations.
Surface.	18°·2 Cent.	10°·2 Cent.
25 mètres.	16·3	6·3
50 „	14·4	2·8
100 „	13·7	2·0
200 „	13·0	1·0
350 „	12·6	0·0

This temperature of 12°·6 (54°·7 F.) he showed to be that of the mean of the winter months (or rather that of the months of January, March, and April) of the area; and he was of opinion that the same temperature obtained at greater depths, referring in support of that opinion to other and deeper soundings by BÉRARD. The following observations by the latter, made between the Balearic Islands and Algeria, are extracted from D'URVILLE'S tables:—

Depths of variable temperature.	Surface in August	27°·1 Cent.
	„ November	14·6
	At depth of 40 brasses in October	16·5
	„ 70 „ „	14·9
Depths of uniform temperature.	„ 600 „ November	13
	„ 600 „ June	13
	„ 750 „ November	13
	„ 1200 „ June	13

This gives the rather higher reading of 55°·4 at depths; but whether arising from BÉRARD using less perfect instruments or from an actual difference of temperature on this southern side of the Mediterranean, is uncertain. The marked agreement between the observations of BÉRARD in 1831–32 and those of the 'Porcupine' expedition in 1870, leads me to suppose that the latter may be the influencing cause.

D'URVILLE'S observations, which were made further north in the western Mediterranean than those of BÉRARD, agree more closely with those of AIMÉ. Thus he found—

At a depth of 300 brasses in March a temperature of . . .				12°·7 Cent.
„	600	„	„	„ . . . 12·6

The only temperature-observations made in the eastern basin of the Mediterranean previously to 1869, with the exception of two of Wüllerstorf, are those of Admiral Spratt. They extend from Malta to Alexandria, and from the Grecian archipelago to the Gulf of Syrtis, forming for this section of the Mediterranean a series complemental to those made in the western section by D'Urville, Bérard, and Aimé. The results he obtained are also, when corrected, in close agreement with those of these several observers. His first experiments were made in Ægina Bay in 1845, in connexion with the natural-history researches of Edward Forbes, and extended only to a distance of three miles from shore. Allowing for a gain of 0°·5 or 1° in hauling up the silt, the corrected readings will then give as the general results:—

For Forbes's Zone	I. (1 to 12 feet) a temperature of .		55° to 82° Fahr.
„	„ II. (at and near 120 feet) . . .		69 to 70
„	„ III. („ 330 feet) . . .		56 to 57
„	„ VII. („ 1260 feet) . . .		54·5 to 55

Three other experiments in the seas of Greece gave him the following readings:—

1080 feet	(four miles off Nio) . .	55°·5	or, allowing for gain in hauling up through warmer waters, of from 54°·5 to 55°.
1200 „	(seven miles off Andros)	55·5	
1260 „	(three miles off Ægina)	55·5	

In the shallower waters of the archipelago he found "the temperature of the intermediate depths between 100 fathoms and the surface range from 55° to 76°, and, indeed, in the summer season sometimes up to 80° and 86° in the littoral waters of enclosed gulfs and shallow bays."

A set of serial observations off Crete, made later with unprotected self-registering thermometers, gave readings as under (these, when corrected for pressure, agree, with the exception of the fourth, which seems a doubtful reading, very closely with those of Bérard in the southern portion of the western Mediterranean basin*):—

Temperature at depths in the Mediterranean off the N.W. Coast of Crete.

	Uncorrected.	Corrected for pressure.
Surface in the month of June . .	73° Fahr.	73° Fahr.
At a depth of 120 feet	68	67·9
„ 300 „	63	62·7
„ 600 „	59¾	59·4
„ 1200 „	59¾ (?)	59 ?
„ 7440 „	59½	55·2

Admiral Spratt says that he found this temperature of "about 59° in all depths from 300 down to 2000 fathoms." In the extreme eastern portion of the Mediterranean

* Nautical Magazine for 1862, p. 10; 'Travels and Researches in Crete' (London, 1865), vol. ii. App. p. 332.

there are, however, indications of a higher temperature, as the following observations, taken, the first three in November, and the last in April 1861, show:—

Deep-sea Temperatures off the Coast of Egypt, west of Alexandria.

	Uncorrected.	Corrected.
At a depth of 180 feet	71° Fahr.	70°·9 Fahr.
„ 300 „	68	67·8
„ 600 „	62½	62·1
„ 1620 „	59½	58·5

Admiral Spratt concluded that "the minimum temperature of their (Eastern Mediterranean, Grecian archipelago, Sea of Marmora, and Black Sea) deeper parts correspond nearly with the mean annual temperature above them." This apparent discrepancy between Aimé and Admiral Spratt evidently arises from the circumstance that the one bases his conclusion on observations made with protected and the other with unprotected thermometers, which gave too high a reading. Subject to correction the results are closely concordant, and both give approximately the mean sub-winter temperature.

The observations of Aimé and others thus proved that in this great inland sea the influence of the variations of temperature at the surface ceases at a depth of from 1000 to 1200 feet, and that below that line a uniform temperature of from 54° to 55°·5 prevails in the western basin, and one possibly 0°·5 to 1° higher in the eastern basin of the Mediterranean.

Some deep temperature-observations have also been made in two other nearly closed seas—the Red Sea and the Sea of Okhotsk,—the latter by Dr. Horner in 1803, and the former by Captain Pullen, with his protected thermometers, in 1858.

The mean winter temperature of the air in the Red Sea may be a little under 70° Fahr. The following observations are not serial, but were taken at intervals in various parts of that sea (see Table III. p. 667).

Temperatures at depths in the Red Sea.

Surface in the months of March and April . . .	78° to 86° Fahr.
At 300 feet.	77
„ 2552 „	71
„ 4068 „	70·5

In the Sea of Okhotsk, where the mean winter temperature is doubtlessly under 20° F., the observations were only carried to a depth of 690 feet, with the following results:—

Temperature at depths in the Sea of Okhotsk.

	Uncorrected.	Corrected.
Surface in the month of August	46°·4	46°·4
At 108 feet	31·6	31·6
„ 360 „	29·0	28·8
„ 690 „	29·0	28·6

Parry's observations in Lyon's Inlet are excluded, for the reasons before given (p. 597).

§ IV. *Hypotheses of* Humboldt, Arago, Lenz, *and others.*

Such is a summary of the results obtained between the years 1749 and 1868. From time to time they had been commented on by some of the most eminent physicists of the time, and the cause of the low temperatures prevailing in the depths of tropical seas discussed.

Humboldt, so far back as 1812, and again in his subsequent works*, contended that "the existence of those cold layers in low latitudes proves the existence of an undercurrent flowing from the poles to the equator." In support of this hypothesis, he showed how it explained the fact, first noticed by Franklin and Williams †, that the water on shoals in the Atlantic was many degrees lower than that surrounding them, from the circumstance that the deeper cold water, flowing and rising over them, displaced the warmer surface-waters ‡. These observations were afterwards confirmed by Du Petit-Thouars, Vaillant, and others. He was further of opinion that "in the narrower seas, as well as in the tropical seas which cover the cold waters from Arctic regions, all the mass of water is in a state of movement."

Humboldt also contested the conclusions of those who considered that the ocean is salter under the equator than at a distance from it, and showed that while in lat. 0° to 14° the specific gravity was 1·0272, it was 1·0282 in lat. 15° to 18°, and 1·0278 in lat. 30° to 40°. Nor did he fail to note § that the equatorial zone is not the hottest water zone; but that two hotter zones lie a few degrees N. and S. of it.

Humboldt subsequently || thus summarized the question as it then stood:—

"As fresh and salt water do not attain the maximum of their density at the same degree of temperature, and as the saltness of the sea lowers the thermometrical degree corresponding to this point, we can understand how the water drawn from great depths of the sea during the voyages of Kotzebue and Du Petit-Thouars could have been found to have only the temperature of 37° and 36°·5. This icy temperature of sea-water, which is likewise manifested at the depths of tropical seas, first led to a study of the lower polar currents, which move from both poles towards the equator. Without these submarine currents the tropical seas at those depths could only have a temperature equal to the local maximum of cold possessed by the falling particles of water at the radiating and cooled surface of the tropical sea. In the Mediterranean the cause of the absence of such a refrigeration of the lower strata is ingeniously explained by Arago,

* 'Voyage': Relation Historique (Paris 1814), vol. i. p. 73. Climatologie Asiatique (Paris 1831), p. 560. 'Kosmos,' Otté's translation, 1849, vol. i. p. 307.

† On the Use of the Thermometer in Navigation. Philadelphia, 1792.

‡ He instances, for example, a case noticed by himself on the "Signal Bank" off Ferroll, where he found the water to have a temperature of from 54°·5 to 56° F., while the water immediately around was from 59° to 59°·6 F.

§ Ann. Chim. et Phys. xxxiii. 1820, p. 40.

|| Kosmos, vol. i. pp. 308, 309 (Sabine's translation, pp. 295, 296).

on the assumption that the entrance of the deeper polar currents into the Straits of Gibraltar, where the water at the surface flows in from the Atlantic Ocean from west to east, is hindered by the submarine counter-currents, which move from east to west, from the Mediterranean into the Atlantic. . . . . The zones at which occur the maxima of the oceanic temperature and of the density (the saline contents) of its waters do not correspond with the equator. The two maxima are separated from one another, and the waters of the highest temperature appear to form two nearly parallel lines north and south of the geographical equator. Lenz, in his voyage of circumnavigation, found in the Pacific the maxima of density in 22° north and 17° south latitude, whilst its minimum was situated a few degrees to the south of the equator. In the region of calms the solar heat can exercise but little influence on evaporation, because the stratum of air impregnated with saline aqueous vapour, which rests on the surface of the sea, remains still and unchanged."

Similar views were adopted by D'Aubuisson in 1819*. The whole subject of Oceanic circulation was again discussed from a fresh point of view by D'Urville † in his account of the results of his voyage of 1826. After arguing (p. 62) that in open seas the temperature at and below 600 brasses (3198 feet) is nearly constant between 4° C. and 5° C., and that perhaps it may be 4°·4 C. (40° F.), he significantly remarks that in the zone 10° on each side of the equator some particular cause seems to occasion in the water "up to 100 brasses a more sudden and rapid cooling than would have been expected." He afterwards (p. 64) proceeds to say that the mass of the equatorial waters, slowly diminished by evaporation, may give rise to a slow and continuous ascensional movement of the lower colder waters, and these so displaced make room for other waters coming from the polar regions, so that "it is rather a transport, nearly in mass and very slow, of the deep waters of high latitudes towards the equator." The point of departure he considered to be between 40° and 60° lat.; and he inferred that the deep cold waters (at 40°) are there directed periodically in two "insensible currents," the one towards the equator and the other towards the pole.

Arago‡ in 1838, reporting to the French Institute on a scientific expedition then in course of preparation to the coast of Africa, thus expresses his opinion:—

"La température des couches inférieures de l'océan, entre les tropiques, est de 22° à 25° centigrades au-dessous du plus bas point auquel les navigateurs aient observé le thermomètre à la surface. Ainsi, cette couche si froide du fond n'est point alimentée par la précipitation des couches superficielles. Il semble donc impossible de ne pas admettre que des courants sous-marins transportent les eaux des mers glaciales jusque sous l'équateur.

* Traité de Géognosie (Strasbourg, 1819), p. 450.

† 'Voyage de l'Astrolabe,' Sect. Météorologie, Physique, et Hydrographie, chap. iii. pp. 51*–85*. Paris, 1833.

‡ "Instructions concernant la Météorologie et la Physique du Globe, par M. Arago, Courants Sous-marins," Comptes Rendus, 1838, part 2, tome vii. pp. 212, 213.

" La conséquence est importante. Les expériences faites au milieu de la Méditerranée, la fortifient. Cette *mer intérieure* ne pourrait recevoir les courants froids, provenant des régions polaires, que par la passe si resserrée de Gibraltar; eh bien! dans la Méditerranée, la température des couches profondes n'est jamais aussi faible, toutes les autres circonstances restant pareilles, qu'en plein océan; on peut même ajouter que nulle part cette température du fond de la Mer Méditerranée ne paraît devoir descendre au dessous de la température moyenne du lieu. Si cette dernière circonstance vient à se confirmer, il en résultera qu'aucune partie du flux glacial venant des pôles ne franchit *le seuil du détroit de Gibraltar.*

" Lorsque M. le Capitaine D'URVILLE partit, il y a quelques années, pour sa première campagne de 'l'Astrolabe,' j'eus la pensée qu'il pourrait être utile de rechercher si les phénomènes de l'océan, quant à la température des couches profondes, se présenteraient dans toute leur pureté *dès qu'on se trouverait à l'ouest du détroit.* L'Académie voulut bien accueillir mon vœu. Sur sa recommandation expresse, quelques observations de la nature de celles que je désirais, furent faites à peu de distance de *Cadiz.* Eh bien! elles donnèrent précisément ce qu'on aurait trouvé dans la Méditerranée.

" Ce fait curieux semble se prêter à deux explications différentes. On peut supposer que le courant polaire se trouve complétement refoulé par un courant sous-marin dirigé de la Méditerranée vers l'océan, et dont l'existence est appuyée sur divers événements de mer. On peut supposer aussi que la saillie si forte de la côte méridionale du *Portugal,* ne permet pas au flux d'eau froide venant du nord, de s'infléchir jusqu'à angle droit pour aller atteindre les régions voisines de l'embouchure du *Guadalquivir.*"

Again*, in reporting on the observations of the 'Vénus,' ARAGO saw no other explanation of the low deep-sea temperatures recorded in tropical seas, but " the existence of submarine currents carrying to the equator the bottom-water of the icy seas."

It is, however, to LENZ (who had, in his previous papers of 1831 and others, concluded that the temperature of the ocean decreases with the depth, rapidly at first and then gradually, until a point of about 36° F. was reached, when it became insensible) that we are indebted for a more special review and discussion of all the facts known up to 1845†. Speaking of the earlier observations made on the temperature of the sea at great depths, he observes:—" The greater number of these observations, with the exception of those made by myself, were taken with thermometrographs, and especially with SIX'S thermometers. It is, however, to be observed that all instruments of this kind are liable to a source of error which hitherto investigators have not borne in mind, viz. the compression of the vessel or the bulb which contains the thermometrical substance (spirits of wine), particularly by the enormous pressure in depths of several thousand feet. I was witness of a series of experiments on the action of strong pressure on a thermometer-bulb, which PARROT undertook in order to ascertain the influence of

* Comptes Rendus, 1840, vol. xi. p. 311.

† " Bemerkungen über die Temperatur des Weltmeeres in verschiedenen Tiefen, von EMIL. LENZ," Bulletin Acad. Sci. St. Petersburg, v. (1847), cols. 65–74.

a strong pressure on different substances, and which he has made known in the 'Memoirs of the Academy of St. Petersburg' (vi. série, Sc. Math. Ph. et Natur., t. ii. p. 595, 1832). It is there mentioned that a pressure of 100 atmospheres caused the thermometer to rise about 20°·5, without the temperature having altered in the least, as was shown by a second thermometer which was protected from pressure by a brass cylinder."

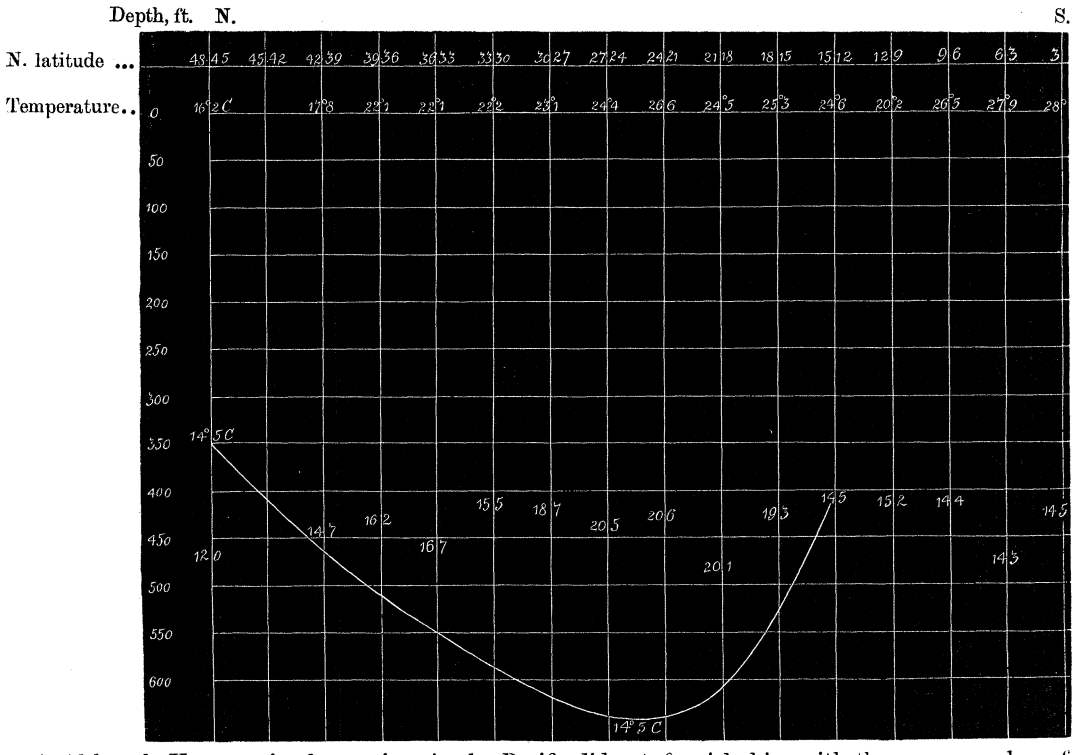
Lenz proceeds to remark that it necessarily follows that thermometrographs (although in such instruments the effect would be much less owing to their form of construction) exposed in the sea to pressures of 100 to 200 atmospheres must give too high a reading, and that the circumstance of the indications in so many deep soundings remaining uniform, or sometimes increasing with the depth, proves the influence of compression.

Reviewing the data furnished by different observers and by himself, and assigning to them, if not an actual, at all events a relative and comparative value for corresponding depths, Lenz notices the circumstance that they all point to the existence of a belt of water at and near the equator cooler than at a short distance to the north and south of it; and in illustration of this he takes the consecutive series of observations at nearly the same depths made by Kotzebue in 1815–1818, at short distances apart over a great length of the Atlantic; and he gives a Table, of which the following is an abstract:—

Zones of latitude.	North Atlantic.		South Atlantic.	
	Mean depth.	Mean temperature.	Mean depth.	Mean temperature.
	feet.	° F.	feet.	° F.
0 to 3	435	58·2	480	57
3 „ 6	460	57·8	405	56·4
6 „ 9	400	58	351	61·5
9 „ 12	390	59·4	426	62·7
12 „ 15	390	58·2	351	60·8
15 „ 18	408	66·7	305	60·3
18 „ 21	468	68·2	378	61·7
21 „ 24	414	69·2	420	63·2
24 „ 27	432	69	..	..
27 „ 30	403	65·7	..	..
30 „ 33	390	60	..	..
33 „ 36	447	62·2	..	..
36 „ 39	418	61·2	..	..
39 „ 42	438	58·5	..	..
45 „ 48	458	53·6	..	..

This, he observes, shows a rapid rise of the isothermal planes in approaching the equator; and taking a definite isotherm of 14°·5 C., he gives the following diagram, in which he shows that this plane, which in lat. 45° to 48° N. lies at a depth of 350 feet, sinks gradually to 640 feet in lat. 23° to 26°, and then, rising more abruptly as it

approaches the equatorial regions, reaches to within 390 feet of the surface in lat. 12° to 15° N.*



* Although KOTZEBUE's observations in the Pacific did not furnish him with the same number of data, he thought there was yet evidence of the same condition prevailing there also; but the observations were much scattered over many parallels of longitude and were made in various currents. The results were:—

Latitude.	Mean depth. feet.	Mean temperature. ° F.
6° to 9° N.	600	56
9 „ 12	499	62
12 „ 15	558	61·3
15 „ 18	498	69·5
18 „ 21	402	69·3
27 „ 30	450	64
30 „ 33	600	62
33 „ 36	600	51·8
36 „ 39	600	52·7

Dr. HORNER had previously noticed, in the Atlantic, this anomaly of a proportionally lower temperature at depths near the equator than 5° S. and 10° N. of it, but without offering any explanation, and gave a series of means of some of KRUSENTERN's observations, of which the following is an extract:—

	No. of Obs.	Lat.	Long.	Depth. feet.	Temp. ° F.
April 20 to 26	5	17° 15′ S.	3° 20′ W.	342	55·4
27 „ 30.....	4	10 24	12 2	396	56·2
30 „ 4 M.	5	5 12	17 5	402	53·3
May 3 „ 10.....	8	0 43 N.	20 28	444	52·5
10 „ 16.....	7	4 51	24 38	450	52·5
15 „ 19.....	5	9 34	29 38	402	52·7
20 „ 24.....	5	19 30	35 7	426	61·0
25 „ 30.....	6	31 0	36 30	426	58·7
31 „ 6 J.	5	40 30	29 40	408	54·2

Edinb. Phil. Journ. 1822, vol. vi. p. 161.

LENZ then proceeds to observe:—"The form of the submarine isothermal line which I have drawn leads us of itself, on the first glance, to an explanation of this striking phenomenon.

"The mass of water in the tropics, warmer down to a certain depth from the sun's heat, cannot maintain its equilibrium with the colder waters of the middle and higher latitudes: a flow of the warmer water from the equator to the poles must necessarily take place on the surface; and this surface-flow must be supplied at the equator by a flow of colder water from high latitudes, which at first would flow in an almost horizontal direction, but which under the equator must rise from below to the surface. In this manner, in the northern hemisphere, a great vertical circulation takes place in the ocean, which has its direction above from the equator to the pole, and below from the pole to the equator. Since these flows or currents moving in opposite directions are distinguished by their different temperatures, we obtain in the submarine isotherm an indication of the direction of the lower portion of this flow. A corresponding flow, but moving in the opposite direction, takes place in the southern hemisphere; so that in a zone surrounding the equator where both are united, the water flows almost in the direction from below up to the surface; and thus one meets with cold water in much shallower depths than in those two zones north and south which lie immediately adjoining, and which, in fact, is shown by the observations.

"It is not my intention to enter here upon the question, how the original direction of this current to the surface becomes greatly altered by the diminution of the speed of rotation and by the influence of the wind, so that the water first arrived at the polar regions by considerably circuitous ways, or how the lower portion of the current was drawn westward by the entrance of bodies of water into latitudes of greater speed of rotation; in any case the last influence will be very much diminished by the opposition of the west bank of the ocean, in comparison with the corresponding diversion or drawing away which the air-currents undergo. It is sufficient for me to have furnished in the figure of the submarine isothermal line proof of the current from the pole to the equator in the depth of the ocean. It would be highly desirable that future navigators should enlarge our knowledge on this point, by a larger number of observations with one and the same instrument, or with corrected instruments, which could be accomplished with very little trouble and in a very short time. If they would be satisfied with letting down the thermometrographs at always one and the same depth of some 100 fathoms, this observation would be made in fifteen minutes; and in any case, by a frequent repetition of it, results would be arrived at, especially in latitudes ranging from 40° N. to 40° S., which would be far more instructive for physical geography than the observations hitherto made, where one proceeded or reasoned more on the determination of the diminution of the temperature than upon compared determinations of different places.

"From a current underneath of colder waters from the poles to the equator, some important conclusions arise, viz.:—

"1. The diminution (pointed out) of temperature everywhere up to latitude 60° with the increase of depth, in direct opposition to the conditions observed on dry land.

"2. My numerous determinations of the salinity of the ocean have shown that the maximum of the salinity does not occur at the equator, but invariably some degrees north and south from it (in the Atlantic at 23° N. and 17° S.). I have endeavoured to explain this condition from the greater evaporation in these latitudes, which is comprehensible from the cooperation of the trade-wind, in opposition to the region of calms at the equator (see Mém. de l'Acad. Sc. Math. Ph. et Nat. t. i. p. 507). According to the above, I do not, however, doubt that also the slight salinity of the uprising polar water in the region of calms contributes materially to this condition.

"3. It is a point which has been determined by HUMBOLDT, JOHN DAVY, and others, that the water of the ocean is colder at the surface over shallows than at some distance from them over very great depths. This phenomenon, the explanation of which hitherto has not been found to be satisfactory (GEHLER'S New Lexicon, t. vi. 3. p. 1687), is a simple consequence of the current of colder water at depths from the pole to the equator; for if this runs against any obstruction, such as a shallow would present, it will rise along it as upon an inclined plane, and approach nearer the surface, and in this manner the surface will be cooled down."

A little later POUILLET*, who does not, however, seem to have been aware of LENZ'S researches, remarks:—"It seems certain that there is in general a surface-current carrying towards the polar seas the warm water of the tropics, and a lower current bringing back from the poles the cold water of the polar regions; but these currents are modified in their direction and intensity by a number of causes which depend on the depth of the sea-basins, their configuration, and the influence of winds and tides."

I have already referred to BIOT'S criticism of ROSS'S work. Reasoning afterwards on the different temperatures shown to exist throughout all seas, and on the impossibility, in consequence, of any portion of it being in a state of rest, he observes†:—"The existence and the initial direction of these constant currents presupposes three things: first, a permanent cause of movement which forces the polar waters towards the equator; secondly, a constant exterior afflux supplying the great polar streams at the origin and along their course; and lastly, some exhausting cause or outflow, preventing the final accumulation of their products" (p. 79). BIOT, however, in consequence, apparently, of the doubts he felt respecting the accuracy of temperature observations at depths, owing to the anomalous results of ROSS'S, hesitates to admit "the inference that the bottom of the sea was occupied by a layer of cold water proceeding from the poles and which is unceasingly renewed" (p. 71), and attaches more weight as a cause of this circulation to the inequality of mean pressure of the atmosphere in different latitudes.

BUFF‡ gave in 1850 a good general summary of the question as it then stood.

* Éléments de Physique, 5 ed. vol. ii. p. 666 (1847).

† 'Journal des Savans' for 1849.

‡ 'Physics of the Earth,' translated by HOFMANN. London, 1851, pp. 172–74.

A few years later Emil von Lenz* described the observations made by Dr. Edward Lenz during a series of voyages across the Atlantic to the west coast of South America at a small but uniform depth, and with the same instruments throughout. For some reason not explained, the temperatures in the low latitudes of the South Atlantic are not given.

North Atlantic.					South Atlantic.				
Lat. N.	Long. W.	Feet deep.	Temp. at depth.	Surface.	Lat. S.	Long. W.	Feet deep.	Temp. at depth.	Surface.
° ′	°		°		° ′	° ′		°	
1 38	27	360	58·2 F.	81·4					
3 14	21	,,	61 ,,	80					
6 9	23	,,	60 ,,	84					
6 52	22	,, †	58·2 ,,	80	13 28	28	360	72·8	80·2
25 35	37	,,	66·3 ,,	72·5	17 17	19 2 (32 ?)	,,	76·6	84
31 48	36	,,	64·3 ,,	73	30 13	46	,,	64	77
35 35	17	,, †	62·6 ,,	63·6	33	72 (52 ?)	,,	52	56
35 37	35	,,	60 ,,	68·4	53 12	58	,,	43	51
35 39	34	,,	61 ,,	67·8	55 19	62	,,	41	48·4
40 40	27	,,	56 ,,	62·6	56	64	,,	41	46

On these he remarks, "The number of observations here are so few, that no valid general conclusions can be drawn from them; I only mention that this attempt was substantiated by me in results made public on an earlier occasion (Bull. Phys. Math. v. 1847); viz. that at the equator, or rather in the region of calms, one finds a notably more rapid diminution of temperature at increased depth than even in the tropic or subtropical zone. We also see here that at 4° N. lat. the temperature at 60 fathoms decreases from 21° R. to 12° R., but at 28° (32 ?) lat. only to 14°·8; and it is first at 36° lat. in this depth that one finds nearly the same temperature as at the equator, viz. 12°·6 Réaumur. In the Southern Atlantic Ocean, the conditions of temperature at depths appear to approximate more nearly to the equator than in the Northern, possibly in consequence of the northern inclination of the region of calms."

§ V. *General Conclusions.*

It is evident that the old observations (all before 1868) have very different degrees of value. In laying down the lines of Section of the Bathymetrical Isotherms on the Admiralty "Track Chart" of the world, I have selected those observations which appear the most reliable, and which at the same time offer the most continuous series over the greatest number of parallels of latitude, such as the observations of Kotzebue in the North and South Atlantic, and those of Dayman‡ in the South Atlantic and

* "Meteorologische Beobachtungen auf dem Atlantischen und Grossen Oceane in den Jahren 1847–49 angestellt von dem Dr. Ed. Lenz, verechnet von E. Lenz," Bull. Acad. Imp. Sci. St. Pétersbourg, iv. 1863, p. 130.

† These numbers do not quite agree with the text, where they stand as "420" and "180."

‡ Only the correction for Dayman's observations should probably be rather higher than that for the others.

Indian Oceans, subject to, as the correction for pressure, the deduction of 1° FAHR. for every 1700 feet of depth. As the 'Challenger' expedition will supply ample data regarding the deeper temperature-soundings in the intertropical seas, the scarcity of them in the earlier voyages is of less importance. Those, on the contrary, collected on the many Arctic and Antarctic voyages under circumstances of so much difficulty, and which bear in so essential a manner upon the intermediate areas, are fortunately much more complete. The lines of Section have therefore been so selected as to embrace the chief observations of the several explorers in both the Arctic and the Antarctic seas. For this purpose two lines traverse respectively the length of the Atlantic and of the Pacific, and two others are run through the Indian and Southern Oceans.

Section No. 1 first traverses the North Atlantic from the top of Baffin Bay to the equator in long. 20° W., and shows the low submarine temperatures prevailing in the higher latitudes on that side of the Atlantic. The bathymetrical isotherm of 35° F. seems on this line not to extend beyond lat. 63° N. Soundings have been made in Davis Strait and Baffin Bay between lat. 60° and 77° N. to the depth of 6000 feet, and everywhere the temperature decreases with the depth down to 29° and 28°, or even 27°, and in one instance so low a degree as 25°·75 F. has been recorded. The isotherms of 40°, 50°, and 60° F. in the western area of the Atlantic have likewise a less northward extension than in the eastern area traversed by Section No. 2; while that of 70° F., which is affected by the Gulf-stream, extends further north.

Section No. 2, which commences in the seas around Spitzbergen, exhibits, to depths within the annual influence, a temperature as low, if not lower, than in No. 1, while below that the temperature, on the contrary, down to the depths hitherto tried (not quite 5000 feet) increases with the depth. Owing to the great diurnal variations of temperature at the surface or to currents, the fluctuations in the upper strata are frequent and rapid. From 1000 down to 3000 feet the temperature is more uniform at 33° to 34°, and reaches, at 4500 to 4600 feet*, 34° to 35° F. or possibly 36°. Off the coast of Greenland the one experiment of SCORESBY shows a decrease of temperature to the full depth tried, viz. to 28°·5 (corr.) at 708 feet.

From the Spitzbergen seas, the bathymetrical isotherm of 35° F. gradually falls until the latitude of about 50° N. is reached, when its depth is twice what it is in lat. 76° to 80°. About lat. 40° N. it appears to have attained its maximum depth of about 11,000 feet, at which it remains to lat. 30°, from about which point it again rises gradually, lying in lat. 12° at a depth of about 8000 feet, and reaching probably still nearer the surface at the equator†. The isotherm of 40° F., which, in this north-eastern part of the Atlantic, extends as far as lat. 72° to 73° north, reaches its maximum depth of about 6000 to 7000 feet between lat. 50° to 30° N., and rises to between 3000

* SCORESBY's deepest sounding was in 76° 30′ N., 4° 48′ W., 7200 feet, no bottom.

† The depths of these isotherms in the Atlantic will no doubt require correction; but this will not affect their relative position and general bearing.

and 4000 feet near the equator. Of these two and other lower isotherms in temperate and tropical seas the older observations afford, however, very few data, and we need say little. We wait for those of the 'Challenger.'

Of the bathymetrical isotherms of 50°, 60°, 70°, and 80° F., the data are more ample. They seem respectively to set in about lat. 60°, 50°, 25°, and 12° N., and the first two to attain their greatest depths between lat. 40° and 20°—the isotherm of 50° F. falling to 3000 feet, and that of 60° F. to 1200 feet. They then rise, and from lat. 12° N. to the equator, the isotherm of 50° F. comes within 1000 to 1200 feet of the surface, and that of 60° F. from 300 to 400 feet.

In the South Atlantic, on the line of section No. 1, which now crosses over to the eastern area of the South Atlantic, the bathymetrical isotherms seem to be prolonged southward more nearly on the same level that they have near the equator—the isotherm of 50° lying at from 1000 to 1400 feet, between lat. 7° and 40° S., and that of 60° F. at 500 or 600 feet. In the western area (sect. No. 2) the isotherms of 50°, 60°, and 70° F. are much more irregular, sinking in lat. 10° to 20° to about 3000, 1800, and 500 feet, and then rising and ending, as in the other line of section, in about lat. 40° and 45° S. But while, on the whole, the higher isotherms range rather further south in the western than in the eastern area, the isotherm of 35° F. is in both prolonged further south, on a nearly uniform level of from 7000 to 8000 feet, between lat. 20° and 65°.

The Pacific Sections (Nos. 3 & 4) exhibit a much lesser number of observations, but still sufficient to draw some general conclusions. Starting in one case in the Arctic Sea north of Behring Strait, and in the other in the sea south of Behring Strait, one line of section (No. 3) passes through the Eastern Pacific to the equator in long. 120° W., and the other (No. 4) through the Western Pacific to the equator in long. 180° W. North of Behring Strait the sea is so shallow that the observations barely pass beyond the limits of diurnal variations. The width and depth (180 feet) of that strait itself are also so small that the intercommunication through it between the polar seas and the North Pacific can have little or no effect on the thermal condition of the latter; nevertheless it may be a question whether the submarine isotherm of 60° F. in that ocean extends beyond the lat. of 40° to 45° N., and the isotherm of 50° F. beyond about lat. 55° N., being about 5° less in either case of their northern range in the eastern area of the North Atlantic; while the isotherm of 35° F. disappears, as in the western division of the Atlantic, between lat. 60° to 70° N., instead of having the more indefinite northward range it has in the open North Atlantic.

These isotherms also, instead of the remarkable rise which they present near the equator in the North Atlantic, exhibit in the North Pacific a gradual decline to the equator, where, judging from the few data we have at our disposal, they seem to lie—that of 60° F. at 800 to 1000 feet, of 50° F. at 2000 to 2500 feet, of 40° F. at 4000 to 5000 feet, of 35° F. at 7000 to 8000 feet respectively, and pass the equatorial zone without rise or apparent change of level.

On the other hand, in the South Pacific the conditions are much more like those of

the South Atlantic. In the Eastern division (section No. 3) the isotherms of 60° F. and 50° F. are on a nearly uniform level from the equator to about 35° to 45° S. lat., and extending apparently not quite so far southward as in the Atlantic. In the Western division of the Pacific (section No. 4) the several isotherms seem to lie rather deeper, and the isotherms of 60° and 50° F. to extend some degrees further south. But we again have, as in the South Atlantic, the same expansion of the isotherms of 40° and 35° F. as they range southward, the latter having in lat. 65° S. a depth of 6000 to 7000 feet; from this point it rises rapidly, or is displaced by colder waters, as it approaches the Antarctic continent.

Section No. 5, which crosses the Indian and Southern Oceans from 20° N. to 40° S., exhibits conditions analogous to those which obtain in the Pacific, though the isotherms of 40° and 35° appear to lie deeper, viz. at depths of about 9000 to 12,000 feet at the equator. They are then prolonged nearly on the same level to about 12° north, and thence to rise as they approach the head of the Arabian Gulf, where they are lost in the heated surface-waters. In the other direction the three higher isotherms on this line of section maintain a more nearly uniform relative depth of about 200, 500, and 1500 feet,—that of 80° F. terminating in about lat. 20° S., that of 70° F. in lat. 30° S., and that of 60° F. in lat. 39° S. At this point the isotherm of 50° F. lies at a depth of about 1500 feet, that of 40° F. at 4000 to 5000 feet, and that of 35° F. may be at about 7000 to 8000 feet. In this section we have no data south of 40° S. lat.

Section No. 6 traverses the Southern Ocean more to the eastward. We there still find the higher isotherms terminating in nearly the same parallels of latitude; but we can follow the lines of 40° F. and 35° F. further south—the former at a depth of about 4000 feet in lat. 53° S. and becoming lost in about lat. 65° S., and the latter rising and disappearing in about lat. 70° S. South of this is a zone in which the temperature of the sea to the depths (1800 feet) yet tried is 30° and 33° F. (corr.).

In the preceding observations the position of the bathymetrical isotherms can only be taken as an approximation to the truth, though they are, there is reason to hope, relatively correct. The deeper isotherms have possibly too high a degree, and the upper ones, it must be borne in mind, are, in different meridians, subject to the action of many causes that may produce aberration, such as displacement by the action of surface-currents, which will vary according to their depth; while another manifest cause, affecting more especially the lower isotherms, arises from the inequalities of the sea-bed, whereby the lower cold strata are deflected and driven nearer to the surface—an effect not only due to submarine banks and some islands, but caused also by continental shores, as on parts of the southern coasts of Africa and of South America*.

Independently, however, of these local variations, certain general conditions have been clearly established by the researches we have had occasion to review,—such as the presence of a stratum of water at and below 35° extending from the Arctic and

* When this takes place the temperature of the sea at or near the surface will be found to become lower on approaching the shore, against which the colder undercurrent rises. Their existence may thus be proved.

Antarctic seas to the equator, and which no doubt has justly been attributed to deep undercurrents carrying the waters of the poles to tropical regions, and the probable rise of these polar waters to the surface in the equatorial zone of the Atlantic. The source of those glacial waters in the North Atlantic lies, probably, in the Arctic Ocean; and the question arises as to the channels by which they travel southward. The comparatively high temperature of 34° to 36° at depths in the seas around Spitzbergen shows that, although a deep body of cold water may move down the east coast of Greenland, the channels of the comparatively shallow sea between Norway and Spitzbergen are entirely, and of the deeper sea between Spitzbergen and Greenland in great part, occupied by a body of warmer water from the south (for without renewal the degree of heat could not be maintained). On the other hand, the constant low temperature at depths in Baffin Bay, and the southward drifting of the large low-sunk icebergs, show that that sea and Davis Strait afford a passage to a deep glacial current derived from the Arctic seas of North America. Issuing from these comparatively narrow channels this body of cold water unites with that passing down the east coast of Greenland, and flows southwards, over the great depths of the Atlantic, apparently to the equator.

In the South Atlantic, on the contrary, the channel of the deep-seated glacial water is coextensive with the wide expanse open to the Antarctic seas, so that an unbroken undercurrent of such waters may occupy the one broad bed of that ocean.

These two great undercurrents of the Atlantic, flowing respectively from the north and the south poles towards the equator, must eventually meet; and, judging from the rise of the bathymetrical isotherms and the low temperature of the sea immediately beneath the heated surface-waters in the equatorial regions, it is probable, as suggested by Lenz, that the meeting is there, and that it is that which in part determines, in conjunction with the excessive evaporation, the surging-up of the polar waters, though other causes presently to be referred to may assist. In whatever way effected, the waters which thus rise to the surface in the equatorial zone necessarily tend to disperse and escape into other areas, whether by a slow movement in mass, or by more rapid currents in shallower and more definite channels, or by both causes combined.

The course of these deep Arctic and Antarctic undercurrents or streams in the Atlantic may be influenced by another cause; viz. by the west to east trend of the South-American continent from the Caribbean Sea to Cape St. Roque, and by that from east to west of the African continent along the coast of Guinea—projections which both contract the width of the Atlantic, and present barriers which may help to deflect sideways and upwards, on the one (American) side the southward flow of the Arctic waters, and on the other (African) side the northward flow of the Antarctic waters, in a manner analogous to that which takes place on shoals and islands.

It is not my intention to enter upon the discussion of the course and magnitude of the Gulf-stream; but I would suggest whether or not the initial start of that great current, together with the others which originate or acquire new power at the equator, such as the Guinea, the South Equatorial, and the Brazilian currents, may not be cradled

by this surging-up of Arctic and Antarctic waters at or near the equator; while other portions of those great bodies of water are deflected back and imperceptibly return the one to the north polar and the other to the south polar seas—in masses unaffected by the more active shallow drifts and currents sweeping over their surface, and whose course is influenced by trade-winds and the earth's rotation; for while the cold waters are found so comparatively near the surface in the equatorial regions, the presence, at depths, in both the polar seas, of bodies of water having a temperature far above not only that of the winter but the annual temperature of those latitudes, is equally well proved. Thus although the mean annual temperature of Spitzbergen does not exceed 18° F. (and Dove estimates* the normal mean temperature of latitudes 80° to 90° at 4°·5 F.), we find that in the seas surrounding that island there is a submarine temperature of 34° to 35°, if not rather higher. In the same way in the Antarctic regions and in latitude 60° to 70° we there also find a submarine temperature nearly as high†. Thus there is a rise of from 6° to 8° Fahr. in descending from the surface to depths of 3000 feet to 4000 feet in the open polar seas, whereas in like depths in the equatorial regions of the Atlantic there is a fall of not less than 40° F., extending at greater depths to about 50° F.

There is every reason to believe that the open seas of the north polar regions are due, as suggested by Maury and others, to the influence of warm southern waters, though this is not, as supposed by those authors, owing to the action of the Gulf-stream‡, but to the surging-up of these deeper warm strata; and in the same way the open sea found by Cook, Weddell, Ross, and others, after passing the first barrier of ice in the south polar seas, may be due to a similar cause. The great body of water at 32° to 35° or 36° F. extending to the depth of 4000 to 5000 feet or more, and passing by Spitzbergen, must ultimately be displaced and deflected by the colder and denser waters between 32° and 25°·4 of the polar regions, and rise to the surface; and as the influx is constant, an equilibrium can only be maintained by an efflux as great to other areas. By Behring Strait, owing to its narrowness and shallowness, comparatively none passes; but the surface-currents through Smith Sound, and the more intricate channels amongst the islands of the North-American coast and so down Baffin Bay, and that down the east coast of Greenland, originate doubtlessly with these effluent waters. The temperature-soundings to depths of 1000 feet in Baffin Bay are in accordance with this view; for after passing the stratum affected by the diurnal variations, the water to about that depth, although there is no surface-current from the south, has generally a temperature of from 30° to 34°, while that at greater depths sinks at places to a point very closely

* The mean summer temperature of Spitzbergen, according to Dove, is 34°·5 F.

† If, as we have reason to think, the observations of Sir James Ross should require a larger correction than others, then the isotherms in the Antarctic and Southern Oceans will have to be raised, and the isotherm of 35° will be replaced by one of 33° or 32° F.

‡ At the same time there cannot, I think, be any doubt of the influence of the Gulf-stream, as a shallow current, on the seas and northern shores of the British Islands and Norway.

approaching to the freezing-point or to that of the maximum density of ordinary sea-water. Moving in the same direction as the great body of colder water which it overlies, the warmer surface-water has a greater velocity than it, and moves over it as a surface-current—the causes which effect its impulsion being of a more energetic character than those which originate during the colder months of the year with the descent of the dense waters and their slow outward propulsion in a deep undercurrent.

In the Pacific Ocean the great breadth of open sea, and the almost entire exclusion of the waters of the north polar seas, have produced conditions very different from those which obtain in the Atlantic. The temperature-soundings are too few to lead to any certain conclusion; but, so far as they go, they seem to show that there is no uprising of cold undercurrents at the equator. The observations referred to by LENZ are so scattered and at such small depths, that they may have been affected by the action of the great cold current which passes northward up the west coast of South America, and is deflected westward at the equator, and by various other surface-currents.

In any case, the remarkable rise of the bathymetrical isotherms in the North Pacific, which cannot be accounted for by any current passing through Behring Strait, leads me to infer that the Antarctic waters pass under the whole length of the Pacific, and are thrown up by the barrier presented at its northern extremity by the American and Asiatic coasts. Some of the great currents of the North Pacific may owe their origin to, while others seem to be strengthened by, these distantly derived waters.

Nor is it easy to account in any other way for the rise of the isotherms of 35° and 40° F. at the head of the Arabian Sea after traversing the deep bed of the Indian Ocean. The high temperature of the surface-waters, however, prevents the effects being so apparent in the upper strata of that sea. Again, the causes which influence the great currents of the North-Indian Ocean appear to correspond with the area of surging-up, as they approach the Asiatic continent, of the south-polar undercurrents.

The cause of these phenomena in both hemispheres is, in all probability, connected with the intense cold of the polar regions,—the mean annual difference of from 70° to 80° F. between the polar and the intertropical regions forming a permanent disturbing cause, owing to the alteration of density to which the affluent waters are unceasingly subjected*. It is a cause, also, which, from the variation in the density of the surface-water in winter and summer, must materially influence the operation of the currents generally, both at the Arctic and Antarctic regions, during the different seasons of the year, increasing the outflow from the polar seas in the cold months, and the influx in the warmer, whence the outflowing current through Behring Strait in the winter or spring, and the inflowing current in the summer. For the same reason we should expect to find the general circulation more active in the one season than in the other. But the discussion of these interesting questions is not our object.

In no way are the effects of the remarkable interchange between the polar and equatorial waters in the great oceans more conspicuous than in the comparison of the

* According to DOVE the mean temperature of the equator is 79°·8 and of the pole 2°·2.

thermal conditions of those oceans with those of inland seas—the one so dependent on local climatal influences, and the other subject to influences so distant; for whereas it is the winter cold of the latitude which regulates the one, it is the cold of the polar winters which affects the other. Thus the temperature of from 54° to 55° F. at depths in the Mediterranean below the influence of the annual variations is that of the sub-winter months of that area, as that of 70° is for the Red Sea. But the most striking case is the sea of Okhotsk, where, in the parallel of Great Britain, but with a winter-cold under 20°, or possibly under 15° F., we have a nearly enclosed sea, of which the submarine temperature at 200 to 700 feet in the month of August is under 29° F., or nearly 2° below zero of Centigrade, the surface-temperature being 47° F.

These questions have necessarily a very important bearing on many geological problems, especially those connected with climates and the distribution of species. For example, it is probable that the increased severity of the climate noticed within the historical period on the east coast of Greenland may arise from that elevation of the land which is shown, by the presence of raised beaches and marine remains at heights of from 50 to 300 feet or more on the north-western coast of Greenland* and amongst the islands of the Northern-American archipelago beyond Baffin Bay, to have taken place at a comparatively recent period; for this, by lessening the width and depth of the many small straits opening into Baffin Bay, has thrown a larger volume of the polar waters into the other channels, as that between Greenland and Spitzbergen, and has thus had the effect of increasing and strengthening the ice-bearing current from the north which passes down the east coast of Greenland. The amelioration of climate towards the close of the Quaternary period may also have been locally greatly influenced by the elevation of the land and shallowing of the seas around Britain and Norway, by which any flow over this area of the deep polar currents has been diverted.

The cognate questions also connected with the southward range of an Arctic fauna or the northward range of a tropical fauna, and, to compare the water with the land, the insular-like character of the fauna of inland seas (all so liable to changes with any alteration in the direction and volume of those deep and obscure † undercurrents to which we have been referring, or by their ingress into seas before closed), are of the highest importance in the consideration whether of the later or of the older geological phenomena of the globe. They are, however, beyond the immediate range of this paper, which I submit as a starting-point for further research.

To conclude, the observations recorded in these pages, after subjecting the readings to the necessary corrections, show:—

1.—*a*. That a stratum of water at and under 35° F. extends beneath the Atlantic from the Arctic to the Antarctic seas‡; and, as it traverses all the parallels of latitude

* There is the same evidence of recent elevation on the coasts of Behring Strait.

† Using the word in contradistinction to "conspicuous" surface-currents, such as the Gulf-stream, the effects of which are well known, and have so often been reasoned upon in connexion with geological phenomena.

‡ This has now been more fully established by the recent expeditions of the 'Porcupine' and 'Challenger.

irrespective of the surface isothermals, it must have an origin dependent not on local influences, but on others at a distance—such, in fact, as accord only with polar influences.

b. That in the North Atlantic the two channels through which the deep-seated cold polar waters pass southward are Baffin Bay and the sea near the east coast of Greenland; while the shallower seas immediately west of Spitzbergen, and between that island and Norway, are occupied to their entire depth by warmer waters flowing northward, from equatorial regions, towards the pole.

2. That in the North Atlantic the isotherm of 35° extends further in the polar seas than in the South Atlantic; but in both its rise is masked by the extreme climatal variations and by surface-currents.

3.—*a*. That in the equatorial regions of the Atlantic the deep-seated north and south polar waters, either owing to their meeting, or from impinging against projecting continental coasts, or from irregularities in the sea-bed, or from the several causes combined, are deflected and surge up at the surface, as shown by the rise of the bathymetrical isotherms.

b. That the main portions of the upper strata of these surging waters flow slowly *en masse* from this equatorial zone towards the poles—such bodies of water moving independently of the drifts and surface-currents by which they are traversed and channelled.

4.—*a*. That in the Pacific there is a similar deep stratum of cold water at and under 35°, extending from the Antarctic Ocean to Behring Sea without rising, as in the Atlantic, at the equator.

b. That in the North Pacific the submarine temperature is as low as or lower than in the open North Atlantic in the same latitudes.

c. Consequently, as the body of cold water in the North Pacific cannot be of north polar origin (comparatively none passing through Behring Strait), there is reason to believe that the south polar waters traverse the whole length of the Pacific, and rise against the coasts bounding that ocean on the north.

5. That in the same way the Southern and Indian Oceans are underlaid by the cold waters proceeding from the Antarctic seas, which surge upwards as they approach the Asiatic coast.

6. That there the surging-up of polar waters in the great oceans, and of tropical waters in Arctic and Antarctic seas, is intimately connected with some of the great surface-currents which originate, or acquire additional force, in equatorial and polar seas, although the ultimate course of these currents may be influenced and determined by the action of the prevailing winds and by the movement of rotation of the earth.

7. That the temperature at depths in inland seas is governed by local causes, and tends in each case to assimilate to (or as near as the physical properties of water will allow) that of the mean winter or sub-winter temperature of the place.

Erratum in Mr. PRESTWICH'S *Paper on Submarine Temperatures. Paragraph* 6, *to replace lines* 32 *to* 36, *p.* 638.

6. That some of the great surface-currents, which originate or acquire additional force in the equatorial and polar seas, are intimately connected with the surging-up of polar waters in the great oceans and of tropical waters in Arctic and Antarctic seas, although the ultimate course of these currents may be influenced and determined by the action of the prevailing winds and by the movement of rotation of the earth.

Tables of Submarine Temperatures of the Great Oceans and Inland Seas, taken between 1749 and 1868, arranged according to the Latitudes in each Hemisphere, and reduced to English measures and Greenwich Longitude.

References to the original observations will be found in § II., in notes to the several voyages (given in order of date). Those alone to which (*u*) is attached are from unpublished documents. Those also where (M.) is added to the name will be found in MARCET's paper (*antè*, p. 595), and not in the works of the original observers. The temperature-readings are given as recorded by each observer. To obtain an approximately true reading, it is necessary to apply the correction named at p. 612, excepting the observations of LENZ (and KOTZEBUE, 2nd voyage), DU PETIT-THOUARS (when stated "cylinder sound"), MARTINS, AIMÉ, SHORTLAND, VAILLANT (in part), D'URVILLE (in part), and some of PULLEN's, and probably ROSS's and PARRY's of 1818–19. The correction consists in a deduction of 1° FAHR. for every 1700 feet of depth. The figures in parentheses attached to DU PETIT-THOUARS's observations give his original corrections of temperature and depth. A separate list of the voyages on which the observations were taken will be found, in connexion with the names in column VIII., in "Explanation of Map," p. 671.

TABLE I.—Northern Hemisphere.

I.	II. Date.	III. North Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr.			VIII. Name of observer.	IX. Remarks.
						At depth.	Surface.	Air.		
1.	Mar., 1828...	° ′ 0 0	° ′ 99 40 W.	N. Pacific ...	480	° 71	° 83	° 83	Beechey	Under the Equator 8° west of the Galapagos Islands.
2.	,, ,,	,, ,,	,, ,,	,, ,,	960	63·5	,,	,,	,, ...	
3.	22 Apr., 1825...	0 ?	179 43 W.	N. Pacific ...	4800	45·5	83·7	...	Kotzebue, 2d voy.	Just N. of the Equator, between the Sandwich Islands and Australia.
4.	May, 1824...	Near the above place		N. Pacific ...	6000	36·5	86	...	,,	
5.	6 May, 1818...	0 7	20 26 W.	N. Atlantic ...	339	59·1	83·3	84·1	Kotzebue.....	Between Brazil and Sierra Leone.
5*a*.	21 Apr., 1848...	0 30	.....	N. Pacific ...	6000	43·5	80·5	...	Belcher	1° W. of Albemarle Island.
6.	Oct., 1836...	0 33	8 16 E.	N. Atlantic ...	3918	43	78·7	...	Wauchope	Gulf of Guinea. Rope vertical.
7.	6 May, 1818...	0 36	20 29 W.	N. Atlantic ...	416	58	83·3	84·5?	Kotzebue.....	Between Brazil and Sierra Leone.
8.	5 Sept., 1772...	0 52	8 W.?	N. Atlantic ...	510	66	74	75·5	Forster	Between the coast of Guinea and Ascension.
9.	8 Aug., 1828...	1	126 40 E.	N. Pacific ...	1541	54·8	82·4	81·2	D'Urville.....	In the Straits of Molucca.
10.	12 Jan., 1847...	1 5	22 32 W.	N. Atlantic ...	2010	52	83	77	Dayman	In mid-ocean. W. of No. 7.
11.	12 May, 1816...	1 17	177 5 W.	N. Pacific ...	1800	55	82·5	83	Kotzebue.....	N. of Island of New Nantucket.
12.	1847-49.....	1 38	27 W.	N. Atlantic ...	360	58·2	81·4	...	E. Lenz	Near the Island of St. Paul.
13.	8 May, 1818...	1 58	21 6 W.	N. Atlantic ...	467	57·5	82·6	74	Kotzebue.....	Not far from No. 10.
14.	2 Dec., 1857...	2 20	28 44 W.	N. Atlantic ...	4080	46·2	80	...	Pullen	In soundings: 90 miles off the Island of St. Paul.
15.	,, ,,	,, ,,	,, ,,	,, ,,	6480	38·5	,,	...	,, ...	
16.	4 Feb., 1829...	2 30	19 10 W.	N. Atlantic ...	5101	43·6	80·5	79·2	D'Urville.....	In mid-ocean; between the north-west of Brazil and the coast of Guinea.
17.	9 May, 1818...	2 32	21 13 W.	N. Atlantic ...	480	58·5	84·3	81·8	Kotzebue.....	
18.	5 Feb., 1829...	3	19 10 W.	N. Atlantic ...	2657	45·6	78·8	80·5	D'Urville.....	
19.	,, ,,	,,	,, ,,	,, ,,	1594	59	83·2	82·8	,, ...	
20.	10 May, 1818...	3 5	21 24 W.	N. Atlantic ...	480	58·9	84·5	84·4	Kotzebue.....	
21.	1847-49.....	3 14	21 W.	N. Atlantic ...	360	61	80	...	E. Lenz	
22.	11 May, 1818...	3 30	21 53 W.	N. Atlantic ...	463	59	83	79·3	Kotzebue.....	
23.	6 Feb., 1829...	3 30	19 20 W.	N. Atlantic ...	53	80·2	81	80·5	D'Urville.....	
24.	,, ,,	,, ,,	,, ,,	,, ,,	133	79·5	,,	,,	,, ...	
25.	,, ,,	,, ,,	,, ,,	,, ,,	266	70·8	,,	,,	,, ...	
26.	,, ,,	,, ,,	,, ,,	,, ,,	531	67·8	81·3	,,	,, ...	
27.	,, ,,	,, ,,	,, ,,	,, ,,	797	65·3	82	81·5	,, ...	
28.	,, ,,	,, ,,	19 10 W.	,, ,,	1062	60·6	81	80·5	,, ...	
28*a*.	22 May, 1803...	3 27	145 W.	N. Pacific ...	600	60·2	82	82	Krusenstern ...	Among the Society Islands.
29.	23 Sept., 1858...	3 37	160 52 E.	N. Pacific ...	1200	71·2	85·8	82·8	Wüllerstorf.....	Between Marshall and Salomon Islands.
30.	22 Feb., 1804...	4	16 ? W.	N. Atlantic ...	2274	45·5	88	88·3	Péron	Therm. remained down 1h 15m.
31.	22 Sept., 1858...	4 2	160 41 E.	N. Pacific ...	600	81·6	84·8	81·6	Wüllerstorf.....	Near the Caroline Islands.
32.	30 Dec., 1838...	4 14	91 8 E.	Indian Ocean	600	70	82·5	82	Pratt	Between Sumatra and Ceylon.

TABLE I.—Northern Hemisphere (continued).

I.	II. Date.	III. North Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr. At depth.	Surface.	Air.	VIII. Name of observer.	IX. Remarks.
33.	12 May, 1818...	4 16	22 42 w.	N. Atlantic ...	480	59·2	82·5	77·1	Kotzebue.....	In mid-ocean, between the coasts of Guinea and of Guayana.
34.	1 Dec., 1857...	4 16	28 42 w.	N. Atlantic ...	6000	42·5	80	...	Pullen	
35.	„ „	„ „	„ „	„ „	9000	39·4	„	...	„	
36.	24 May, 1839...	4 23	26 06 w.	N. Atlantic ...	6398 (5151?)	42·8 (39·7)	80·6	77·5	DuPetit Thouars	Cylinder full of water.
37.	„ „	„ „	„ „	„ „	6398 (6037?)	37·8	„	„	„ „	Cylinder sound.
38.	27 June, 1837...	4 32	134 34 w.	N. Pacific ...	12273	35	81	78·8	DuPetit Thouars	Instrument crushed. Index fixed.
39.	13 May, 1818...	4 33	24 11 w.	N. Atlantic ...	471	57·9	82·6	81·9	Kotzebue.....	Between Island of St. Paul and Sierra Leone.
40.	Oct., 1823...	5	22 ? w.	N. Atlantic ...	3000	43·2	83·8	...	Kotzebue, 2d voy.	In mid-ocean: near No. 33.
41.	19 Feb., 1804...	5	18 ? w.	N. Atlantic ...	1280	48·6	87	90	Péron	Therm. remained down 1h 50m.
42.	7 Jan., 1847...	5 8	22 19 w.	N. Atlantic ...	2040	49	83	82	Dayman	Mid-ocean, between Brazil and Sierra Leone.
43.	14 May, 1818...	5 29	26 9 w.	N. Atlantic ...	479	56·5	82·9	83·9	Kotzebue.....	Between Guayana and Liberia.
44.	6 Jan., 1847...	5 54	22 34 w.	N. Atlantic ...	2166	50	82	79	Dayman	In mid-ocean: near No. 42.
45.	15 May, 1818...	6	27 34 w.	N. Atlantic ...	414	55·9	81·9	81·8	Kotzebue.....	Between Guayana and Liberia.
46.	1847–49.....	6 9	23 w.	N. Atlantic ...	360	60	84	...	E. Lenz	
47.	5 Jan., 1847...	6 28	22 39 w.	N. Atlantic ...	1110	51	84	82	Dayman	Between Sierra Leone and Guayana.
48.	1847–49.....	6 52	22 w.	N. Atlantic ...	420	58·2	80	...	E. Lenz	Between Cape-Verd Is & St. Paul.
49.	24 Nov., 1800...	7	20 w.?	N. Atlantic ...	320	61·2	86	...	Péron	Therm. broke and replaced.
50.	16 May, 1818...	7 13	28 32 w.	N. Atlantic ...	368	58	81·5	82·3	Kotzebue.....	In mid-ocean, between Brazil and Sierra Leone.
51.	10 Oct., 1823...	7 20	21 59 w.	N. Atlantic ...	3435	35·9	78·5	...	Lenz.....	
52.	16 Mar., 1858...	7 47	93 18 E.	Indian Ocean	510	68·8	81·8	81·8	Wüllerstorf.....	Near the Nicobar Islands.
53.	22 Nov., 1800...	8	Par. of Cape Verd Isl.	N. Atlantic	532	77	86·5	86	Péron	Therm. down only 5m.
54.	14 Sept., 1858...	8 2	158 10 E.	N. Pacific ...	1200	66·5	84·5	82	Wüllerstorf.....	Amongst the Caroline Islands.
55.	5 Mar., „ ...	8 29	93 33 E.	Indian Ocean	480	78·2	83	80·3	„	East of Nicobar Islands.
56.	3 Jan., 1847...	8 55	22 38 w.	N. Atlantic ...	1146	59	82	78	Dayman	In the parallel of Sierra Leone.
57.	13 Nov., 1817...	8 59	155 36 E.	N. Pacific ...	600	56·2	87	85	Kotzebue.....	Between the Radack and the Mariana Islands.
58.	6 July, 1826...	9	20 40 w.	N. Atlantic ...	2125	41·2	80·3	76·8	D'Urville.....	7° W. of Sierra Leone.
59.	12 May, 1846...	9	97 w.	N. Pacific ...	60	85	87	84	Kellett.....	
60.	„ „	„	„	„ „	120	83	„	„	„	
61.	„ „	„	„	„ „	180	81	„	„	„	
62.	„ „	„	„	„ „	240	77	„	„	„	
63.	„ „	„	„	„ „	300	66	„	„	„	Between the Galapagos Islands and Acapulca, Mexico.
64.	„ „	„	„	„ „	600	56	„	„	„	
65.	„ „	„	„	„ „	1200	53	„	„	„	
66.	„ „	„	„	„ „	1800	48	„	„	„	
67.	„ „	„	„	„ „	2400	46	„	„	„	
68.	„ „	„	„	„ „	3000	44	„	„	„	
69.	14 Nov., 1817...	9 20	155 16 E.	N. Pacific ...	150	77	83	84	Kotzebue.....	Amongst the Caroline Islands.
70.	15 Nov., 1817...	9 26	154 59 E.	N. Pacific ...	90	79	87·4	85·7	Kotzebue.....	
71.	„ „	„	„ „	„ „	300	59·1	„	„	„	Between the Radack and the Mariana Islands.
72.	„ „	„	„ „	„ „	414	51·4	„	„	„	
73.	„ „	„	„ „	„ „	606	49·5	„	„	„	
74.	17 May, 1818...	9 27	29 7 w.	N. Atlantic ...	432	58·4	79·2	80	Kotzebue.....	Between the Cape-Verd and St. Paul Islands.

TABLE I.—Northern Hemisphere (continued).

I.	II. Date.	III. North Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr.			VIII. Name of observer.	IX. Remarks.
						At depth.	Surface.	Air.		
75.	12 Apr., 1828...	10° 3′	80° 31′ E.	Bay of Bengal	531	63°	86°	86°	Blosseville	Off the north coast of Ceylon.
76.	„ „	„ „	„ „	„ „	3082	47	„	„	„	
77.	17 Nov., 1817...	10 3	153 17 E.	N. Pacific ...	438	57·4	84·2	83·5	Kotzebue.....	N. of the Caroline Islands.
78.	Aug., 1816...	10 14	29 9 W.	N. Atlantic...	5796	51	80	...	Wauchope	Corrected depth 2880 feet.
79.	18 Nov., 1817...	10 41	152 07 E.	N. Pacific ...	366	59·9	83·9	83·2	Kotzebue.....	N. of the Caroline Islands.
80.	19 „ „	11 4	150 56 E.	„ „	492	56·6	83·7	82·7	„	
81.	18 May, 1818...	11 35	30 56 W.	N. Atlantic...	393	59·4	78·8	79·8	„	S.W. of Cape-Verd Islands.
82.	20 Nov., 1817...	11 42	150 09 E.	N. Pacific ...	516	63	84	84·2	Kotzebue.....	Between the Mariana and the Caroline Islands.
83.	30 Aug., 1858...	11 55	149 53 E.	„ „	270	84·8	84·5	83·8	Wüllerstorf.....	
83*a*.	3 Sept., 1836...	11 59	111 55 W.	„ „	4266	42·8	78·8	81	Vaillant	Between Mexico and the Marquesas Islands.
83*b*.	4 „ „	12 6	112 40 W.	„ „	2133	49	80	82·4	„	
84.	21 Nov., 1817...	12 28	149 06 E.	„ „	468	66·9	83·3	81·1	Kotzebue.....	Between the Mariana and the Caroline Islands.
85.	22 July, 1843...	12 36	25 35 W.	N. Atlantic...	900	52	79·5	...	James Ross.....	140 miles W. of Cape-Verd Islands. No soundings in 11,100 feet.
86.	„ „	„ „	„ „	„ „	1800	47·6	„	...	„	
87.	„ „	„ „	„ „	„ „	8100	39·5	„	...	„	
88.	„ „	„ „	„ „	„ „	11100	39·6	„	...	„	
89.	Before 1857	13 ?	78 W.?	Caribbean Sea	1440	48	83	...	Dunsterville ...	Quoted by Maury without date or exact position.
90.	„ „	„ „	„ „	„ „	2316	43	„	...	„ ...	
91.	„ „	„ „	„ „	„ „	2700	42	„	...	„ ...	
92.	„ „	„ „	„ „	„ „	3000	43	„	...	„ ...	
93.	Apr., 1859...	13	48 10 E.	Gulf of Aden	7200	45	81·5	...	Pullen (*u*)	In soundings.
94.	19 May, 1818...	13 24	32 2 W.	N. Atlantic...	393	58·1	76·5	77·7	Kotzebue.....	Between Cape-Verd Islands and Guayana.
94*a*.	27 Mar., 1837...	13 27	83 20 E.	Bay of Bengal	3200	46	78·8	78	Vaillant	Uncertain.
95.	22 Nov., 1817...	13 28	147 18 E.	N. Pacific ...	396	69·9	83	83·1	Kotzebue.....	E. of the Mariana Islands.
96.	13 Dec., „	13 51	119 36 E.	China Sea ...	561	61·5	82·2	84·5	„	West of Luzon.
97.	23 Nov., „	13 52	145 11 E.	N. Pacific ...	270	71·1	82·9	83·7	„	Between the Mariana and the Philippine Islands.
98.	Mar., 1828...	14 22	99 35 W.	N. Pacific ...	600	57	88	91	Beechey	Off the south-west coast of Mexico.
99.	„ „	„ „	„ „	„ „	1200	55	„	„	„	
100.	„ „	„ „	„ „	„ „	1800	48·5	„	„	„	
101.	„ „	„ „	„ „	„ „	2400	49·5	„	„	„	
102.	Apr., 1859...	14 26	54 5 E.	Arabian Sea...	9000	43·5	82·5	...	Pullen (*u*)	In soundings. Entrance of the Gulf of Aden.
103.	28 June, 1826...	15	22 40 W.	N. Atlantic...	425	64·8	73·4	73·4	D'Urville.....	E. of the Cape-Verd Islands.
104.	28 June, 1858...	15 5	118 3 E.	China Sea ...	510	83	84·7	84·5	Wüllerstorf.....	1½° W. of Luzon.
105.	2 Jan., 1847...	15 28	23 22 W.	N. Atlantic...	1080	53	73	72	Dayman	E. of the Cape-Verd Islands.
106.	20 May, 1818...	15 51	32 56 W.	N. Atlantic...	384	65·5	76·5	77·8	Kotzebue.....	W. of Cape-Verd Islands.
107.	Jan., 1827...	16 5	133 35 W.	N. Pacific ...	1992	49	75	76	Beechey	Between Mexico and the Sandwich Islands.
108.	„ „	„ „	„ „	„ „	2592	45	„	„	„	
109.	1 Dec., 1817...	16 32	140 56 E.	N. Pacific ...	534	68·7	82·5	82·5	Kotzebue.....	Between the Mariana and the Philippine Islands.
110.	12 „ „	16 42	119 26 E.	China Sea ...	483	60·1	80·5	81·7	„	West of Luzon.
110*a*	11 Sept., 1836...	16 47	115 40 W.	N. Pacific ...	6930	42·4	82	84·7	Vaillant	5° N.W. of No. 83*b*.
111.	Apr., 1859...	16 57	64 21 E.	Arabian Sea...	11280	44·4	82	...	Pullen (*u*)	In soundings.
112.	10 Oct., 1827...	17 5	83 12 E.	Bay of Bengal	1647	50·4	85·7	90·5	Blosseville	Off the Circars coast.
113.	8 July, 1857...	17 19	29 50 W.	N. Atlantic...	1200	60·3	80·8	78·9	Wüllerstorf.....	W. of the Cape-Verd Islands.

TABLE I.—Northern Hemisphere (continued).

I.	II. Date.	III. North Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr. At depth.	Surface.	Air.	VIII. Name of observer.	IX. Remarks.
114.	2 Dec., 1817...	17° 23′	139° 14′ E.	N. Pacific ...	456	70°2	81°4	81°2	Kotzebue.....	Between the Mariana and the Philippine Islands.
115.	June, 1825...	17 30	27 1 W.	N. Atlantic...	480	60·5	76·5	77	Beechey	N.W. of Cape-Verd Islands.
115*a*	29 Jan., 1837...	17 54	119 47 E.	China Sea ...	3733	42·4	81·2	78	Vaillant	In sight of Luzon.
116.	11 Dec., 1817...	18	119 53 E.	China Sea ...	570	60	82	82	Kotzebue.....	W. of Luzon.
117.	21 May, 1818...	18 1	34 24 W.	N. Atlantic...	432	68·6	78·8	77·7	,, ...	Between Senegal and Martinique.
118.	10 Nov., 1836...	18 21	134 20 E.	N. Pacific ...	3182	42	80	81·5	Vaillant	Between the Philippine and the Mariana Islands.
119.	27 ,, ,,	,, 27	134 18 E.	,, ,,	4261	40·6	,,	79	,, ...	
120.	3 Dec., 1817...	18 25	137 56 E.	N. Pacific ...	366	71·8	81·5	79·6	Kotzebue.....	
121.	1 Jan., 1847...	18 40	23 18 W.	N. Atlantic...	468	70	73	68	Dayman	N. of the Cape-Verd Islands.
122.	,, ,,	,, ,,	,, ,,	,, ,,	1068	57	,,	,,	,, ...	
123.	Mar., 1827...	18 51	163 58 E.	N. Pacific ...	600	67	79·5	75	Beechey	Between Lamira and the Marshall Islands, Polynesian Archipelago.
124.	,, ,,	,, ,,	,, ,,	,, ,,	1200	54	,,	,,	,, ...	
125.	,, ,,	,, ,,	,, ,,	,, ,,	1860	48	,,	,,	,, ...	
126.	Mar., 1827...	18 51	161 30 E.	N. Pacific ...	2520	44	79	76	Beechey	
127.	,, ,,	18 53	148 54 E.	,, ,,	1200	57	79·5	82	,, ...	E. of the Mariana Islands.
127*a*	Feb. 1804...	19	114 E.	Indian Ocean	420	58	72·2	...	Horner	Off the N.W. coast of Australia.
128.	4 Dec., 1817...	19 20	134 32 E.	N. Pacific ...	270	70·9	80·8	79·8	Kotzebue.....	Between the Mariana and Philippine Islands.
129.	5 ,, ,,	19 44	132 15 E.	,, ,,	438	67·1	79	79·8	,, ...	
130.	6 ,, ,,	19 44	130 35 E.	,, ,,	498	67·6	79	77·3	,, ...	
131.	22 May, 1818...	19 59	35 10 W.	N. Atlantic...	471	68·5	76·2	76·9	Kotzebue.....	In mid-ocean.
132.	13 Nov., 1822...	20 30	83 30 W.	Caribbean Sea	7476	45·5	83	...	Sabine	Corrected depth 6000 feet.
133.	9 July, 1837...	21 06	155 59 W.	N. Pacific ...	531	55·4	77	76	DuPetit Thouars	Cylinder sound.
134.	31 Dec., 1846...	21 13	22 1 W.	N. Atlantic...	1158	61	71	66	Dayman	Between the Canaries and Cape-Verd Islands.
135.	18 May, 1824...	21 14	164 E.	N. Pacific ...	898	61·5	79·5	...	Lenz.....	Between the Sandwich Islands and the coast of China.
136.	,, ,,	,, ,,	,, ,,	,, ,,	2635	37·6	,,	...	,, ...	
137.	,, ,,	,, ,,	,, ,,	,, ,,	4236	37·3	,,	...	,, ...	
138.	,, ,,	,, ,,	,, ,,	,, ,,	5835	36·4	,,	...	,, ...	
139.	23 May, 1818...	21 40	36 14 W.	N. Atlantic...	368	68·8	75·8	76·7	Kotzebue.....	Between Canaries and West-Indian Islands.
140.	13 Jan., 1837...	21 50	19 33 W.	N. Atlantic...	2657 (1607 ?)	50	70·2	71·6	DuPetit Thouars	Cylinder full of water.
141.	June, 1825...	22 2	21 14 W.	N. Atlantic...	240	63	72	74	Beechey	4° W. of Cape Blanco.
141*a*	Nov. 1804...	23	132 E.	N. Pacific ...	300	72	74·2	...	Horner	Between the Loo-choo and the Mariana Islands.
141*b*	,, ,, ...	,,	,,	,, ,,	780	60·2	,,	...	,, ...	

The later observations in the Indian Ocean by Capt. SHORTLAND are given as a whole without separate particulars:—

1868. Between Jan. 28 and Feb. 12 ...	Between Kooria-Mooria and Bombay (17° to 20° lat. N. and 45° to 70° long. E.)	600	60	75	74·5	Shortland	Mean of all the observations between these dates.
		3000	50·9	,,	,,	,, ...	
		6000	42·8	,,	,,	,, ...	
		9000	35·3	,,	,,	,, ...	
		12240	33·7	,,	,,	,, ...	
		13020	33·5	,,	,,	,, ...	
Feb. 22 to March 6	Between Kooria-Mooria and Aden (13° to 17° lat. N. and 45° to 55° long. E.)	600	67·7	76·5	78·8	,, ...	Mean of the observations between these dates.
		3000	54·2	,,	,,	,, ...	
		6000	45·4	,,	,,	,, ...	
		7800	36	,,	,,	,, ...	

TABLE I.—Northern Hemisphere (continued).

I.	II. Date.	III. North Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr.			VIII. Name of observer.	IX. Remarks.
						At depth.	Surface.	Air.		
141*c*	June, 1804...	23 ° ′	178 ° ′ E.	N. Pacific ...	150	76·4	78	...	Horner	Between the Sandwich Islands and Japan.
141*d*	,, ...	,,	,,	,, ,,	300	70·8	,,	...	,, ...	
141*e*	,, ...	,,	,,	,, ,,	750	62	,,	...	,, ...	
142.	24 May, 1818...	23 6	36 51 W.	N. Atlantic ...	471	69·6	76·9	77	Kotzebue	In mid-ocean.
143.	May, 1827...	23 6	124 52 E.	China Sea ...	1260	55·5	80·5	82	Beechey	Off the east coast of Formosa.
144.	,, ,,	,, ,,	,, ,,	,, ,,	1860	47	,,	,,	,, ...	
145.	,, ,,	,, ,,	,, ,,	,, ,,	2100	45	,,	,,	,, ...	
146.	30 Dec., 1846 ...	23 22	20 58 W.	N. Atlantic ...	396	66	69	68	Dayman	Between the Cape-Verd and Canary Islands.
147.	,, ,,	,, ,,	,, ,,	,, ,,	1140	61	,,	,,	,, ...	
147*a*	22 June, 1804...	On the N. tropic.	178 4 E.	N. Pacific ...	150	76	78	...	Krusenstern ...	Between the Sandwich Islands and Japan.
147*b*	,, ,,	,, ,,	,, ,,	,, ,,	300	71	,,	...	,, ...	
147*c*	,, ,,	,, ,,	,, ,,	,, ,,	750	62·6	,,	...	,, ...	
148.	June, 1826...	24 57	163 21 W.	N. Pacific ...	1200	67	77	76	Beechey	Between Sandwich and Gardner Island.
149.	8 Feb., 1825...	25 6	156 58 W.	N. Pacific ...	1070	57·5	71	...	Lenz.....	N. of the Sandwich Islands.
150.	1749 ...	25 13	25 12 W.	N. Atlantic ...	3900	53	84	84	Ellis.....	43^m to haul up.
151.	,, ...	,, ,,	,, ,,	,, ,,	5346	53	,,	,,	,, ...	
152.	25 May, 1818...	25 23	37 W.	N. Atlantic ...	435	68·9	76	76	Kotzebue	Between the Canaries and the W.-India Islands.
153.	1847-49 ...	25 35	37 W.	N. Atlantic ...	360	66·3	72·5	...	E. Lenz	
154.	Dec., 1827...	25 38	117 48 W.	N. Pacific ...	300	62	63	62·5	Beechey	3° distant from the coast of Lower California.
155.	,, ,,	,, ,,	,, ,,	,, ,,	900	50	,,	,,	,,	
156.	,, ,,	,, ,,	,, ,,	,, ,,	1260	47·5	,,	,,	,,	
157.	,, ,,	,, ,,	,, ,,	,, ,,	1860	47·5	,,	,,	,,	
158.	June, 1853...	Off Cape Florida.		N. Atlantic ...	3300	49	...	...	Bache	12 miles E. of the lighthouse.
158*a*	June, 1803...	26	37 W.	N. Atlantic ...	420	65·7	74·2	...	Horner	Between Africa and the West-India Islands.
158*b*	,, ,,	,,	,,	,, ,,	1200	63	,,	...	,, ...	
159.	6 June, 1846...	26 38	133 26 W.	N. Pacific ...	60	69	71	70	Kellett.....	Between Lower California and the Sandwich Islands.
160.	,, ,,	,, ,,	,, ,,	,, ,,	120	68	,,	,,	,, ...	
161.	,, ,,	,, ,,	,, ,,	,, ,,	180	68	,,	,,	,, ...	
162.	,, ,,	,, ,,	,, ,,	,, ,,	240	68	,,	,,	,, ...	
163.	,, ,,	,, ,,	,, ,,	,, ,,	300	68	,,	,,	,, ...	
164.	,, ,,	,, ,,	,, ,,	,, ,,	600	64·5	,,	,,	,, ...	
165.	,, ,,	,, ,,	,, ,,	,, ,,	1200	50	,,	,,	,, ...	
166.	,, ,,	,, ,,	,, ,,	,, ,,	1800	46	,,	,,	,, ...	
167.	,, ,,	,, ,,	,, ,,	,, ,,	2400	44·5	,,	,,	,, ...	
168.	,, ,,	,, ,,	,, ,,	,, ,,	3000	43	,,	,,	,, ...	
168*a*	Nov., 1804...	27	147 W.	N. Pacific ...	180	70·8	78	...	Horner	10° N.E. of the Sandwich Islands.
168*b*	,, ,,	,,	,,	,, ,,	540	64·7	,,	...	,, ...	
168*c*	,, ,,	,,	,,	,, ,,	600	64·4	,,	...	,, ...	
168*d*	,, ,,	,,	,,	,, ,,	720	64·4	,,	...	,, ...	
169.	4 Mar., 1829...	27	31 40 W.	N. Atlantic ...	2657	51·2	69·3	68	D'Urville.....	Between Teneriffe and Bermuda.
170.	27 June, 1857...	27 2	24 7 W.	N. Atlantic ...	600	72·2	74·4	73·8	Wüllerstorf.....	No soundings in 24,300 feet.
171.	,, ,,	,, ,,	,, ,,	,, ,,	1440	63·7	,,	,,	,, ...	

Table I.—Northern Hemisphere (continued).

I.	II. Date.	III. North Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr.			VIII. Name of observer.	IX. Remarks.
						At depth.	Surface.	Air.		
		° ′	° ′			°	°	°		
172.	9 Nov., 1857...	27 31	21 39 W.	N. Atlantic...	3000	50	72	...	Pullen (*u*)	Between the Canaries and Cape-Verd Islands.
173.	„ „	„ „	„ „	„ „	4800	44·5	„	...	„ (*u*)	
174.	26 May, 1818...	27 38	37 10 W.	N. Atlantic...	448	65·7	74·5	75	Kotzebue.....	In mid-ocean.
175.	22 Sept., 1817...	27 50	152 21 W.	N. Pacific ...	30	75	77	76·1	Kotzebue.....	6° N.E. from the Sandwich Islands.
176.	„ „	„ „	„ „	„ „	60	74·5	„	„	„	
177.	„ „	„ „	„ „	„ „	150	73·7	„	„	„	
178.	„ „	„ „	„ „	„ „	300	67·2	„	„	„	
179.	„ „	„ „	„ „	„ „	600	61	„	„	„	
180.	„ „	„ „	„ „	„ „	1200	51·5	„	„	„	
181.	June, 1826...	28 22	172 17 W.	N. Pacific ...	900	57	76·5	77	Beechey	Off Bunker Island.
182.	1854	95 miles Cana	off Cape veral.	N. Atlantic...	2100	50	82?	...	Craven.....	Exact position not given.
183.	30 Dec., 1846...	28 34	18 38 W.	N. Atlantic...	780	63	67	66	Dayman	W. of the Canaries.
184.	June, 1826...	28 52	173 9 W.	N. Pacific ...	2400	47	78	81	Beechey	N. of Bunker Island; Polynesian Archipelago.
185.	„ „	„ „	„ „	„ „	3600	41	„	„	„	
186.	„ „	„ „	„ „	„ „	4704	42·8	„	„	„	
187.	10 Oct., 1837...	29 32	34 40 W.	N. Atlantic...	8838	44	75	79	Vaillant	Between the Canaries and Florida.
188.	1 June, 1816...	29 24	160 34 E.	N. Pacific ...	600	62	74	75	Kotzebue.....	7° N.N.W. of the Sandwich Islands.
189.	„ „	„ „	„ „	„ „	1800	52·5	„	„	„	
190.	17 Nov., 1837...	29 25	118 51 W.	N. Pacific ...	2657	43·3	65·3	69·5	DuPetitThouars	Cylinder full.
190*a*	June, 1803...	30	40 W.	N. Atlantic...	90	70·2	72·5	...	Horner	Between the Canaries and Bermuda.
190*b*	„ „	„	„	„ „	180	68·5	„	...	„	
190*c*	„ „	„	„	„ „	378	65·7	„	...	„	
190*d*	„ „	„	„	„ „	840	62	„	...	„	
190*e*	„ „	„	„	„ „	1020	62	„	...	„	
190*f*	„ „	„	„	„ „	1200	62	„	...	„	
191.	27 May, 1818...	30 3	37 24 W.	N. Atlantic...	368	66·5	73	75·5	Kotzebue.....	Between the Canaries and Madeira.
192.	25 Oct., 1815...	30 12	15 14 W.	N. Atlantic...	1176	56·3	74·3	74·3	Kotzebue.....	Between the Canaries and the Azores.
193.	22 June, 1857...	30 50	23 6 W.	N. Atlantic...	576	67	71	71	Wüllerstorf.....	E. of Chusan.
194.	23 July, 1817...	31 1	123 46 E.	Yellow Sea ...	240	65	74	76	Abel.....	Between the Azores and West-India Islands.
195.	1847–49 ..	31 48	36 W.	N. Atlantic...	360	64·3	73	„	E. Lenz	About 3° distant from the south coast of Japan.
196.	31 Aug., 1825...	32 6	136 48 W.	N. Pacific ...	578	56	70·6	...	Lenz	
197.	„ „	„ „	„ „	„ „	1364	43·6	„	...	„	
198.	„ „	„ „	„ „	„ „	2870	38·8	„	...	„	
199.	„ „	„ „	„ „	„ „	3773	35·9	„	...	„	
200.	6 Nov., 1857...	32 13	19 5 W.	N. Atlantic...	2400	51·5	70·5	„	Pullen	Between Madeira and the Canaries.
201.	6 May, 1826...	32 20	42 30 W.	N. Atlantic...	6470	36	69·7	...	Lenz	Between Madeira and Bermuda.
202.	28 May, 1818...	32 36	36 35 W.	N. Atlantic...	393	67·1	72	72·7	Kotzebue.....	
203.	1844?	32 46	165 53 W.	N. Pacific ...	600	55·7	...	...	Belcher	Between the Sandwich and the Aleutian Islands. Quoted by Jas. Ross, vol. ii. p. 53.
204.	.....	„ „	„ „	„ „	900	52·7	...	...	„	
205.	.....	„ „	„ „	„ „	1800	48·1	...	...	„	
206.	.....	„ „	„ „	„ „	2700	43·2	...	...	„	
207.	.....	„ „	„ „	„ „	3600	43·2	...	...	„	

TABLE I.—Northern Hemisphere (continued).

I.	II. Date.	III. North Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr.			VIII. Name of observer.	IX. Remarks.
						At depth.	Surface.	Air.		
		° ′	° ′			°	°	°		
207*a*	July, 1804...	33	170 E.	N. Pacific ...	330	60·5	70·2	...	Horner.	Between the Sandwich Islands and Japan.
207*b*	„ „	„	„	„ „	1200	53·6	„	...	„	
208.	7 June, 1857...	33 38	14 4 W.	N. Atlantic...	720	59·6	69	68·6	Wüllerstorf.....	Between Madeira and Morocco.
209.	29 May, 1818...	34 34	35 55 W.	N. Atlantic...	452	62	69·2	69·3	Kotzebue.....	Between Bermuda and Spain.
210.	June, 1826...	34 51	165 39 E.	N. Pacific ...	1920	54·7	78	69	Beechey	Between Japan and the Sandwich Islands.
211.	„ „	„ „	„ „	„ „	3450	43	„	„	„	
212.	„ „	„ „	„ „	„ „	4560	43·5	„	„	„	
213.	17 Dec., 1846...	34 52	16 24 W.	N. Atlantic...	792	61	61	59	Dayman	N. of Madeira.
213*a*	.....	about 35°?	65 W.?	N. Atlantic...	.....	35	80	...	Maury.....	Bottom of Gulf-stream.
214.	June, 1826...	35 11	165 21 E.	N. Pacific ...	900	62	72	78	Beechey	In mid-ocean.
215.	„ „	„ „	„ „	„ „	1500	57·2	„	„	„	
216.	4 June, 1857...	35 20	8 55 W.	N. Atlantic...	420	59·6	65·5	66·8	Wüllerstorf.....	Near the Strait of Gibraltar.
217.	1847–49 ...	35 35	17 W.	N. Atlantic...	180	62·6	63·6	...	E. Lenz	N. of Madeira.
218.	„ ...	35 37	35 W.	„ „	360	60	68·4	...	„	S.W. of the Azores.
219.	„ ...	35 39	34 W.	„ „	360	61	67·8	...	„	S.W. of the Azores.
220.	30 May, 1818...	35 41	35 12 W.	N. Atlantic...	445	62·3	74·5	69·9	Kotzebue.....	7° S.W. of the Azores.
221.	14 Sept., 1817...	35 51	147 38 W.	N. Pacific ...	24	72	72·2	75	Kotzebue.....	Between the Sandwich Islands and the coast of California.
222.	„ „	„ „	„ „	„ „	48	70·9	„	„	„	
223.	„ „	„ „	„ „	„ „	90	68·1	„	„	„	
224.	„ „	„ „	„ „	„ „	150	57·6	„	„	„	
225.	„ „	„ „	„ „	„ „	300	54	„	„	„	
226.	„ „	„ „	„ „	„ „	600	51	„	„	„	
227.	„ „	„ „	„ „	„ „	2448	42·8	„	„	„	
228.	18 Sept., 1817...	36 9	148 9 W.	N. Pacific ...	150	57·1	71·9	73	Kotzebue.....	
229.	„ „	„ „	„ „	„ „	600	52·8	„	„	„	
230.	„ „	„ „	„ „	„ „	1800	44	„	„	„	
231.	24 July, 1817...	36 24	122 59 E.	Yellow Sea ...	90	67	71	75	Abel.....	S. of Staunton Island.
232.	6 June, 1816...	37 3	160 43 E.	N. Pacific ...	60	59·5	61	63	Kotzebue.....	Between the Polynesian Archipelago and Kamtschatka.
233.	„ „	„ „	„ „	„ „	150	56·8	„	„	„	
234.	„ „	„ „	„ „	„ „	600	52·7	„	„	„	
235.	„ „	„ „	„ „	„ „	1800	43	„	„	„	
236.	31 May, 1818...	37 9	34 31 W.	N. Atlantic...	378	62·2	68·7	73	Kotzebue.....	6° W. of the Azores.
237.	25 July, 1817...	37 30	122 40 E.	Yellow Sea ...	90	66	69	74	Abel.....	Upper part near the coast.
238.	„ „	„ „	„ „	„ „	120	62	67	72	„	
239.	26 „ „ ...	37 38	121 34 E.	„ „	90	66	67	74	„	
240.	1 June, 1818...	38 9	33 8 W.	N. Atlantic...	445	61·5	68·9	68·7	Kotzebue.....	W. of Fayal.
241.	27 July, 1817...	38 12	120 20 E.	Yellow Sea ...	90	72	74	75	Abel.....	Gulf of Petchili.
242.	June, 1826...	38 55	165 48 E.	N. Pacific ...	1080	44	61	64	Beechey	Between the Polynesian Archipelago and Aleutian Islands.
243.	„ „	„ „	„ „	„ „	2280	41·5	„	„	„	
244.	16 Oct., 1815...	39 4	13 8 W.	N. Atlantic...	828	55	69·1	72·5	Kotzebue.....	4° W. of Lisbon.
245.	„ „	„ „	„ „	„ „	576	56	„	„	„	
246.	2 June, 1818...	39 15	31 3 W.	N. Atlantic...	432	60·1	67·5	65	„	Mid-ocean; W. of the Azores.
247.	15 Oct., 1815...	39 27	12 57 W.	N. Atlantic...	600	55·7	68·5	71·1	„	Off the coast of Portugal.

TABLE I.—Northern Hemisphere (continued).

I.	II. Date.	III. North Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr.			VIII. Name of observer.	IX. Remarks.
						At depth.	Surface.	Air.		
		° ′	° ′			°	°	°		
248.	1847-49 ...	40 40	27 w.	N. Atlantic ...	360	56	62·6	...	E. Lenz	N. of the Azores.
249.	24 Aug., 1825...	41 12	141 58 w.	N. Pacific ...	1308	41·2	66·5	...	Lenz	Between the Sandwich Islands and British Columbia.
250.	„ „	„ „	„ „	„ „	3263	35·8	„	...	„	
250*a*	1854 ...	160 miles off Nantucket.		N. Atlantic ...	120	67	82?	...	Craven.....	Exact position not given.
251.	„ ...			„ „	5400	35	„	...	„	
252.	May, 1825...	41 20	14 40 w.	N. Atlantic ..	840	58	64	62	Beechey	6° W. of the coast of Portugal.
253.	19 Aug., 1837...	41 42	162 42 E.	N. Pacific ...	1066 (905½)	41·2	58	53·6	DuPetitThouars	Cylinder sound.
254.	4 June, 1818...	41 43	27 23 w.	N. Atlantic ...	442	58·6	64·1	64	Kotzebue.....	4° N. of the Azores.
255.	26 Oct., 1837...	42 32	34 58 w.	N. Atlantic ...	4688	46	61	64	Vaillant	Between Portugal and New York.
256.	18 Aug., 1837...	42 1	163 38 E.	N. Pacific ...	1066 (640?)	41·5	58·6	60·2	DuPetitThouars	South of Kamtschatka. Cylinders sound.
256*a*	15 July, 1868...	43 30	38 50 w.	N. Atlantic ...	600	62	73	77	Chimmo	Soundings in 13,680 feet.
256*b*	„ „	„ „	„ „	„ „	1800	52	„	„	„	
256*c*	„ „	„ „	„ „	„ „	6000	42	„	„	„	
256*d*	Sept., 1868...	43 40?	38 0 w.?	N. Atlantic ...	600	59	69	68	Chimmo	Near the Grand Bank of Newfoundland.
256*e*	„ „	„ „	„ „	„ „	2400	49	„	„	„	
256*f*	„ „	„ „	„ „	„ „	6000	43	„	„	„	
256*g*	„ „	„ „	„ „	„ „	12000	42	„	„	„	
256*h*	29 Aug., 1868...	44 3	48 7 w.	N. Atlantic ...	300	43	61	61	Chimmo	Soundings in 9900 feet.
256*i*	„ „	„ „	„ „	„ „	6000	39·5	„	„	„	
256*j*	July, 1868...	Western edge of Newfoundland Bank.			3000	39·5	60	...	„	Soundings in 9000 feet.
256*k*	„ „				6000	40·3	„	...	„	
256*l*	„ „	Between Flemish Cap and Grand Bank.			1500	38	50	50	„	
257.	21 Aug., 1837...	45 5	161 48 E.	N. Pacific ...	958 (479?)	39·2	54·7	55·4	DuPetitThouars	South of Kamtschatka. Cylinders sound.
258.	30 June, 1846...	45 30	133 w.	N. Pacific ...	60	48	52	51	Kellett.....	10° W. of the mouth of the Columbia River, Oregon.
259.	„ „	„ „	„	„ „	120	48	„	„	„	
260.	„ „	„ „	„	„ „	180	48	„	„	„	
261.	„ „	„ „	„	„ „	240	47	„	„	„	
262.	„ „	„ „	„	„ „	300	47	„	„	„	
263.	„ „	„ „	„	„ „	600	45	„	„	„	
264.	„ „	„ „	„	„ „	1200	42	„	„	„	
265.	„ „	„ „	„	„ „	1800	42	„	„	„	
266.	„ „	„ „	„	„ „	2400	42	„	„	„	
267.	„ „	„ „	„	„ „	3000	42	„	„	„	
268.	26 May, 1826...	45 53	15 17 w.	N. Atlantic ...	1252	50·7	58·3	...	Lenz	Near the Bay of Biscay.
269.	„ „	„ „	„ „	„ „	2524	49·9	„	...	„	
270.	6 June, 1818...	45 57	21 23 w.	N. Atlantic ...	357	54·7	60·6	65	Kotzebue.....	Between Portugal and Azores.
270*a*	Sept., 1804...	47	158 E.	N. Pacific ...	480	33	60	...	Horner.	Outside the Kurile Islands.
270*b*	12 Sept., 1868...	47 11	23 14 w.	N. Atlantic ...	12000	42	.....	...	Chimmo	Between Ireland&Newfoundland.
271.	7 June, 1818...	47 18	20 30 w.	N. Atlantic ...	402	54·5	60	60·7	Kotzebue.....	Between Ireland and the Azores.
272.	„ „ ...	47 32	20 24 w.	„ „	462	54·7	60·3	61·3	„	

TABLE I.—Northern Hemisphere (continued).

I.	II. Date.	III. North Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr. At depth.	Surface.	Air.	VIII. Name of observer.	IX. Remarks.
273.	9 June, 1818...	48° 2′	19° 42′ W.	N. Atlantic...	451	54°2	62°5	60°4	Kotzebue	Between Ireland and the Azores.
274.	10 „ „	48 2	17 56 W.	„ „	472	54·2	62	62·3	„	
275.	11 „ „	48 8	15 33 W.	„ „	480	52·3	62·5	63·5	„	
276.	12 „ „	48 22	13 45 W.	„ „	429	51·1	63·8	69·9	„	
277.	13 „ „	48 42	10 50 W.	„ „	492	52·1	59·5	68	„	5° W. of the Scilly Isles.
278.	May, 1845...	48 45	6 19 W.	N. Atlantic...	498	52	57	59	Beechey	Entrance of British Channel.
279.	19 July, 1850...	50	170 W.?	N. Pacific ...	1080	40	51	50	Armstrong	No soundings. S. of Aleutian Is.
280.	18 Sept., 1837...	51 34	161 41 E.	N. Pacific ...	5872 (5741½)	36·4	53	51·8	DuPetit Thouars	Cylinder sound.
280*a*	July, 1805...	52	160 E.	N. Pacific ...	600	31·2	43·1	...	Horner	Off Petropaulovski.
281.	Oct., 1826 ...	53 12	163 39 W.	N. Pacific ...	600	39	47·5	46	Beechey	3° to the S.E. of the Aleutian Islands.
282.	„ „	„ „	„ „	„ „	1200	39·7	„	„	„	
283.	„ „	„ „	„ „	„ „	2136	40·7	„	„	„	
284.	„ „	„ „	„ „	„ „	2736	40	„	„	„	
285.	11 June, 1773...	55?	0 37 W.?	N. Atlantic...	192	49	51	55	Phipps.....	North Sea; off Whitby.
286.	4 June, 1819...	55 1	35 36 W.	N. Atlantic...	1500	44·5	44·2	43	Parry	No soundings.
287.	27 May, 1819...	56 59	24 33 W.	„ „	6120	45·5	48·5	49	„	Between Ireland and Greenland.
288.	25 „ „	57 4	17 52 W.	„ „	600	49	50	50·5	„	Near Rockall. Marcet's bottle.
289.	24 „ „	57 42	14 16 W.	„ „	840	47·7	49·5	50	„	Do. do. In soundings.
290.	28 „ „	57 26	25 16 W.	„ „	780	48	49	49	„	Marcet's bottle used.
291.	5 May, 1828...	57 35	36 36 W.	N. Atlantic...	660	44·4	46·4	51·3	Graah	Betw. Ireland and Newfoundland.
292.	17 June, 1819...	57 51	41 5 W.	N. Atlantic...	1410	39	40·5	41·5	Parry	Off the south of Greenland.
293.	July, 1827...	58 48	175 2 E.	N. Pacific ...	600	45	54	57	Beechey	Off the Siberian coast; Behring Sea.
294.	„ „	„ „	„ „	„ „	1200	41·5	„	„	„	
295.	„ „	„ „	„ „	„ „	1962	40·5	„	„	„	
296.	„ „	„ „	„ „	„ „	2652	40·5	„	„	„	
297.	17 June, 1819...	58 52	48 12 W.	N. Atlantic...	1740	38·7	38·5	38·5	Parry	Entrance to Davis Strait.
298.	23 May, 1818...	59	44 W.	N. Atlantic...	480	37	39	40	Sabine (M.).....	No soundings. Off C. Farewell.
299.	1860 ...	59 27	26 41 W.	N. Atlantic...	600	48·5	48	44	Wallich	Soundings in 7560 feet.
300.	30 June, 1859...	59 35	38 9 W.	N. Atlantic...	1800	44·4	44·6	...	Kündson	Off S. of Greenland.
301.	18 June, 1819...	59 40	47 46 W.	N. Atlantic...	1560	39	37	35	Parry	Entrance to Davis Strait. No soundings.
302.	12 June, 1773...	60	0 10 E.?	N. Atlantic...	390	44	50	50	Phipps.....	Off Shetland.
304.	4 Oct., 1818...	60	58 W.	Davis Strait .	5400	35·7	40	37	Sabine (M.).....	No soundings.
305.	8 Aug., 1859...	60 10	36 21 W.	N. Atlantic...	1800	45	48·6	...	Kündson	Parallel of Cape Farewell.
306.	7 Sept., 1773...	60 14	2 30 E.?	N. Atlantic...	336	50	57	60	Irving	Between Shetland and Norway.
307.	29 June, 1859...	60 27	35 34 W.	N. Atlantic...	1800	44·1	48	...	Kündson	Parallel of Cape Farewell.
308.	27 Oct., 1818...	61	7 W.	N. Atlantic...	2820	47	49·5	50·5	Sabine (M.).....	No soundings.
308*a*	14 Aug., 1858...	62?	55 W.?	Baffin's Bay...	150	31·5	38	...	Walker.	Doubtful about position.
308*b*	„ „	„	„ „	„ „	300	29·5	„	...	„	
308*c*	„ „	„	„ „	„ „	684	30	„	...	„	
309.	July, 1827...	61 10	176 32 E.	N. Pacific ...	30	41·5	43·5	45	Beechey	Off the coast of Siberia; northern part of Behring Sea.
310.	„ „	„ „	„ „	„ „	60	38	„	„	„	
311.	„ „	„ „	„ „	„ „	120	29·5	„	„	„	

TABLE I.—Northern Hemisphere (continued).

I.	II. Date.	III. North Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr. At depth.	Surface.	Air.	VIII. Name of observer.	IX. Remarks.
312.	July, 1827...	61° 10′	176° 32′ E.	N. Pacific ...	120	30°5	43°5	45°	Beechey	
313.	„ „	„ „	„ „	„ „	180	30·5	„	„	„	
314.	„ „	„ „	„ „	„ „	180	30·5	„	„	„	Off the coast of Siberia; northern part of Behring Sea.
315.	„ „	„ „	„ „	„ „	312	32·5?	„	„	„	
316.	„ „	„ „	„ „	„ „	600	32·5	„	„	„	
317.	„ „	„ „	„ „	„ „	1200	32·5	„	„	„	[bottle used.
318.	11 Oct., 1820 ...	61 11	31 12 W.	N. Atlantic ...	1920	44·2	47·5	48	Parry	15°W. of Cape Farewell. Marcet's
319.	28 June, 1859...	61 12	33 W.	N. Atlantic ...	1200	43·7	46·4	...	Kündson	Between Cape Farewell and Iceland.
320.	27 Oct., 1818 ...	61 48	1 52 W.	N. Atlantic ...	2838	47	49	50	Parry (M.)	N. of the Shetland Islands.
321.	1 June, 1818...	63 50	55 30 W.	Davis Straits.	870	32	36	35·5	Parry (M.).	
322.	3 Sept., 1823	64 to 64 30?	84 to 85 W.?	Arctic America.	900	30	30	38	Parry	
323.	„ „	„ „	„	„ „	1080	30	30·5	40	„	
324.	4 Sept. „	„ „	„	„ „	600	30·5	30	37	„	
325.	„ „	„ „	„	„ „	840	31	31	42	„	
326.	„ „	„ „	„	„ „	1020	30·5	30·5	39	„	
327.	„ „	„ „	„	„ „	1200	30·5	30·5	37	„	
328.	5 Sept., „	„ „	„	„ „	960	31·4	31·7	37	„	
329.	6 Sept., „	„ „	„	„ „	690	29·5	30	30	„	
330.	„ „	„ „	„	„ „	750	30·7	30·7	36	„	
331.	„ „	„ „	„	„ „	780	30	30·5	34	„	Beset in ice, in and near Lyon Inlet, Fox Channel, Hudson Bay. Soundings were obtained in each case at a further depth of from 30 to 100 feet. Marcet's water-bottle supposed to have been used.
332.	„ „	„ „	„	„ „	810	30	30·5	33	„	
333.	7 Sept., „	„ „	„	„ „	600	30·5	31	36	„	
334.	„ „	„ „	„	„ „	630	29·5	29·5	32	„	
335.	„ „	„ „	„	„ „	690	29·5	30·2	33	„	
336.	„ „	„ „	„	„ „	744	30·2	31	36	„	
337.	8 Sept., „	„ „	„	„ „	636	29	30	34	„	
338.	„ „	„ „	„	„ „	648	29·6	30·5	35	„	
339.	„ „	„ „	„	„ „	660	29·7	30	36	„	
340.	„ „	„ „	„	„ „	720	29·5	29·7	33	„	
341.	9 Sept., „	„ „	„	„ „	600	30	30	35	„	
342.	„ „	„ „	„	„ „	720	30	30·5	38	„	
343.	10 „ „	„ „	„	„ „	840	30	30	37	„	
344.	11 „ „	„ „	„	„ „	720	30	30	35	„	
345.	4 Sept., 1773...	65 ?	2 21 E.	N. Atlantic ...	4098	40	55	66·5	Phipps.....	Between Iceland and Norway.
346.	26 Sept., 1818...	65 50	59 30 W.	Davis Strait...	1860	29	34	36	Sabine (M.).....	Soundings in 2220 feet.
347.	24 Sept., 1818...	66 35	5 33 E.	N. Atlantic ...	1560	41·5	43	44·5	Franklin	Between Iceland and Norway.
348.	24 Sept., 1818...	66 38	5 44 E.	N. Atlantic ...	1560	41·5	43·5	...	Beechey (M.) ...	
349.	19 Sept., 1818..	66 50	61 W.	Davis Strait...	600	30	33	35	Sabine (M.).....	
350.	„ „	„ „	„	„ „	1200	29	„	„	„	Soundings in 4500 feet.
351.	„ „	„ „	„	„ „	2400	29	„	„	„	
352.	„ „	„ „	„	„ „	4080	25·75	..	„	Ross & Sabine (M).	[used.
353.	21 Sept., 1820...	67 38	59 1 W.	Davis Strait...	1200	33·2	34·5	30	Parry	In soundings. Marcet's bottle
354.	20 „ „	68 12	60 50 W.	„ „	1908	33	32	31·5	„	Parallel of Disco Island.

TABLE I.—Northern Hemisphere (continued).

I.	II. Date.	III. North Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr. At depth.	Surface.	Air.	VIII. Name of observer.	IX. Remarks.
355.	11 Sept., 1820...	68° 19′	66° 05′ W.	Davis Strait...	876	34°	32°	34°	Parry	Near the American coast.
356.	„ „	„ „	„ „	„ „	990	34	„	„	„	
357.	18 „ „	68 24	63 08 W.	Davis Strait...	1908	30	30	29	„	Near mid-channel.
358.	15 „ „	68 24	63 32 W.	„ „	1020	30·5	30.5	31	„	No soundings in 3660 feet.
359	16 „ „	68 29	63 48 W.	„ „	4854	27	31	34	Parry & Fisher.	Six's therm. used. In soundings.
360.	17 Aug., 1855...	68 42	174 27 W.	Arctic Ocean .	120	38	45	48·6	Rodgers(Maury)	Off the Asiatic coast. Soundings very near the bottom.
361.	„ „	„ „	„ „	„ „	168	40·2	„	„	„ „	
362.	9 Sept., 1820...	69 24	67 05 W.	Davis Strait...	210	31	32·5	34	Parry	Between Disco Island and Cape Kater.
363.	Aug., 1827...	70 2	164 40 W.	Arctic Ocean .	126	37	49	57	Beechey	Off Icy Cape.
364.	19 Aug., 1850...	70 30?	148 W.?	Arctic Ocean .	540	29·5	29?	33?	Armstrong	No soundings.
365.	4 July, 1839...	70 40	23 36 E.	Arctic Ocean .	567	39	40	...	Bravais	Bay of Hammerfest.
366.	15 July, 1839...	70 40	23 35 E.	Arctic Ocean .	390	39·5	41	48	Martins	Bay of Hammerfest. Temperature at bottom.
367.	„ „	„ „	„ „	„ „	640	39	„	..	„	
368.	6 Sept., 1820...	70 47	67 56 W.	Baffin Bay ...	456	31·3	33	32	Parry	Near the American coast.
369.	„ „	„ „	„ „	„ „	1170	31·5	„	„	„	
370.	22 Aug., 1839...	71 1	23 23 E.	Arctic Ocean .	266	39·1	45	45	Martins	Off N. coast of Norway, bottom temperature.
371.	„ „	„ „	„ „	„ „	788	38·9	„	„	„	
372.	16 Aug., 1855...	71 16	176 5 W.	Arctic Ocean .	90	31·6	38·2	37·5	Rodgers(Maury)	Between Kellet Land and Siberia, being near the bottom.
373.	„ „	„ „	„ „	„ „	186	34	„	„	„ „	
374.	14 Aug., 1855...	71 21	175 22 W.	Arctic Ocean .	60	33·4	44	45	Rodgers(Maury)	The next day's reading gave 3° higher.
375.	„ „	„ „	„ „	„ „	150	37·3	„	„	„ „	
376.	3 Sept., 1820...	71 24	70 58 W.	Baffin Bay ...	528	33	35·5	38	Parry	In soundings.
377.	9 Sept., 1850...	71 30?	120 W.?	Arctic Seas ...	210	29?	...	35?	Armstrong	Amongst ice, Prince of Wales Strait.
378.	„ „	„ „	„	„ „	450	31?	...	„	„	
379.	13 Aug., 1855...	72 2	174 37 W.	Arctic Ocean .	120	34	43·7	45·2	Rodgers(Maury)	Within 2 feet of bottom.
380.	„ „	„ „	„ „	„ „	240	41	„	„	„ „	
381.	6 Aug., 1822...	72 7	19 11 W.	Arctic Seas ...	708	29	34	42	Scoresby	Off the east coast of Greenland.
382.	2 Sept., 1820...	72 9	73 58 W.	Baffin Bay ...	450	32·2	32	33	Parry	Marcet's bottle used.
383.	7 Sept., 1818...	72 16	71 18 W.	Baffin Bay ...	6000	28·7	35	33	Sabine (M.). ...	Soundings in 6000 feet.
384.	6 Sept., 1818...	72 22	73 06 W.	Baffin Bay ...	1476	30	36	41	Parry (M.)	Near Pond's Bay.
385.	7 Sept., 1818..	72 22	73 58 W.	Baffin Bay ...	6000	28·7	35	...	John Ross	
386.	6 Sept., 1818...	72 23	72 55 W.	Baffin Bay ...	1476	30	36	37	Sabine (M.).....	No soundings.
387.	21 Aug., 1839..	72 29	19 54 E.	Arctic Ocean .	531	40·1	43·4	43·8	Martins	Between Norway and Bear Island.
388.	„ „	„ „	„ „	„ „	1279	38·5	„	„	„	
389.	5 Sept., 1818...	72 37	74 6 W.	Baffin Bay ...	1140	30·2	35	35·5	Sabine (M.).....	Soundings in 1140 feet.
390.	5 Sept., 1818...	72 39	74 30 W.	Baffin Bay ...	1140	30·2	35	39	Parry (M.)	West side of the Bay.
391.	28 July, 1849...	72 51	163 W.	Arctic Ocean .	30	33	36	...	Kellett (Seeman)	Off the American coast, near the ice-pack.
392.	„ „	„ „	„	„ „	60	32	„	...	„ „	
393.	„ „	„ „	„	„ „	90	29	„	...	„ „	
394.	„ „	„ „	„	„ „	120	29	„	...	„ „	
395.	„ „	„ „	„	„ „	130	29	„	...	„ „	
396.	„ „	„ „	„	„ „	180	29	„	...	„ „	
397.	„ „	„ „	„	„ „	210	29·5	„	...	„ „	

TABLE I.—Northern Hemisphere (continued).

I.	II. Date.	III. North Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr. At depth.	Surface.	Air.	VIII. Name of observer.	IX. Remarks.
398.	1 Sept., 1820...	72 55?	75 19 W.?	Baffin Bay ...	660	30·2	30·5	31	Parry	Pond Bay. Marcet's bottle used.
399.	..... „	73	90 W.	Arctic Sea ...	.....	.....	...	...	.....	Prince Regent Inlet.
400.	14 Aug., 1819...	73 35	80 1 W.	Baffin Bay ...	1110	34	34	39	Parry	Lancaster Sound: soundings in 1260 feet. Marcet's bottle used.
401.	20 July, 1839...	73 36	20 52 E.	Arctic Ocean.	2854	32·2	42·2	42·2	Martins	Mean of four experiments.
402.	1 Sept., 1818...	73 38	77 19 W.	Baffin Bay ...	750	30·5	35	36	Parry (M.)	Near Pond Bay.
403.	8 Aug., 1838...	73 52	16 23 E.	Arctic Ocean.	1010	36·3	41·8	34·3	Bravais et Martins	Mean of two experiments. Between Norway and Bear Island.
404.	30 Aug., 1818...	74 4	79 W.	Lancaster Sd.	1410	29·2	36·5	37	Sabine (M.).....	No soundings.
405.	Aug., 1818...	74 20?	80 W.?	Baffin Bay ...	3900	29	...	...	John Ross	Entrance of Lancaster Sound.
406.	31 „ „	74 8	„	„ „	4044	29·5	...	...	„	
407.	Sept., 1818...	74 21	112 48 W.	Arct. America	630	32	31·2	34	Parry (M.)	Entrance to Banks Strait. In soundings.
408.	18 July, 1838...	74 45	15 E.	Arctic Ocean.	1493	34·5	39·2	37·3	Bravais et Martins	Mean of two experiments. Between Norway and Bear Isl.
409.	6 Nov., 1819...	74 47?	110 48 W.?	Arct. America	30	30	28	−16	Parry	South of Melville Island.
410.	9 „ „	74 47?	110 48 W.?	„ „	30	31	28	...	„	
411.	6 July, 1818...	74 48	10 15 E.	Arctic Ocean.	204	34·5	34	36	Franklin	At bottom; near land. Query, lat. 79° 48′?
412.	18 July, 1818...	74 50	59 30 W.	Baffin Bay ...	1182	29·5	32	37	Parry (M.)	Off the Greenland coast.
413.	19 Aug., 1839...	74 52	12 57 E.	Arctic Ocean.	397	37·8	41·2	39·8	Martins	Bottom temperature. Between Norway and Spitzbergen.
414.	„ „	„ „	„ „	„ „	1598	33·4	„	„	„	
415.	29 Aug., 1818...	74 58	77 42 W.	Baffin Bay ...	1020	31	36	34	Parry (M.)	Near Lancaster Sound.
416.	29 Aug., 1818...	74 59	76 37 W.	Baffin Bay ...	1020	31	36	34	Sabine (M.).....	Soundings in 1020 feet.
417.	27 Aug., 1820...	75 2	105 14 W.	Arct. America	564	31·7	30	31	Parry	In soundings. Marcet's bottle used.
418.	10 Sept., 1818...	75 14	3 53 E.?	Arctic Ocean.	4536	36	35	37	Franklin (M.)...	Between Spitzbergen and Iceland.
419.	14 Aug., 1818...	75 50	66 W.	Baffin Bay ...	1200	30·1	32	38	Sabine (M.).....	Melville Bay; soundings in 2700 feet.
420.	„ „	„ „	„	„ „	2532	29·7	„	„	„	
421.	3 Aug., 1818...	75 52	63 W.	Baffin Bay ...	2490	29	34	38	Sabine (M.).. ...	Melville Bay. Soundings.
422.	26 July, 1839...	75 55	9 16 E.	Arctic Ocean.	2395	32·7	38·2	38·2	Martins	Mean of four experiments; bottom temperature.
423.	14 Aug., 1818...	75 56	66 31 W.	Baffin Bay ...	1200	30·2	32	36	Parry (M.)	Melville Bay.
424.	„ „	„ „	„ „	„ „	2532	29·2	„	„	„ „	
425.	25 July, 1839...	75 59	9 51 E.	Arctic Ocean.	2142	32	38·2	38	Martins	Mean of two experiments. Bottom.
426.	1 Aug., 1818...	76?	62 W.?	Baffin Bay ...	1260	29·5	...	...	John Ross	Top of Melville Bay.
427.	2 „ „	75 51	62 59	„ „	2520	29·5	...	...	„	
428.	„ „	76?	65 W.?	„ „	2730	29·5	...	...	„	Near Melville Bay.
429.	25 Aug., 1818...	76 8	21 W.	Baffin Bay ...	324	29·5	32·5	31·5	Sabine (M.).....	Soundings in 336 feet.
430.	25 Aug., 1818...	76 8	31 W.	Baffin Bay ...	324	29·5	32	31·5	Parry (M.).....	In soundings. Entrance to Jones Sound.
431.	18 Aug., 1839...	76 13	12 48 E.	Arct. Ocean A.	308	37·2	40·4	40·2	Martins	Between Bear Island and Spitzbergen. Mean of two experiments.
432.	„ „	„ „	„ „	„ „	1296	33·4	„	„	„	
433.	„ „	„ „	„ „	„ „	2103	32·3	„	„	„	Mean of four experiments: at bottom.
434.	9 April, 1810...	76 16	9 0 E.	Arctic Ocean.	300	31·3	28·8	12	Scoresby	
435.	„ „	„ „	„ „	„ „	738	33·8	„	„	„	In ice, 1° S.W. of Spitzbergen.
436.	„ „	„ „	„ „	„ „	1380	33·8	„	„	„	
437.	23 Apr., 1810...	76 16	10 50 E.	Arctic Ocean	120	28	28·3	16	Scoresby	
438.	„ „	„ „	„ „	„ „	300	28·3	„	„	„	Frozen up.
439.	„ „	„ „	„ „	„ „	738	30	„	„	„	
440.	24 Aug., 1818...	76 22	77 38 W.	Baffin Bay ...	600	30·2	31·5	33	Parry (M.)	Near Cobourg Island.

TABLE I.—Northern Hemisphere (continued).

I.	II Date.	III. North Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr. At depth.	Surface.	Air.	VIII. Name of observer.	IX. Remarks.
441.	24 Aug., 1818...	76 22	77 38 W.	Baffin Bay ...	1440	29·5	31·5	33	Parry (M.)	Near Cobourg Island.
442.	22 „ „	76 33	77 10 W.	„ „	612	29·5	32	36	„	Entrance of Smith Sound.
443.	23 Apr., 1811...	76 34	10 E.	Arctic Ocean.	120	31	30	25	Scoresby	Frozen up: off the S.W. of Spitzbergen.
444.	„ „	„ „	„	„ „	240	35	„	„	„	
445.	„ „	„ „	„	„ „	360	34	„	„	„	
446.	„ „	„ „	„	„ „	600	34·7	„	„	„	
447.	24 Aug., 1818...	76 35	78 W.	Baffin Bay ...	600	30·2	31·5	33	Sabine (M.).....	Entrance of Smith Sound.
448.	„ „	„ „	„	„ „	1440	29·5	„	„	„	
449.	26 May, 1818...	76 48	12 26 E.	Arctic Ocean.	4200	43	33	29	Franklin & Buchan...	Off S. of Spitzbergen. Franklin ascribes the high temperature to the water-bucket being examined in the cabin.
450.	28 July, 1839...	76 57	13 29 E.	Arctic Ocean.	515	37·4	37·8	37·3	Martins	Mean of 2 expts. each: off Spitzbergen; bottom temperature
451.	„ „	„ „	„ „	„ „	1040	34·7	„	„	„	
452.	1 May, 1811...	77 15	8 10 E.	Arctic Ocean.	120	29·3	29·3	16	Scoresby	In ice: off the W. coast of Spitzbergen.
453.	„ „	„ „	„ „	„ „	240	29·3	„	„	„	
454.	„ „	„ „	„ „	„ „	360	30	„	„	„	
455.	„ „	„ „	„ „	„ „	600	30	„	„	„	
456.	20 May, 1813...	77 40	2 30 E.	Arctic Ocean.	300	29·3	29	30	Scoresby	Amongst floes; between Spitzbergen and Greenland.
457.	„ „	„ „	„ „	„ „	660	31	„	„	„	
458.	15 Aug., 1839...	77 43	12 11 E.	Arctic Ocean.	397	34·3	36·4	35·9	Martins	Mean of 4 expts.: at bottom.
459.	7 June, 1817...	78 2	0 10 W.	Arctic Ocean.	4566	38	32	36	Scoresby	Ice near: between Spitzbergen and Greenland.
460.	14 Aug., 1839...	78 41	9 39 E.	Arctic Ocean.	321	33·5	34·7	36·3	Martins	Mean of 4 expts.: at bottom.
461.	20 May, 1816...	79	5 40 E.	Arctic Ocean.	78	31	29	34	Scoresby	Moored to a floe, N.W. of Spitzbergen.
462.	„ „	„	„ „	„ „	222	33·8	„	„	„	
463.	„ „	„	„ „	„ „	342	34·5	„	„	„	
464.	„ „	„	„ „	„ „	600	36	„	„	„	
465.	„ „	„	„ „	„ „	2400	36	„	„	„	
466.	21 May, 1816...	79 4	5 38 E.	Arctic Ocean.	4380	37	29	38	Scoresby	Amongst floes.
467.	13 Aug., 1839...	79 33	10 54 E.	Arctic Ocean.	213	34·2	35·7	38	Martins	4 expts. Off Magdalena Bay, Spitzbergen.
468.	„ „	„ „	„ „	„ „	404	34·1	„	„	„	4 expts.
469.	26 June, 1818...	79 44	9 33 E.	Arctic Ocean.	90	34	34	35	Frankl. & Buch.	At bottom.
470.	3 Aug., 1839...	In	Magdalena	Bay.	79	32·4	33·2	38·6	Martins	West coast of Spitzbergen.
470a	„ „	„	„	„	361	28·6	„	„	„	
471.	4 June, 1827...	79 49	15 11 E.	Arctic Ocean.	441	29·2	30	38	Parry	Beset in the ice: off the north coast of Spitzbergen.
472.	5 June, 1827...	79 49	15 17 E.	Arctic Ocean.	459	29·7	30·5	43	Parry	
473.	„ „	„ „	„ „	„ „	471	29·8	31	43	„	
474.	„ „	„ „	„ „	„ „	480	29·8	31	44	„	
475.	„ „	„ „	„ „	„ „	492	28·7	30	41	„	
476.	„ „	„ „	„ „	„ „	492	30	31	43	„	
477.	„ „	„ „	„ „	„ „	507	29·5	30	43	„	
478.	6 June, 1827...	79 49	15 22 E.	Arctic Ocean.	408	30	31	39	Parry	
479.	„ „	„ „	„ „	„ „	408	29	30·2	39	„	
480.	„ „	„ „	„ „	„ „	408	30	30·5	39	„	
481.	„ „	„ „	„ „	„ „	408	29·2	30·5	38	„	

TABLE I.—Northern Hemisphere (continued).

I.	II. Date.	III. North Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr. At depth.	Surface.	Air.	VIII. Name of observer.	IX. Remarks.
482.	6 June, 1827...	° ′ 79 49	° ′ 15 22 E.	Arctic Ocean.	408	29·2	30·5	37·5	Parry	
483.	,, ,,	,, ,,	,, ,,	,, ,,	456	29·5	30·5	38	,, ...	
484.	,, ,,	,, ,,	,, ,,	,, ,,	504	30	30	37	,, ...	
485.	,, ,,	,, ,,	,, ,,	,, ,,	408	29·5	29·7	41	,, ...	
486.	,, ,,	,, ,,	,, ,,	,, ,,	420	29·7	32	41	,, ...	
487.	,, ,,	,, ,,	,, ,,	,, ,,	438	30	30	38	,, ...	
488.	,, ,,	,, ,,	,, ,,	,, ,,	474	29·2	31	42	,, ...	
489.	7 June, 1827...	79 50	15 30 E.	Arctic Ocean.	312	29	31·5	38	Parry	
490.	,, ,,	,, ,,	,, ,,	,, ,,	312	29	32	40	,, ...	
491.	,, ,,	,, ,,	,, ,,	,, ,,	315	30	33	37	,, ...	
492.	,, ,,	,, ,,	,, ,,	,, ,,	318	29·5	31·5	39	,, ...	Beset in the ice: off the north coast of Spitzbergen.
493.	,, ,,	,, ,,	,, ,,	,, ,,	318	29	31	41	,, ...	
494.	,, ,,	,, ,,	,, ,,	,, ,,	324	30	30·5	40·5	,, ...	
495.	,, ,,	,, ,,	,, ,,	,, ,,	336	29	31·5	41	,, ...	
496.	,, ,,	,, ,,	,, ,,	,, ,,	336	30	32	42	,, ...	
497.	,, ,,	,, ,,	,, ,,	,, ,,	348	29·8	31	39	,, ...	
498.	,, ,,	,, ,,	,, ,,	,, ,,	384	29	31·5	41	,, ...	
499.	,, ,,	,, ,,	,, ,,	,, ,,	408	30	31·5	42	,, ...	
500.	,, ,,	,, ,,	,, ,,	,, ,,	468	29·5	31	40	,, ...	
501.	8 June, 1827...	79 50	15 30 E.	Arctic Ocean.	288	28·8	30	42	Parry	
502.	,, ,,	,, ,,	,, ,,	,, ,,	312	29	32	40	,, ...	
503.	,, ,,	,, ,,	,, ,,	,, ,,	321	29·2	31·5	40	,, ...	
504.	25 June, 1818...	79 51	10 E.	Arctic Ocean.	102	34	33	34	Frankl. & Buch.	N.W. of Spitzbergen. Soundings.
505.	,, ,,	,, ,,	,,	,, ,,	360	34	33	34	,, ,,	
506.	29 June, 1818...	79 51	10 E.	,, ,,	102	34	34	39	,, ,,	Near the land in a current.
507.	,, ,,	,, ,,	,,	,, ,,	114	34	34	37	,, ,,	
508.	27 June, 1818...	79 51½	,,	,, ,,	432	34·5	34	36	,, ,,	Near ice.
509.	19 May, 1827...	79 55	13 46 E.	Arctic Ocean.	372	29	28·5	13	Parry	Beset: N. of Spitzbergen.
510.	,, ,,	,, ,,	,, ,,	,, ,,	426	28	28	14	,, ...	
511.	18 May, 1827...	79 56	13 39 E.	Arctic Ocean.	570	30	28	22	Parry	Beset: N. of Spitzbergen.
512.	,, ,,	,, ,,	,, ,,	,, ,,	432	28·5	28	15	,, ...	
513.	21 June, 1818...	79 56	11 30 E.	Arctic Ocean.	114	31	30	30	Frankl. & Buch.	Ice around; bottom.
514.	20 ,, ,,	79 58	11 25 E.	,, ,,	144	31	31·5	30	,, ,,	At bottom; beset.
515.	23 June, 1818...	79 59	10 12 E.	Arctic Ocean.	126	32·5	31·5	30	Frankl. & Buch.	Beset.
516.	22 ,, ,,	80	11 14 E.	,, ,,	198	31	30	30	,, ,,	Beset: off the land.
517.	7 June, 1816...	80	5 E.	Arctic Ocean.	720	36·3	29·7	40	Scoresby	Beset: N.W. of Spitzbergen.
518.	16 May, 1827...	80 1	13 5 E.	Arctic Ocean.	564	29·5	28·7	18	Parry	Beset: N. of Spitzbergen.
519.	,, ,,	,, ,,	,, ,,	,, ,,	576	28·5	28·5	18·5	,, ...	
520.	15 ,, ,,	,, ,,	,, ,,	,, ,,	606	30	28	17	,, ...	
521.	15 May, 1827...	80 4	12 39 E.	Arctic Ocean.	690	32	29·5	41	Parry	N. of Spitzbergen.
522.	22 July, 1818...	80 13	11 31 E.	Arctic Ocean.	498	35·8	31	41	Frankl. & Buch.	At bottom: N.W. of Spitzbergen.
523.	21 ,, ,,	80 14	11 12 E.	,, ,,	570	35·3	32·5	41·5	,, ,,	At bottom. ,, ,,
524.	23 ,, ,,	80 15	11 36 E.	,, ,,	438	36·8	32·5	37	,, ,,	At bottom. ,, ,,

TABLE I.—Northern Hemisphere (continued).

I.	II. Date.	III. North Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr. At depth.	Surface.	Air.	VIII. Name of observer.	IX. Remarks.
525.	25 July, 1818...	80° 18′	11° 40′ E.	Arctic Ocean.	549	36°	32°·5	34°	Frankl. & Buch.	At bottom.
526.	7 „ „	80 18	11 10 E.	„ „	720	36	33	35	„ „	North-west of Spitzbergen. At bottom: beset. The temperature of the air is taken from Marcet.
527.	10 „ „	80 19	11 24 E.	„ „	714	36	32	...	„ „	
528.	8 „ „	80 20	11 10 E.	„ „	780	36·5	31·5	35	„ „	
529.	9 „ „	80 20	10 55 E.	„ „	660	35·5	30·5	30·5	„ „	
530.	12 „ „	80 20	11 7 E.	„ „	870	35·8	32	36	„ „	
531.	26 „ „	80 20	11 25 E.	„ „	330	36	32·5	36	„ „	
532.	20 „ „	80 21	10 12 E.	„ „	648	35·5	32·5	34°5	„ „	
533.	11 „ „	80 22	10 30 E.	„ „	720	36	32	40	„ „	
534.	13 „ „	80 22	10 2 E.	„ „	1410	35·5	32	40·5	„ „	
535.	13 July, 1818...	80 22	11 E.	Arctic Ocean.	1302	37	32·5	...	Franklin (M.)...	N. of Spitzbergen: rocky bottom.
536.	„ „	„ „	10 55 E.	„ „	1422	35·5	31·5	40	„ „	N. of Spitzbergen: beset.
537.	19 July, 1818...	80 24	11 14 E.	Arctic Ocean.	618	36·5	31·5	41	Frankl. & Buch.	At bottom: beset.
538.	14 „ „	80 26	10 45 E.	„ „	1398	35·5	32	39	„ „	
539.	16 „ „	80 26	11 25 E.	„ „	1038	36·3	36·5	39	„ „	
540.	18 „ „	80 26	10 30 E.	„ „	1986	36	32·5	36	„ „	
541.	9 July, 1818...	80 26	11 38 E.	Arctic Ocean.	720	36	31	35	Franklin (M.)...	N.W. of Spitzbergen: beset.
542.	15 July, 1818...	80 27	10 20 E.	Arctic Ocean.	1188	36	32	38	Frankl. & Buch.	At bottom: beset.
543.	17 „ „	80 27	11 E.	„ „	1710	35·5	34	...	„ „	
544.	15 July, 1818...	80 28	10 20 E.	Arctic Ocean.	1110	36·2	32·5	...	Franklin (M.)...	Beset.
545.	4 Aug., 1773...	80 30	16 E.	Arctic Ocean.	360	39	36	32	Phipps.....	Under the ice.
546.	14 June, 1827...	80 47	18 22 E.	Arctic Ocean.	570	29·8	31	26	Parry	N. of Spitzbergen.
547.	15 „ „	80 49	19 7 E.	„ „	450	29	30	27	„	
548.	„ „	„ „	„ „	„ „	492	28·6	29	26	„	

NOTE.—The observations where it is said that MARCET's water-bottle has been used are not reliable. There is an ambiguity in the few remarks in WÜLLERSTORF's 'Voyage of the Novara' "On the Temperature and Density of Sea-water at Depths," which perhaps should exclude those observations also. The irregularity of the readings would seem to indicate that the temperature is rather that at time of taking the specific gravity than that at time of emersion of the apparatus. Some may be about right, others much wrong.

TABLE II.—Southern Hemisphere.

I.	II. Date.	III. South Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr.			VIII. Name of observer.	IX. Remarks.
						At depth.	Surface.	Air.		
		° ′	° ′			°	°	°		[lands.
1*a*.	May, 1804...	0 0	146 0 W.	Pacific	1200	57·5	84·5	...	Horner	10° N.W. of the Marquesas Is-
1.	5 Mar., 1858...	0 13	58 26 E.	Indian Ocean	7980	41	81	...	Pullen (*u*)	North of Seychelles Islands.
2.	,, ,,	,, ,,	,, ,,	,, ,,	11760	67?	,,	...	,, ...	Weather bad, and readings uncertain.
3.	,, ,,	,, ,,	,, ,,	,, ,,	14280	40	,,	...	,, ...	
4.	7 Feb., 1838...	0 31	97 19 W.	S. Pacific.....	2656 (1706?)	45	80·7	84·2	DuPetitThouars	Cylinder sound.
5.	30 Dec., 1857...	0 46	82 43 E.	Indian Ocean	720	77·4	82	81·6	Wüllerstorf.....	In mid-ocean.
6.	5 May, 1818...	0 53	20 28 W.	S. Atlantic ...	480	57·3	83	83	Kotzebue.....	Between N. Brazil and Guinea.
7.	8 Feb., 1838...	0 55	97 7 W.	S. Pacific.....	5872 (2296?)	37·4	79·7	86	DuPetitThouars	Cylinder sound.
7*a*.	May, 1804...	1 5	146 W.	S. Pacific.....	600	59	82·5	...	Horner	Near No. 1*a*.
8.	4 May, 1818...	2 17	19 50 W.	S. Atlantic ...	480	57·1	83	82·5	Kotzebue.....	In mid-ocean.
9.	7 Aug., 1845...	2 32	30 53 W.	S. Atlantic ..	2400	50·5	78	80	Kellett.....	Soundings in 17,970 feet.
10.	23 Mar., 1843...	2 32	8 11 W.	S. Atlantic ...	1800	46	79	...	Belcher	Between Ascension Island and the coast of Guinea.
11.	,, ,,	,, ,,	,, ,,	,, ,,	2400	38?	,,	...	,, ...	
12.	,, ,,	,, ,,	,, ,,	,, ,,	3000	46	,,	...	,, ...	
13.	,, ,,	,, ,,	,, ,,	,, ,,	3600	45·5	,,	...	,, ...	
14.	,, ,,	,, ,,	,, ,,	,, ,,	4200	46	,,	...	,, ...	
15.	,, ,,	,, ,,	,, ,,	,, ,,	4800	45	,,	...	,, ...	
16.	,, ,,	,, ,,	,, ,,	,, ,,	5400	40·2	,,	...	,, ...	
17.	,, ,,	,, ,,	,, ,,	,, ,,	6000	42·7	,,	...	,, ...	
18.	14 Jan., 1847...	2 37	26 15 W.	S. Atlantic ...	1608	53	80	79	Dayman	Between St. Paul and Ascension.
19.	Sept., 1816...	3 26	7 39 E.	S. Atlantic ...	8610	42	73	...	Wauchope	Off the coast of Congo. Corrected depth 6060 feet.
20.	3 May, 1818...	3 42	18 41 W.	S. Atlantic ...	426	56	82·6	83·5	Kotzebue.....	Between Brazil and Guinea.
21.	28 Sept., 1827...	3 48	128 7 E.	S. Pacific.....	425	74	83	81·6	D'Urville.....	Amongst the Molucca Islands.
22.	Aug., 1836...	3 58	1 37 W.	S. Atlantic ...	1800	52	73	...	Wauchope	32^{m} to haul in.
23.	18 July, 1827...	4 42	152 40 E.	S. Pacific.....	212	81	83·2	85·1	D'Urville.....	Off New Ireland.
24.	2 May, 1818...	5 8	17 14 W.	S. Atlantic ...	378	57·6	81·6	82	Kotzebue.....	In mid-ocean.
25.	15 Jan., 1847...	5 9	27 51 W.	S. Atlantic ...	918	54	80	78	Dayman	East of Juan Fernando. Reading probably reversed.
26.	,, ,,	,, ,,	,, ,,	,, ,,	1758	60	,,	,,	,, ...	
27.	28 Feb., 1858...	5 31	61 31 E.	Indian Ocean	13980	35	84	...	Pullen (*u*)	In soundings.
27*a*.	10 Mar., 1836...	5 59	24 35	S. Atlantic ...	3733	43·7	79·5	79·5	Vaillant	Cylinder full.
28.	1 May, 1818...	6 35	15 34 W.	S. Atlantic ...	339	59	81·5	81·7	Kotzebue.....	N. of Ascension.
29.	26 Feb., 1858...	7 12	60 52 E.	Indian Ocean	12000	38·2	81·5	...	Pullen (*u*)	No bottom at 13,524 feet.
30.	21 Dec., 1838...	7 29	85 18 E.	Indian Ocean	600	78	83	82·5	Pratt	Between Sumatra and the Mauritius.
31.	20 ,, ,,	7 54	85 20 E.	,, ,,	240	81·5	84	82·5	,, ...	
31*a*.	July, 1839...	7 54	112 53 W.	S. Pacific.....	2700	44·5	74	...	Wilkes.....	[Islands. Between Peru and Marquesas
32.	16 Jan., 1847...	7 55	29 11 W.	S. Atlantic ...	1098	53	80	79	Dayman	Between Ascension and Brazil.
33.	,, ,,	,, ,,	,, ,,	,, ,,	1638	47	,,	,,	,, ...	
34.	30 Apr., 1818...	8 15	14 3 W.	S. Atlantic ...	367	64	80·3	80·3	Kotzebue.....	Near Ascension Island.
35.	17 Oct., 1858...	8 21	162 56 E.	S. Pacific.....	300	83·5	84·2	83·2	Wüllerstorf.....	East of the Salomon Isles.
36.	,, ,,	,, ,,	,, ,,	,, ,,	600	81·1	,,	,,	,, ...	
37.	,, ,,	,, ,,	,, ,,	,, ,,	900	77·7	,,	,,	,, ...	
38.	,, ,,	,, ,,	,, ,,	,, ,,	1140	73·8	,,	,,	,, ...	

TABLE II.—Southern Hemisphere (continued).

I.	II. Date.	III. South Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr. At depth.	Surface.	Air.	VIII. Name of observer.	IX. Remarks.
39.	8 Dec., 1857...	° ′ 9 30	° ′ 30 38 W.	S. Atlantic ...	5280	° 41·5	° 80	° ...	Pullen (*u*)	Soundings in 7680 feet.
40.	29 Apr., 1818...	9 39	12 46 W.	S. Atlantic ...	420	60·1	79·4	80·7	Kotzebue.....	Between Ascension and St. Helena.
41.	19 June, 1839...	10?	Off Peru	S. Pacific.....	498	57	63	...	Wilkes.....	Latitude estimated.
42.	23 Feb., 1858...	10 54	58 44 E.	Indian Ocean	2640	51·5	83	...	Pullen (*u*)	No bottom in 7920 feet. Probable error in reading of last depth, from shifting of index.
43.	,, ,,	,, ,,	,, ,,	,, ,,	5280	41·5	,,	...	,, ...	
44.	,, ,,	,, ,,	,, ,,	,, ,,	7920	51·5?	,,	...	,, ...	
45.	28 Apr., 1818...	11 11	11 21 W.	S. Atlantic ...	432	65·5	78·5	80·3	Kotzebue.....	Between Ascension and St. Helena.
46.	April, 1836 ...	12	97 E.?	Indian Ocean	2178	45	...	...	FitzRoy	Near Keeling Island.
47.	15 July, 1839...	12?	Off Callao	S. Pacific.....	1800	51	67	...	Wilkes.....	Latitude estimated.
48.	18 ,, ,,	12?	,, ,,	,, ,,	1740	50	70	...	,, ...	
49.	27 Apr., 1818...	12 30	9 58 W.	S. Atlantic ...	368	59·8	77·2	78·3	Kotzebue.....	Between Ascension and St. Helena.
50.	23 May, 1837...	12 39	77 7 W.	S. Pacific.....	682	55·7	67·8	64·4	DuPetitThouars	Cylinder sound: in soundings.
51.	17 Jan., 1847...	12 49	32 23 W.	S. Atlantic ...	354	80	81	79	Dayman	Off the coast of Brazil.
52.	1847–49.....	13 28	28 W.	S. Atlantic ...	360	72·8	80·2	...	E. Lenz	Between Bahia and Ascension.
53.	22 May, 1837...	13 50	76 41 W.	S. Pacific.....	688	55·4	65	68	DuPetitThouars	Cylinder sound: off Pisco Bay.
54.	26 Apr., 1818...	14 12	7 55 W.	S. Atlantic ...	339	62	75·6	74	Kotzebue.....	North of St. Helena.
54*a*.	December ...	15	31 W.	S. Atlantic ...	360	74·6	78	...	Horner	No soundings in 27,600 feet.
55.	3 June, 1843...	15 3	23 14 W.	S. Atlantic ...	5400	40·3	77	...	James Ross	
56.	,, ,,	,, ,,	,, ,,	,, ,,	7200	39·5	,,	...	,, ...	
57.	19 Jan., 1847...	15 5	34 44 W.	S. Atlantic ...	1356	59	80	79	Dayman	Off Bahia, Brazil: reading probably reversed.
58.	,, ,,	,, ,,	,, ,,	,, ,,	1902	62	,,	,,	,, ...	
59.	13 Apr., 1816...	15 26	133 42 W.	S. Pacific.....	60	79	80	79·8	Kotzebue.....	North of the Low Islands; or 15° E. of the Society Islands.
60.	,, ,,	,, ,,	,, ,,	,, ,,	120	79	,,	,,	,, ...	
61.	,, ,,	,, ,,	,, ,,	,, ,,	300	78·8	,,	,,	,, ...	
62.	,, ,,	,, ,,	,, ,,	,, ,,	600	72	,,	,,	,, ...	
63.	,, ,,	,, ,,	,, ,,	,, ,,	1200	56	,,	,,	,, ...	
64.	27 Oct., 1827...	15 40	120 50 E.	Indian Ocean	2136	46·2	82·4	80·3	D'Urville.....	Between Australia and Java.
65.	8 May, 1839...	15 54	10 23 W.	S. Atlantic ...	1066	53·6	74·5	74·8	DuPetitThouars	Cylinder sound: near St. Helena.
66.	28 July, 1826...	16	26 40 W.	S. Atlantic ...	960	51·5	73·6	71·6	D'Urville.....	Between St. Helena and Brazil.
67.	24 Apr., 1818...	16 14	5 7 W.	S. Atlantic ...	276	62·8	74·3	72·5	Kotzebue.....	Near St. Helena.
68.	28 Oct., 1827...	16 40	120 20 E.	Indian Ocean	1068	69·3	82·8	81·6	D'Urville.....	Off N.W. coast of Australia.
69.	23 Apr., 1818...	17 55	3 8 W.	S. Atlantic ...	327	58·1	73·7	75	Kotzebue.....	S.E. of St. Helena.
70.	1847–49.....	17 17	192 (32?)	,, ,,	360	76·6	84	...	E. Lenz.	Apparent error of longitude.
71.	11 Nov., 1827...	17 30	135 20 E.?	Indian Ocean	1602	55·8	80·1	78·8	D'Urville.....	Probable error of longitude, should be 114° 20′ E.
72.	29 Oct., ,, ...	17 30	120 20 E.	,, ,,	640	73·8	80·6	81	,, ...	Near the Rowley Shoals.
73.	20 Jan., 1847...	17 48	36 20 W.	S. Atlantic ...	792	67	81	80	Dayman	Off the coast of Brazil.
74.	29 July, 1839...	17 54	112 53 W.	S. Pacific.....	2700	44·5	74	...	Wilkes.....	Amer. Journ. Sc., January, 1848. In mid-ocean.
75.	30 Oct., 1827...	18	119 50 E.	Indian Ocean	480*	75·5	78·8	80·1	D'Urville.....	Near the north-west coast of Australia.
76.	,, ,,	,,	,, ,,	,, ,,	506*	76·8	80·3	79	,, ...	
77.	4 Aug., 1839...	18?	120 W.?	S. Pacific.....	300	74	75	...	Wilkes.....	Between the coast of America and the Society Islands.
78.	,, ,,	,,	,,	,, ,,	600	73·5	,,	...	,, ...	
79.	,, ,,	,,	,,	,, ,,	1200	61	,,	...	,, ...	
80.	,, ,,	,,	,,	,, ,,	1800	50	,,	...	,, ...	

TABLE II.—Southern Hemisphere (continued).

I.	II. Date.	III. South Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr. At depth.	Surface.	Air.	VIII. Name of observer.	IX. Remarks.
81.	31 July, 1857...	18° 7′	37° 16′ W.	S. Atlantic ...	240	75°8	76°3	74°5	Wüllerstorf ...	Off the coast of Brazil.
82.	7 Aug., 1839...	18 14	125 W.	S. Pacific.....	600	75	77	...	Wilkes.....	In mid-ocean; between the Marquesas and Easter Island.
83.	7 Apr., 1816...	18 17	124 56 W.	S. Pacific.....	750	68·5	78·5	79·2	Kotzebue.....	
84.	,, ,,	,, ,,	,, ,,	,, ,,	750	68	79·6	80	,, ...	
85.	,, ,,	,, ,,	,, ,,	,, ,,	1050	57·5	78·5	79·2	,, ...	
86.	,, ,,	,, ,,	,, ,,	,, ,,	1200	54	79·6	80	,, ...	
87.	Jan., 1826...	18 38	136 1 W.	S. Pacific.....	1410	70	76	76·5	Beechey	Near Clermont Tonnerre Isl.
88.	22 Apr., 1818...	19 18	1 25 W.	S. Atlantic ...	393	62·8	73	72·1	Kotzebue.....	Between St. Helena and the Cape.
89.	14 Dec., 1857...	19 34	27 19 W.	S. Atlantic ...	2400	53	76	...	Pullen (*u*)	Between Rio Janeiro and St. Helena.
90.	,, ,,	,, ,,	,, ,,	,, ,,	4800	38·5	,,	...	,, ...	
91.	,, ,,	,, ,,	,, ,,	,, ,,	7200	41·2?	,,	...	,, ...	
92.	23 Sept., 1828...	20	70 20 E.	Indian Ocean	6194	45·3	73·4	71·2	D'Urville.....	E. of Rodrigue Isl. Thermometer wrong; too high.
93.	17 Apr., 1827...	20 20	174 10 W.	S. Pacific.....	1602	51·7	77·8	73·3	,, ...	Amongst the Friendly Islands.
94.	21 Jan., 1847...	20 10	37 58 W.	S. Atlantic ...	876	59	80	78	Dayman	Off the coast of Brazil.
95.	,, ,,	,, ,,	,, ,,	,, ,,	1836	50	,,	,,	,, ...	
96.	16 Feb., 1858...	20 14	59 35 E.	Indian Ocean	2880	50·5	80	...	Pullen (*u*)	Off the east coast of Mauritius.
97.	,, ,,	,, ,,	,, ,,	,, ,,	5610	40	,,	...	,, ...	
98.	,, ,,	,, ,,	,, ,,	,, ,,	8250	40·5?	,,	...	,, ...	
99.	31 July, 1829...	20 32	29 20 W.	S. Atlantic ...	426	69·4	72·6	71	D'Urville.....	Near Martin-Vaz Island.
100.	20 Apr., 1818...	20 33	0 54 E.	S. Atlantic ...	367	60·8	73·5	71·8	Kotzebue.....	Between St. Helena and the Cape.
101.	July, 1825...	20 38	38 46 W.	S. Atlantic ...	2760	43·5	73	71	Beechey	Near the coast of Brazil.
102.	3 May, 1847...	20 42	58 47 E.	Indian Ocean	840	74	77	76	Dayman	E. of the Mauritius.
103.	,, ,,	,, ,,	,, ,,	,, ,,	1800	57	,,	,,	,, ...	
104.	Feb., 1826...	21 19	140 23 W.	S. Pacific.....	1200	58·5	81·5	76	Beechey	Between the Society Islands and Pitcairn Island.
105.	,, ,,	,, ,,	,, ,,	,, ,,	1800	51	,,	,,	,, ...	
106.	,, ,,	,, ,,	,, ,,	,, ,,	2400	45	,,	,,	,, ...	
107.	6 Feb., 1859...	21 51	149 59 W.	S. Pacific.....	1080	71·3	81·6	82·4	Wüllerstorf.....	Between the Society and Tubuai Isles.
108.	18 May, 1847...	21 53	56 45 E.	Indian Ocean	1092	63	77	77	Dayman	Near the Isle of Bourbon.
109.	18 Jan., 1819...	22 31	40 31 W.	S. Atlantic ...	600	69·5	74·7	...	Wauchope	Near the coast of Brazil.
110.	17 Feb., 1837...	23 30	43 21 W.	S. Atlantic ...	373	60	72·5	74·3	DuPetitThouars	Cylinder full.
111.	July, 1825..	23 32	41 12 W.	S. Atlantic ...	1200	56	75	71	Beechey	Off Rio Janeiro.
112.	15 Sept., 1857...	33 49	0 39 W.	S. Atlantic ...	840	56·3	57·5	55	Wüllerstorf.....	(Entered in wrong place.)
113.	31 July, 1837...	24 7	54 20 E.	Indian Ocean	4740	43	69·8	70·4	Vaillant	Between Bourbon and Madagascar.
114.	19 May, 1847...	24 16	56 58 E.	Indian Ocean	1092	71	75	76	Dayman	S. of Isle of Bourbon.
115.	Dec., 1825...	24 35	127 W.	S. Pacific.....	1440	60·5	76	76·5	Beechey	Near Elizabeth Island.
116.	27 Sept., 1772...	24 44	24 54 W.	S. Atlantic ...	480	68	70	72·5	Forster	Between Brazil and the Cape.
117.	6 Aug., 1857...	24 54	43 10 W.	S. Atlantic ...	84	72·8	72·2	72·3	Wüllerstorf.	
118.	1 May, 1839... (morning)	25 10	7 59 E.	S. Atlantic ...	5316	37·4	67·3	69	DuPetitThouars	1st cylinder sound: south of St. Helena. 2nd cylinder full. Corr. 1=1790° feet.
119.	1 May, 1839... (noon)	,, ,,	,, ,,	,, ,,	5316	40·4 (37·4)	67·2	67·5	,, ,,	
120.	Apr., 1828...	25 30	108 W.	S. Pacific.....	600	69	80	80	Beechey	To the N.E. of Easter Island.
121.	,, ,,	,, ,,	,,	,, ,,	1200	58	,,	,,	,, ...	
122.	,, ,,	,, ,,	,,	,, ,,	1860	50	,,	,,	,, ...	

TABLE II.—Southern Hemisphere (continued).

I.	II. Date.	III. South Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr.			VIII. Name of observer.	IX. Remarks.
						At depth.	Surface.	Air.		
123.	Apr., 1828...	25 30	108 W.	S. Pacific.....	2460	44	80	80	Beechey	To the N.E. of Easter Island.
124.	31 Mar., 1840...	25 40	160 E.	S. Pacific.....	60	70	75	...	Wilkes.....	Between New South Wales and New Caledonia.
125.	" "	" "	"	" "	120	72	"	...	"	
126.	" "	" "	"	" "	180	73	"	...	"	
127.	" "	" "	"	" "	240	71·5	"	...	"	
128.	" "	" "	"	" "	300	72	"	...	"	
129.	" "	" "	"	" "	360	71?	"	...	"	
130.	" "	" "	"	" "	420	71·5	"	...	"	
131.	" "	" "	"	" "	480	71·5	"	...	"	
132.	" "	" "	"	" "	540	69·5	"	...	"	
133.	" "	" "	"	" "	600	73?	"	...	"	
134.	" "	" "	"	" "	1200	63·5	"	...	"	
135.	" "	" "	"	" "	1800	56	"	...	"	
136.	" "	" "	"	" "	2400	52	"	...	"	
137.	" "	" "	"	" "	3000	49	"	...	"	
138.	1 May, 1847 ...	25 48	61 6 E.	Indian Ocean	990	62	...	74	Dayman	Between Mauritius and Isl. of Amsterdam.
139.	" "	" "	" "	" "	1920	59	...	"	"	
140.	4 Feb., 1847 ...	26 7	40 30 W.	S. Atlantic ...	1386	60	77	66	Dayman	Off the coast of Brazil.
141.	" "	" "	" "	" "	2106	51	"	"	"	
142.	20 May, 1847 ...	26 9	58 45 E.	Indian Ocean	840	63	71	74	Dayman	S. of the Mauritius. Reading probably reversed.
143.	" "	" "	" "	" "	2160	73	"	"	"	
144.	22 May, 1850 ...	26 34	101 28 W.	S. Pacific.....	660	65	72	71	Armstrong	Between the Society Islands and Chili.
145.	" "	" "	" "	" "	1110	53	"	"	"	
146.	Nov., 1825...	26 36	112 40 W.	S. Pacific.....	2598	44	74·5	71	Beechey	West of Easter Island.
147.	" "	" "	" "	" "	3240	43	"	"	"	
148.	" "	" "	" "	" "	3840	44·5?	"	"	"	
149.	29 April, 1839...	26 36	7 32 E.	S. Atlantic ...	5315	41·7 (38·5)	68	69·8	DuPetit Thouars	Cylinder full; near the Cape.
150.	19 Dec., 1857 ...	26 46	23 52 W.	S. Atlantic ...	16200	35	75	...	Pullen	In soundings; descent 1 hour; ascent 2 hours.
151.	14 Feb., 1839 ...	26 47	98 30 E.	Indian Ocean	5316 (5200)	42·8 (38·7)	73·8	74·3	DuPetit Thouars	Cylinder full; in mid-ocean.
152.	30 Sept., 1838...	26 53	174 31 W.	S. Pacific.....	5316 (4987)	45·2 (42·1)	66·7	66·7	DuPetit Thouars	Cylinder full; Kermadec Island.
153.	28 April, 1847 .	26 56	57 31 E.	Indian Ocean	1200	60	74	70	Dayman	South of Mauritius.
154.	" "	" "	" "	" "	2100	57	"	"	"	
155.	27 Nov., 1827...	27	98 40 E.	Indian Ocean	1602	52·3	70·5	69	D'Urville	Between Mauritius and Australia.
156.	Nov., 1825...	27 17	103 W.	S. Pacific.....	600	64·5	68·5	66	Beechey	Between the Society Islands and Chili.
157.	" "	" "	"	" "	1260	51·5	"	"	"	
158.	" "	" "	"	" "	1800	46	"	"	"	
159.	5 Feb., 1847 ...	27 21	38 1 W.	S. Atlantic ...	1092	65	76	73	Dayman	Between the River Plata and the Isl. of Tristan d'Acunha.
160.	" "	" "	" "	" "	2052	51	"	"	"	
161.	15 May, 1836 ...	27 30	41 E.	Indian Ocean	30	74·5	75·6	...	FitzRoy	Between Natal and Madagascar.
162.	" "	" "	"	" "	48	74·2	"	...	"	
163.	" "	" "	"	" "	108	74	"	...	"	
164.	" "	" "	"	" "	120	74	"	...	"	

Table II.—Southern Hemisphere (continued).

I.	II. Date.	III. South Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr. At depth.	Surface.	Air.	VIII. Name of observer.	IX. Remarks.
165.	15 May, 1836 ...	27 30	41 E.	Indian Ocean	168	73	75·6	...	FitzRoy	Southern entrance of Mozambique Channel, between Madagascar and Natal. The 4th, 7th, 8th, and 10th observations, on being repeated, gave exactly the same results. The 1st, however, gave 74·4.
166.	„ „	„ „	„	„ „	240	72·5	„	...	„	
167.	„ „	„ „	„	„ „	288	71	„	...	„	
168.	„ „	„ „	„	„ „	300	70	„	...	„	
169.	„ „	„ „	„	„ „	450	68	„	...	„	
170.	„ „	„ „	„	„ „	600	64·5	„	...	„	
171.	„ „	„ „	„	„ „	1200	58·5	„	...	„	
172.	„ „	„ „	„	„ „	1800	55·5	„	...	„	
173.	„ „	„ „	„	„ „	2400	52·5	„	...	„	
174.	„ „	„ „	„	„ „	2520	52	„	...	„	
175.	21 May, 1847 ...	27 36	61 9 E.	Indian Ocean	1998	54	73	69	Dayman	Between Madagascar and Isl. of Amsterdam.
176.	11 Feb., 1839 ...	27 47	100 20 E.	Indian Ocean	5316 (5282)	37	74·8	76·2	DuPetit Thouars	Cylinder sound. W. of Australia.
177.	24 May, 1847 ...	28 1	67 28 E.	Indian Ocean	1716	54	69	67	Dayman	Between Mauritius and the Island of Amsterdam.
178.	22 „ „ ...	28 6	63 30 E.	„ „	1800	53	69	68	„	
179.	27 April, 1847 .	28 16	57 18 E.	Indian Ocean	1260	60	73	70	Dayman	Between Madagascar and Isl. of Amsterdam.
180.	„ „	„ „	„ „	„ „	2160	57	„	„	„	
181.	April, 1828 .	28 40	96 W.	S. Pacific.....	600	71	74	73	Beechey	Between Valparaiso and Easter Island.
182.	„ „	„ „	„	„ „	1200	53	„	„	„	
183.	„ „	„ „	„	„ „	1800	49	„	„	„	
184.	„ „	„ „	„	„ „	2400	45	„	„	„	
185.	14 Dec., 1857 ...	28 45	84 48 E.	Indian Ocean	720	63·7	69·9	67·7	Wüllerstorf.....	Between Madagascar and Australia.
186.	4 Oct., 1838 ...	28 49	177 18 W.	S. Pacific.....	5316 (3740?)	44·7 (42·6)	67	66·2	DuPetit Thouars	Cylinder full. Near No. 152.
187.	27 July, 1827 ...	29 13	12 54 W.	S. Atlantic ...	1655	50·4	66·6	69·5	Blosseville	Between the Cape and Paraguay.
188.	18 Nov., 1827...	19 20	107 30 E.	Indian Ocean	4378	40	73·4	71·2	D'Urville.....	(Entered in wrong place.)
189.	13 Dec., 1857 ...	29 25	85 2 E.	Indian Ocean	720	68	69·1	66·6	Wüllerstorf.....	Between Natal and Australia.
190.	26 April, 1839 .	29 33	10 57 E.	S. Atlantic ...	6396 (6133)	41·2 (37·6)	66·2	62·7	DuPetit Thouars	Full; between the Cape and Tristan d'Acunha.
191.	25 May, 1847...	29 49	67 14 E.	Indian Ocean	2160	54	66	66	Dayman	Between Madagascar and Isl. of Amsterdam.
192.	10 Aug., 1826...	30	22 40 W.	S. Atlantic ...	1602	50	63·6	59	D'Urville	Between the Cape and Uruguay.
193.	7 Dec., 1828 ...	30	44 20 E.	Indian Ocean	1602	58·8	72·8	73·6	„	Between Madagascar and the Cape.
194.	17 Aug., 1826...	30	13 40 W.	S. Atlantic ...	1494	51·8	64	55·4	„	In mid-ocean.
195.	21 Dec., 1857 ...	30 6	20 14 W.	S. Atlantic ...	2400	43·5	74·5	...	Pullen (*u*)	Mid-ocean; between the Cape and Brazil.
196.	„ „	„ „	„ „	„ „	4800	40·2	„	...	„	
197.	„ „	„ „	„ „	„ „	7200	38·2	„	...	„	
198.	1847–49.....	30 13	46 W.	S. Atlantic ...	360	64	77	...	E. Lenz	Off coast of Uruguay.
199.	26 April, 1847 .	30 13	56 50 E.	Indian Ocean	972	61	71	65	Dayman	Between Mauritius and the Cape.
200.	„ „	„ „	„ „	„ „	1698	60	„	„	„	
201.	Nov., 1825...	30 21	89 34 W.	S. Pacific.....	600	62·5	63	66·5	Beechey	Between Easter Island and Valparaiso.
202.	„ „	„ „	„ „	„ „	1320	50	„	„	„	
203.	„ „	„ „	„ „	„ „	1920	45·2	„	„	„	
204.	13 April, 1818...	30 39	14 27 E.	S. Atlantic ...	150	66·1	67·5	68	Kotzebue.....	West of the Colony of the Cape; northern part.
205.	„ „	„ „	„ „	„ „	300	60·8	„	„	„	
206.	„ „	„ „	„ „	„ „	1200	49·5	„	„	„	

TABLE II.—Southern Hemisphere (continued).

I.	II. Date.	III. South Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr.			VIII. Name of observer.	IX. Remarks.
						At depth.	Surface.	Air.		
207.	8 Feb., 1847 ...	30° 52′	36° 48′ W.	S. Atlantic ...	1200	61°	73°	71°	Dayman	In mid-ocean; parallel of Uruguay.
208.	„ „	„ „	„ „	„ „	2160	51	„	„	„	
209.	8 March, 1840.	45 miles	W. of Cape.	S. Atlantic ...	762	45	56	65	James Ross.....	Lat. and long. not given.
210.	10 „ „	60 miles	„ „	„ „	1200	43·5	61	64	„	
211.	7 „ „	120miles	„ „	„ „	2400	?	70	71	„	
212.	Aug., 1825...	31 29	45 57 W.	S. Atlantic ...	1860	46·5	66	62	Beechey	Off the coast of Uruguay.
213.	23 March, 1839.	31 33	33 30 E.	Indian Ocean	5316 (4659)	39·5	75·2	72·2	DuPetit Thouars	Cylinder sound; off Natal.
214.	9 Dec., 1828 ...	32	35 50 E.	Indian Ocean	2136	56·4	70·4	66·5	D'Urville.....	Between the Cape and Madagascar.
215.	26 May, 1847 ...	32 4	68 6 E.	Indian Ocean	2040	55	65	65	Dayman	Midway between the Cape and Western Australia.
216.	27 Jan., 1859...	32 21	157 18 W.	S. Pacific.....	1200	60·3	73·1	71·2	Wüllerstorf.....	Between Australia and Valparaiso.
217.	7 Oct., 1838...	32 51	176 42 E.	S. Pacific.....	5316 (4692)	44·4 (41·7)	61·3	66·2	DuPetit Thouars	Cylinder full. N. of N. Zealand.
218.	12 June, 1827...	32 54	11 26 W.	S. Atlantic ...	2455	56·4	72	72·5	Blosseville	Between the Cape & Rio Janeiro.
219.	1847–49 ...	32	72 (52?) W.	.....	360	52	56	...	E. Lenz	Apparent error in longitude.
220.	16 Dec., 1828...	33	30 20 E.	Indian Ocean	801	64·2	69·7	69	D'Urville	Off the S. coast of Natal.
221.	16 „ „	33	29 20 E.	„ „	1014	69	74·2	72·3	„	
222.	24 Mar., 1818...	33 14	29 59 E.	Indian Ocean	870	62·7	71·9	76·1	Kotzebue.....	On the Bank off the Cape.
223.	9 Feb., 1847...	33 22	36 54 W.	S. Atlantic ...	1104	60	70	68	Dayman	Between Monte Video and the Cape.
224.	„ „	„ „	„ „	„ „	1944	50	„	„	„	
225.	1 Mar., 1840...	33 23	7 41 E.	S. Atlantic ...	600	56	70	71	James Ross.....	Vol. ii. p. 53. In mid-ocean between the Cape and the Island of Tristan d'Acunha.
226.	„ „	„ „	„ „	„ „	900	53·2	„	„	„	
227.	„ „	„ „	„ „	„ „	1800	47·4	„	„	„	
228.	„ „	„ „	„ „	„ „	2700	43	„	„	„	
229.	„ „	„ „	„ „	„ „	3600	41·7	„	„	„	
230.	24 Apr., 1837...	33 26	72 03 W.	S. Pacific.....	853	49·1	54·7	51·8	DuPetit Thouars	Cylinder sound; soundings in 960 feet. Off Valparaiso.
231.	27 Mar., 1827...	33 30	175 50 E.	S. Pacific.....	3204	44·5	69·3	68·2	D'Urville	North of New Zealand.
232.	11 Aug., 1841...	33 32	167 40 E.	S. Pacific.....	900	53	.....	...	James Ross.....	In soundings on a bank between New Zealand and N. S. Wales.
233.	„ „	„ „	„ „	„ „	1200	51	.....	...	„	
234.	„ „	„ „	„ „	„ „	1800	48·1	.....	...	„	
235.	„ „	„ „	„ „	„ „	2400	45·3	.....	...	„	
236.	9 Aug., 1841...	33 40	164 18 E.	S. Pacific.....	900	55·8	59	...	James Ross.....	Between New Zealand and N. S. Wales.
237	„ „	„ „	„ „	„ „	1800	49·7	„	...	„	
238.	10 Aug., 1841...	33 41	166 23 E.	S. Pacific.....	12	58·7	59·7	...	James Ross.....	Between the North Island of New Zealand and New South Wales. No bottom in 4920 feet.
239.	„ „	„ „	„ „	„ „	300	57·6	„	...	„	
240.	„ „	„ „	„ „	„ „	600	56·7	„	...	„	
241.	„ „	„ „	„ „	„ „	900	53·6	„	...	„	
242.	„ „	„ „	„ „	„ „	1800	49·5	„	...	„	
243.	„ „	„ „	„ „	„ „	2700	45·6	„	...	„	
244.	„ „	„ „	„ „	„ „	3600	42·7	„	...	„	
245.	„ „	„ „	„ „	„ „	4500	40·4	„	...	„	
246.	27 May, 1847...	33 48	70 11 E.	Indian Ocean	2100	54	63	63	Dayman	Between the Cape and Australia.
247.	17 Dec., 1828...	34	27 20 E.	Indian Ocean	334*	66·9	69·5	74·2	D'Urville	Near Algoa Bay.
248.	26 Mar., 1818...	34 2	28 12 E.	Indian Ocean	324	64	71·1	72	Kotzebue.....	On the Bank off the Cape.

TABLE II.—Southern Hemisphere (continued).

I.	II. Date.	III. South Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr. At depth.	Surface.	Air.	VIII. Name of observer.	IX. Remarks.
249.	24 Apr., 1847...	34 24	54 14 E.	Indian Ocean	942	60	64	60	Dayman	Between Island of Amsterdam and the Cape.
250.	„ „	„ „	„ „	„ „	1772	58	„	„	„	
251.	19 Nov., 1838...	34 34	161 2 E.	S. Pacific.....	4264 (3347?)	40·8	65	65·3	DuPetitThouars	Between New Zealand and Sydney. Cylinder sound.
252.	? „	34 37	171 1 E.	„ „	3214 (2920)	42·8	62·7	61·2	„ „	
253.	24 Feb., 1847...	34 42	4 15 W.	S. Atlantic ...	2184	51	70	69	Dayman	Between St. Helena and Tristan d'Acunha.
254.	„ „	„ „	„ „	„ „	3900	44	„	„	„	
255.	12 Oct., 1772...	34 48?	7 E.?	S. Atlantic ...	600	58	59	60	Forster	In the parallel of the Cape.
256.	12 Oct., 1838...	34 54	174 5 E.	S. Pacific.....	1607 (951?)	50·5	62	60·8	DuPetitThouars	Soundings N. of New Zealand.
256*a*	20 April, 1836...	34 57	52 30 W.	S. Atlantic ...	266	55	62·2	56·7	Vaillant	Entrance of Rio de la Plata.
256*b*	„ „	35 1	„ „	„ „	250	60·6	61	62·6	„	
257.	1 June, 1847...	35	80 56 E.	Indian Ocean	2076*	55	59	61	Dayman	Between the Cape and King George's Sound.
258.	19 Dec., 1828...	35	23 20 E.	Indian Ocean	378	60·4	68·2	70·7	D'Urville	S.W. of Algoa Bay.
259.	21 Dec., 1828...	35	18 20 E.	S. Atlantic ...	694	59·6	67·6	68	„	Off the Cape.
260.	4 Oct., 1826...	35	111 20 E.	Indian Ocean	480	56·3	57	59·8	„	Off the S.W. of Australia.
261.	„ „	35 7	118 5 E.	„ „	229*	58	62	58	„	Off King George's Sound.
262.	27 Mar., 1818...	35 17	22 56 E.	Indian Ocean	516	51·7	68·1	77·5	Kotzebue.....	Off the Cape.
263.	10 Feb., 1847...	35 21	35 31 W.	S. Atlantic ...	1008	62	68	68	Dayman	Between Monte Video and Tristan d'Acunha Island.
264.	„ „	„ „	„ „	„ „	1854	49	„	„	„	
265.	25 Feb., 1847...	35 28	3 6 W.	S. Atlantic ...	1170	54	69	68	Dayman	Between the African coast and Tristan d'Acunha Island.
266.	„ „	„ „	„ „	„ „	2010	46	„	„	„	
267.	4 Jan., 1827...	35 30	137 20 E.	S. Pacific.....	1869	46·2	66·3	63·4	D'Urville	Off South Australia.
268.	17 Feb., 1847...	35 30	19 34 W.	S. Atlantic ...	1290	58	69	64	Dayman	Between the Cape and Monte Video. ? Reading reversed.
269.	„ „	„ „	„ „	„ „	2196	61	„	„	„	
270.	28 May, 1847...	35 33	72 6 E.	Indian Ocean	2100	55	60	61	Dayman	Between the Mauritius and the Island of Amsterdam.
271.	20 Dec., 1858...	35 34	175 31 E.	S. Pacific.....	1020	60	67	63·7	Wüllerstorf ...	N. of New Zealand.
272.	5 Sept., 1826...	36	33 20 E.	Indian Ocean	1174	55·4	62·1	59	D'Urville	Off Natal.
273.	27 Oct., „	36	121 20 E.	„ „	1708	45·3	56·6	54·9	„	Near King George's Sound.
274.	23 Feb., 1847...	36 4	4 53 W.	S. Atlantic ...	1230	61	67	62	Dayman	Between the Cape and Monte Video.
275.	„ „	„ „	„ „	„ „	2070	48	„	„	„	
276.	29 May, 1847...	36 6	74 15 E.	Indian Ocean	2100	52	59	60	Dayman	Near the Island of Amsterdam.
277.	16 Feb., 1837...	36 7	21 4 W.	S. Atlantic ...	1176	55	66	59	Dayman	Between the Cape and Monte Video.
278.	„ „	„ „	„ „	„ „	2016	47	„	„	„	
279.	5 Feb., 1858...	36 11	54 12 E.	Indian Ocean	3600	46·8	66·5	...	Pullen (*u*)	Between the Cape and Island of Amsterdam.
280.	„ „	„ „	„ „	„ „	6000	40·8	„	...	„	
281.	13 Apr., 1847...	36 17	26 43 E.	Indian Ocean	1290	62	68	61	Dayman	South of Algoa Bay.
282.	„ „	„ „	„ „	„ „	2160	60	„	„	„	
283.	20 Sept., 1857...	36 22	5 29 E.	S. Atlantic ...	1320	53	51·8	56·8	Wüllerstorf.....	Between Tristan d'Acunha and the Cape.
284.	29 Oct., „ ...	36 22	17 34 E.	„ „	600	63·3	63·5	59·9	„	South of the Cape.
285.	5 Mar., 1847...	36 22	13 40 E.	S. Atlantic ...	1302	52	68	66	Dayman	Off the Cape.
286.	„ „	„ „	„ „	„ „	2202	46	„	„	„	
287.	6 Mar., 1847...	36 24	14 42 E.	S. Atlantic ...	882	65	70	71	Dayman	
288.	„ „	„ „	„ „	„ „	1704	56	„	„	„	

TABLE II.—Southern Hemisphere (continued).

I.	II. Date.	III. South Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr. At depth.	Surface.	Air.	VIII. Name of observer.	IX. Remarks.
289.	17 Feb., 1827...	36° 30′	176° 40′ E.	S. Pacific.....	907	50·8	65·5	64·2	D'Urville	North of New Zealand.
290.	15 Feb., 1847...	36 31	24 7 W.	S. Atlantic ...	1164	58	64	63	Dayman	In mid-ocean.
291.	„ „	„ „	„ „	„ „	2034	45	„	„	„	
292.	27 Jan., 1839...	36 36	118 28 E.	Indian Ocean	5316 (5282)	37	64·2	63·5	DuPetitThouars	Cylinder sound. Near King George's Sound.
293.	4 Mar., 1847...	36 41	12 1 E.	S. Atlantic ...	1128	55	64	66	Dayman	S.W. of the Cape.
294.	„ „	„ „	„ „	„ „	1968	46	„	„	„	
295.	6 June, 1847...	36 42	97 54 E.	Indian Ocean	1920	51	56	55	Dayman	Between Amsterdam Island and Australia.
296.	18 Feb., 1847...	36 47	18 47 W.	S. Atlantic ...	768	57	68	54	Dayman	Between the Cape and Buenos Ayres.
297.	„ „	„ „	„ „	„ „	1542	50	„	„	„	
298.	3 Mar., 1847...	36 47	10 24 E.	S. Atlantic ...	1248	54	66	63	Dayman	S.W. of the Cape.
299.	„ „	„ „	„ „	„ „	2088	46	„	„	„	
300.	30 Oct., 1857 ...	36 48	18 11 E.	.....	900	52	63·5	62·2	Wüllerstorf.....	S. of the Cape.
301.	13 Feb., 1847...	36 50	27 50 W.	S. Atlantic ...	1290	62	66	66	Dayman	Between Tristan d'Acunha and Monte Video.
302.	„ „	„ „	„ „	„ „	2220	45	„	„	„	
303.	14 April, 1847...	36 53	27 49 E.	Indian Ocean	1290	65	69	66	Dayman	Off Algoa Bay.
304.	„ „	„ „	„ „	„ „	2160	56	„	„	„	
305.	26 Feb., 1847...	36 57	1 31 W.	S. Atlantic ...	1170	53	67	65	Dayman	Between Tristan d'Acunha Island and the Cape.
306.	„ „	„ „	„ „	„ „	2010	49	„	„	„	
307.	18 Feb., 1827...	37	176 20 E.	S. Pacific.....	801	57·7	67·1	64·2	D'Urville.....	North of New Zealand.
308.	12 July, 1841...	37 20	151 36 E.	S. Pacific.....	3300	46·2	60	...	James Ross.....	Off Port Jackson: no soundings.
309.	11 „ „	17 miles	off C. Howe.	S. Pacific.....	1752	49·7	59	59	„	In soundings.
310.	July, 1828...	37 20	48 47 W.	S. Atlantic ...	600	57	60	57	Beechey	Off Rio de la Plata.
311.	„ „	„ „	„ „	„ „	1140	56·5	„	„	„	
312.	„ „	„ „	„ „	„ „	1740	48·5	„	„	„	
313.	12 Feb., 1847...	37 20	30 58 W.	S. Atlantic ..	1230	57	66	69	Dayman	Between La Plata and the Cape.
314.	„ „	„ „	„ „	„ „	2130	45	„	„	„	
315.	13 Jan., 1827...	37 30	157 20 E.	S. Pacific.....	3257	42	67	65·5	D'Urville	Between New Zealand and New South Wales.
316.	8 Feb., „ ...	37 30	178 55 E.	„ „	1922	46	67·4	65·3	„	Near the N.E. of New Zealand.
317.	1 Feb., 1839...	37 42	114 58 E.	Indian Ocean	5315 (5282)	37·4	62·2	61·1	DuPetit Thouars	S. of Cape Leeuwin, Australia.
318.	19 April, 1847...	37 49	39 50 E.	Indian Ocean	1596	51	59	64	Dayman	Between the Cape and Crozet Island. ? Reading reversed.
319.	„ „	„ „	„ „	„ „	1896	53	„	„	„	
320.	21 Feb., 1847...	37 54	10 28 W.	S. Atlantic ...	1230	53	62	59	Dayman	Between the Cape and La Plata.
321.	„ „	„ „	„ „	„ „	2070	43	„	„	„	
322.	1 Sept., 1826...	38	24 20 E.	Indian Ocean	587	54·7	63·2	54·7	D'Urville.....	S.W. of Algoa Bay.
323.	„ „	„	„ „	„ „	2776	41·3	„	„	„	
324.	21 Nov., „ ...	38	149 20 E.	S. Pacific.....	934	55·4	60	60·8	„	Bass's Strait.
325.	19 Feb., 1847...	38 7	16 43 W.	S. Atlantic ...	2220	48	63	65	Dayman	Between La Plata and the Cape.
326.	16 April, 1847 .	38 8	32 54 E.	Indian Ocean	768	64	69	69	Dayman	Between Port Natal and Prince Edward Island.
327.	„ „	„ „	„ „	„ „	1668	60	„	„	„	
328.	3 Dec., 1857 ...	38 9	77 46 E.	Indian Ocean	720	55·4	56·7	54	Wüllerstorf.....	Near the Island of Amsterdam.
329.	15 April, 1847 .	38 10	29 39 E.	Indian Ocean	1230	67	69	67	Dayman	South of Algoa Bay.
330.	„ „	„ „	„ „	„ „	2100	58	„	„	„	
331.	26 Feb., 1837...	38 12	33 40 W.	S. Atlantic ...	2132 (1968?)	37·4	62·3	71·6	DuPetit Thouars	Cylinder full: in mid-ocean.

TABLE II.—Southern Hemisphere (continued).

I.	II. Date.	III. South Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr.			VIII. Name of observer.	IX. Remarks.
						At depth.	Surface.	Air.		
332.	21 April, 1847...	38° 13′	45° 36′ E.	Indian Ocean	948	55°	60°	66°	Dayman	Between the Cape and Island of Amsterdam.
333.	" "	" "	" "	" "	1758	52	"	"	"	
333a	27 Feb., 1847 ...	38 22	0 28 W.	S. Atlantic ...	1152	55	62	64	Dayman	In open ocean.
333b	" "	" "	" "	" "	2028	45	"	"	"	
334.	1 Mar., 1847...	38 25	4 1 E.	S. Atlantic ...	1170	48	55	56	Dayman	Between the Cape and Gough Island.
335.	" "	" "	" "	" "	2010	44	"	"	"	
336.	14 Nov., 1826...	38 30	145 16 E.	S. Pacific.....	58	60·2	63·6	65·3	D'Urville.....	In Bass's Strait.
337.	Oct., 1825 ...	38 30	75 44 W.	S. Pacific.....	540	51	55·5	54	Beechey	Off the south coast of Chili.
338.	" "	" "	" "	" "	1200	44·5	"	"	"	
339.	" "	" "	" "	" "	1800	45·5	"	"	"	
340.	" "	" "	" "	" "	2400	44	"	"	"	
341.	26 Nov., 1857...	38 41	77 45 E.	Indian Ocean	720	55·4	56	54·7	Wüllerstorf.....	Near the Island of Amsterdam.
342.	10 Nov., 1826...	39	141 50 E.	S. Pacific.....	1708	47·5	56·2	63·6	D'Urville.....	Off the S. coast of Australia.
343.	23 Jan., 1839 ...	39 4	123 22 E.	S. Pacific.....	1870	48·5 (47·5)	60·8	58·7	DuPetitThouars	Cylinder full. S. of Australia.
344.	27 Nov., 1841...	39 16	177 25 W.	S. Pacific.....	900	53·5	58	...	James Ross.....	Off the east coast of the North Island of New Zealand: no soundings.
345.	" "	" "	" "	" "	1800	49·2	"	...	"	
346.	" "	" "	" "	" "	2700	46·8	"	...	"	
347.	" "	" "	" "	" "	3600	44·9	"	...	"	
348.	Aug., 1825...	39 31	45 2 W.	S. Atlantic ...	1482	55	59	47	Beechey	Open ocean.
349.	15 Mar., 1839...	39 51	44 17 E.	Indian Ocean	5316 (3051?)	37·8	78	80·6	DuPetitThouars	Cylinder sound. Open ocean.
350.	12 June, 1847...	39 57	118 E.	Indian Ocean	1920	45	54	48	Dayman	S. of King George's Sound.
351.	14 Nov., 1857...	40 44	60 8 E.	Indian Ocean	.....	.....	.....	...	Wüllerstorf.....	To the N.W. of Kerguelen I. No soundings in 37,020 feet.
352.	14 June, 1847...	40 46	123 26 E.	S. Pacific.....	2280	50	53	49	Dayman	South of W. Australia.
353.	11 Nov., 1857...	40 52	49 57 E.	Indian Ocean	600	54·9	54·3	47·7	Wüllerstorf.....	Between the Cape and Kerguelen Island.
354.	20 Jan., 1827 ...	40 58	173 5 E.	S. Pacific.....	32*	63·5	64·4	65	D'Urville.....	In Cook Strait.
355.	5 April, 1850 .	41	54 35 W.	S. Atlantic ...	900	40	59	...	Armstrong	Off La Plata.
356.	2 Feb., 1827 ...	40 31	176 48 E.	S. Pacific.....	506*	58·7	65·2	65	D'Urville.....	Cook's Strait, New Zealand.
357.	2 Mar., 1837...	41 56	55 6 W.	S. Atlantic ...	1066 (591?)	38·5	60·8	62·7	DuPetitThouars	Cylinder full.
358.	4 Jan., 1827 ...	42	171 E.	S. Pacific.....	534	55·8	63	61	D'Urville.....	Near the W. coast of N. Zealand.
359.	Sept., 1825...	42 2	46 8 W.	S. Atlantic ...	1200	41	47·5	47	Beechey	In the parallel of Rio Negro.
360.	27 Dec., 1838 ...	42 34	153 10 E.	S. Pacific.....	5316 (3904?)	43·5 (41·4)	55·7	55·4	DuPetitThouars	Cylinder full.
361.	17 Jan., 1839 ...	43 2	131 54 E.	S. Pacific.....	5872	44·6 (41·2)	55·4	53·6	DuPetitThouars	S. of Australia; cylinder full.
362.	26 March, 1843.	43 10	14 44 E.	S. Atlantic ...	1800	44	53	52·7	James Ross.....	Between the Cape of Good Hope and Bouvet Island: no soundings.
363.	" "	" "	" "	" "	2700	41·1	"	"	"	
364.	" "	" "	" "	" "	6300	39·8	"	"	"	
365.	" "	" "	" "	" "	7200	39·5	"	"	"	
366.	17 Dec., 1827 ...	43 25	147 7 E.	S. Pacific.....	160*	55·6	59	59	D'Urville.....	Off east coast of Tasmania.
366a	9 July, 1847 ...	15 miles	E. of Cape	Pillar	2250	48	55	53	Dayman	Tasmania.
367.	16 April, 1836...	43 47	79 6 W.	S. Pacific.....	2656	39·3	55·7	55·5	DuPetit Thouars	Off the Isle of Chiloe. Cylinder sound.
368.	" "	" "	" "	" "	5872	36·1	55·4	55	"	

TABLE II.—Southern Hemisphere (continued).

I.	II. Date.	III. South Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr. At depth.	Surface.	Air.	VIII. Name of observer.	IX. Remarks.
369.	27 Mar., 1843...	° ′ 43 52	° ′ 13 23 E.	S. Atlantic ...	900	° 44	° 47·5	° 49·8	James Ross.....	
370.	,, ,,	,, ,,	,, ,,	,, ,,	1800	40·3	,,	,,	,, ,, ...	Between the Cape and Bouvet Island.
371.	,, ,,	,, ,,	,, ,,	,, ,,	2700	39·8	,,	,,	,, ,, ...	
372.	,, ,,	,, ,,	,, ,,	,, ,,	3600	39·5	,,	,,	,, ,, ...	
373.	8 Jan., 1816...	44 47	57 31 W.	S. Atlantic ...	1176	38·8	54·9	57·6	Kotzebue.....	Between Monte Video and the Falkland Islands.
374.	5 Mar., 1837... (8 A.M.)	45 38	61 10 W.	S. Atlantic ...	160	48·2	57·5	59	DuPetitThouars	
375.	,, (7 A.M.)	,, ,,	,, ,,	,, ,,	213	42·4	57·2	55·4	,, ,,	Cylinder sound. In soundings N. of the Falkland Islands.
376.	,, (6 A.M.)	,, ,,	,, ,,	,, ,,	374	41·3	,,	55	,, ,,	
377.	,, (noon)	,, ,,	,, ,,	,, ,,	374	41·3	58·6	63	,, ,,	
378.	Sept., 1825...	46 15	51 53 W.	S. Atlantic ...	1680	41	51	55	Beechey	N.E. of the Falkland Islands.
379.	14 Nov., 1840...	?	?	S. Pacific.....	900	49·8	51	46·8	James Ross.....	
380.	,, ,,	,, ,,	,, ,,	,, ,,	1800	48	,,	,,	,, ,, ...	Two days' sail south of Van Diemen Land: no soundings.
381.	,, ,,	,, ,,	,, ,,	,, ,,	2700	46·5	,,	,,	,, ,, ...	
382.	,, ,,	,, ,,	,, ,,	,, ,,	3600	45·6	,,	,,	,, ,, ...	
383.	Sept., 1825...	47 18	53 30 W.	S. Atlantic ...	1620	44·7	49·8	43	Beechey	
384.	,, ,,	,, ,,	,, ,,	,, ,,	3618	39·2	,,	,,	,, ...	Open sea to the N.E. of the Falkland Islands.
385.	,, ,,	,, ,,	,, ,,	,, ,,	4398	40·1	,,	,,	,, ...	
386.	,, ,,	,, ,,	,, ,,	,, ,,	5124	39·4	,,	,,	,, ...	
387.	4 Dec., 1841...	49 17	172 28 W.	S. Pacific.....	900	48·7	53	49·7	James Ross.....	
388.	,, ,,	,, ,,	,, ,,	,, ,,	2700	44·5	,,	,,	,, ,, ...	
389.	,, ,,	,, ,,	,, ,,	,, ,,	3600	42·2	,,	,,	,, ,, ...	Near Antipodes Island. No soundings in 6600 feet.
390.	,, ,,	,, ,,	,, ,,	,, ,,	4500	41	,,	,,	,, ,, ...	
391.	,, ,,	,, ,,	,, ,,	,, ,,	5400	40·2	,,	,,	,, ,, ...	
392.	,, ,,	,, ,,	,, ,,	,, ,,	6300	40	,,	,,	,, ,, ...	
392*a*	Feb., 1804 ...	52	68 W.	S. Atlantic ...	330	46	53·4	...	Horner	Off Patagonia.
393.	2 April, 1841...	52 10	136 56 E.	South'n Ocean	900	42	43	...	James Ross.....	
394.	,, ,,	,, ,,	,, ,,	,,	1800	41	,,	...	,, ,, ...	Between Australia and the Antarctic Land. Soundings in 9240 feet.
395.	,, ,,	,, ,,	,, ,,	,,	2700	40	,,	...	,, ,, ...	
396.	,, ,,	,, ,,	,, ,,	,,	3600	39·8	,,	...	,, ,, ...	
397.	23 Dec., 1772...	52 26	?	S. Ocean	600	34·5	32	33	Forster	20° south of the Cape.
398.	1847–49.....	53 12	55 W.	S. Ocean	360	43	51	...	E. Lenz	S.E. of the Falkland Islands.
398*a*	9 May, 1836 ...	53 47	62 45 W.	S. Atlantic ...	957	39·2	41	38	Vaillant	Off Terra del Fuego.
399.	16 Sept., 1842...	54 41	55 12 W.	S. Ocean	900	39·8	39·5	33·5	James Ross.....	
400.	,, ,,	,, ,,	,, ,,	,,	1680	39·8	,,	,,	,, ,, ...	In soundings. 10° east of Cape Horn.
401.	10 Jan., 1840...	55?	157 E.?	S. Ocean	1800	39	43	...	Wilkes.....	
402.	22 ,, ,, ...	?	?	,,	1920	27·5	32	...	,, ...	Off Macquarie Island. Mud at bottom of No. 402.
403.	16 ,, ,, ...	?	157 46 E.	,,	5100	31·5	31	...	,, ...	
404.	16 Mar., 1839...	55	65 W.	,,	2400	37	44	...	,, ...	Near Le Maire Strait.
405.	15 Dec., 1772...	55 8	22 E.?	S. Ocean	600	34	30	32	Cook	Amongst ice: S. of the Cape.
406.	30 Mar., 1841...	55 9	132 28 E.	S. Ocean	900	39	38·5	39?	James Ross.....	
407.	,, ,,	,, ,,	,, ,,	,,	1800	39·5	,,	,,	,, ,, ...	Open ocean, on the parallel of Macquarie Island: no soundings.
408.	,, ,,	,, ,,	,, ,,	,,	2700	39·8	,,	,,	,, ,, ...	
409.	,, ,,	,, ,,	,, ,,	,,	3600	39·8	,,	,,	,, ,, ...	

TABLE II.—Southern Hemisphere (continued).

I.	II. Date.	III. South Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr. At depth.	Surface.	Air.	VIII. Name of observer.	IX. Remarks.
410.	13 Dec., 1841...	° ′ 55 18	° ′ 149 20 W.	S. Ocean	900	° 39·6	° 39	° 42·5	James Ross.....	
411.	„ „	„ „	„ „	„	1800	39·9	„	„	„ „	Between Cape Horn and New Zealand: no soundings.
412.	13 Dec., 1841...	„ „	„ „	„	2700	39·7	39	42·5	„ „	
413.	„ „	„ „	„ „	„	3600	39·7	„	„	„ „	
414.	1847–49.....	55 19	62 W.	S. Ocean	360	41	48·4	...	E. Lenz	Between Cape Horn and the South Shetlands.
415.	23 Dec., 1772...	55 20	31 30 E.	S. Ocean	600	34·5	32	33	Cook	Near ice: between Cape and Enderby Land.
416.	18 Sept., 1842...	55 40	63 8 W.	S. Ocean	1800	37·2	40·2	31·9	James Ross.....	No soundings.
417.	20 Dec., 1842...	55 48	54 40 W.	S. Ocean	900	40	40	45·4	James Ross.....	
418.	„ „	„ „	„ „	„	1800	39·6	„	„	„ „	
419.	„ „	„ „	„ „	„	2700	39·6	„	„	„ „	Between the Falkland Islands and Elephant Island: no soundings.
420.	„ „	„ „	„ „	„	3600	39·4	„	„	„ „	
421.	„ „	„ „	„ „	„	4500	39·3	„	„	„ „	
422.	„ „	„ „	„ „	„	6000	39·5	„	„	„ „	
423.	Sept., 1825...	55 58	72 10 W.	S. Ocean	600	42·5	43·5	37	Beechey	
424.	„ „	„ „	„ „	„	1380	42·5	„	„	„	Off the south coast of Terra del Fuego.
425.	„ „	„ „	„ „	„	1980	40·5	„	„	„	
426.	„ „	„ „	„ „	„	2580	41·6	„	„	„	
427.	1847–49.....	56	64 W.		360	41	46	...	E. Lenz	East of Cape Horn.
428.	14 Dec., 1841...	56 20	148 8 W.	S. Ocean	900	38	35·8	41	James Ross.....	In mid-ocean: no soundings.
429.	„ „	„ „	„ „	„	1800 to 7200	39·7	„	„	„ „	
430.	18 Mar., 1843...	56 41	6 5 W.	S. Ocean	900	35·2	33·5	33·2	James Ross.....	
431.	„ „	„ „	„ „	„	1800	36·8	„	„	„ „	In mid-ocean, between Bouvet Island and Sandwich Isl.: no soundings.
432.	„ „	„ „	„ „	„	2700	37·8	„	„	„ „	
433.	„ „	„ „	„ „	„	3600	39	„	„	„ „	
434.	5 April, 1837...	56 58	82 16 W.	S. Ocean	13124 (12828)	?	44·6	42·6	DuPetitThouars	Cylinder crushed: index fixed.
435.	21 Dec., 1840...	57 52	170 30 E.	S. Ocean	1380	39·5	42	39	James Ross.	
436.	23 Mar., 1837...	58 32	73 29 W.	S. Ocean	2132 (1608)	39·5	44	45	DuPetitThouars	Near No. 448. Cylinder sound.
437.	23 Mar., 1842...	58 36	104 40 W.	S. Ocean	300	40·8	41	32	James Ross.....	
438.	„ „	„ „	„ „	„	600	40·8	„	„	„ „	
439.	„ „	„ „	„ „	„	900	40·7	„	„	„ „	Between Dougherty Island and Cape Horn: no soundings.
440.	„ „	„ „	„ „	„	1800	40·8	„	„	„ „	
441.	„ „	„ „	„ „	„	2700	40·5	„	„	„ „	
442.	„ „	„ „	„ „	„	3600	40	„	„	„ „	
443.	1 April, 1837...	58 40	79 15 W.	S. Ocean	2657 (1870)	38·6	42·4	42·4	DuPetitThouars	Cylinder full.
444.	28 Mar., 1842...	58 55	83 16 W.	S. Ocean	900	40·8	42	40	James Ross.....	
445.	„ „	„ „	„ „	„	1800	40·8	„	„	„	Open sea to the S.W. of Cape Horn.
446.	„ „	„ „	„ „	„	2700	40·5	„	„	„	
447.	„ „	„ „	„ „	„	3600	40	„	„	„	
448.	22 Dec., 1840...	59	171 E.	S. Ocean	900	38·5	37	37·4	James Ross.....	
449.	„ „	„	„ „	„	1800	39·5	„	„	„	Between New Zealand and South Victoria Land.
450.	„	„	„ „	„	2700	39·7	„	„	„	
451.	„ „	„	„ „	„	3600	39·7	„	„	„	

TABLE II.—Southern Hemisphere (continued).

I.	II. Date.	III. South Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr.			VIII. Name of observer.	IX. Remarks.
						At depth.	Surface.	Air.		
452.	26 Mar., 1837...	° ′ 59 48	° ′ 79 56 W.	S. Ocean	2657 (2395)	° 39	° 42·9	° 42·4	DuPetitThouars	Near his last. Cylinder full.
453.	25 Mar., 1841...	60 22	131 28 E.	S. Ocean	900	37	35	34·4	James Ross.....	Between Australia and Adélie Land: no soundings.
454.	,, ,,	,, ,,	,, ,,	,,	1800	38	,,	,,	,, ...	
455.	,, ,,	,, ,,	,, ,,	,,	2700	39·5	,,	,,	,, ...	
456.	,, ,,	,, ,,	,, ,,	,,	3600	40·5	,,	,,	,, ...	
457.	Mar., 1839...	61 ?	55 W.?	South Seas ...	1800	33	36	...	Wilkes.....	Off Elephant Island.
458.	22 Feb., 1843...	61 30	22 30 W.	S. Ocean	4500	39·2	32	30	James Ross.....	In mid-ocean: no soundings.
459.	8 Mar., 1842...	62 15	163 50 W.	S. Ocean	600	32·2	35	32	James Ross.....	Between the Society Islands and Antarctic Continent. From the surface to 600 ft. the temperature was 30°·8.
460.	,, ,,	,, ,,	,, ,,	,,	900	35·5	,,	,,	,, ...	
461.	,, ,,	,, ,,	,, ,,	,,	1800	37·2	,,	,,	,, ...	
462.	,, ,,	,, ,,	,, ,,	,,	2700	38·5	,,	,,	,, ...	
463.	,, ,,	,, ,,	,, ,,	,,	3600	39	,,	,,	,, ...	
464.	1839	63 ?	57 W.?	S. Ocean	600	29	29	28	Wilkes.....	Near the South Shetlands.
465.	27 Dec., 1840...	63	174 30 E.	S. Ocean	900	35·5	30	31·9	James Ross.....	Between New Zealand and S. Victoria Land: no soundings.
466.	,, ,,	,,	,, ,,	,,	1800	38·2	,,	,,	,, ...	
467.	,, ,,	,,	,, ,,	,,	3600	39·7	,,	,,	,, ...	
468.	4 Mar., 1839...	63 18	55 W.	S. Ocean	600	30	31	...	Wilkes.....	See Amer. Journ. of Sc. Jan. 1848.
469.	20 Dec., 1841...	63 47	151 34 W.	S. Ocean	900	35·6	30	27·7	James Ross.....	Amongst ice. Between Dougherty Island and South Victoria Land. Soundings in 10,200 feet.
470.	,, ,,	,, ,,	,, ,,	,,	1800	38·4	,,	,,	,, ...	
471.	,, ,,	,, ,,	,, ,,	,,	3600	40	,,	,,	,, ...	
472.	,, ,,	,, ,,	,, ,,	,,	4500	39·6	,,	,,	,, ...	
473.	,, ,,	,, ,,	,, ,,	,,	5400	39·8	,,	,,	,, ...	
474.	8 Feb., 1843...	63 49	51 7 W.	S. Ocean	600	32·2	32	33	James Ross.....	Near Louis Philippe Land, Antarctic Continent. Off the pack. No soundings in 7260 feet.
475.	,, ,,	,, ,,	,, ,,	,,	900	33·2	,,	,,	,, ...	
476.	,, ,,	,, ,,	,, ,,	,,	1800	35·5	,,	,,	,, ...	
477.	,, ,,	,, ,,	,, ,,	,,	2700	36·4	,,	,,	,, ...	
478.	,, ,,	,, ,,	,, ,,	,,	3600	37·3	,,	,,	,, ...	
479.	,, ,,	,, ,,	,, ,,	,,	7260	39·5	,,	,,	,, ...	
480.	18 Mar., 1841...	63 51	151 47 E.	S. Ocean	900	35·5	30·4	28·3	James Ross.....	Between Van Diemen Land and South Victoria Land. Near the pack: no soundings.
481.	,, ,,	,, ,,	,, ,,	,,	1800	37·5	,,	,,	,, ...	
482.	,, ,,	,, ,,	,, ,,	,,	2700	38·5	,,	,,	,, ...	
483.	,, ,,	,, ,,	,, ,,	,,	3600	39·2	,,	,,	,, ...	
484.	18 Jan., 1843...	63 59	54 35 W.	S. Ocean	900	30	32	...	James Ross.....	Off the pack: soundings in 1260 feet.
485.	21 Mar., 1841...	64 7	140 22 E.	S. Ocean	900	34	30·8	27	James Ross.....	Near the pack: no soundings. N. of Adélie Land.
486.	,, ,,	,, ,,	,, ,,	,,	1800	36·5	,,	,,	,, ...	
487.	,, ,,	,, ,,	,, ,,	,,	2700	38	,,	,,	,, ...	
488.	,, ,,	,, ,,	,, ,,	,,	3600	38·7	,,	,,	,, ...	
489.	13 Jan., 1773...	64 30?	39 E.?	S. Ocean	600	32	33·5	36	Cook	N.W. of Enderby Land.
490.	30 Dec., 1840...	64 38	173 10 E.	S. Ocean	900	35·2	31	32·2	James Ross.....	Between New Zealand and South Victoria Land. Soundings in 9360 feet.
491.	,, ,,	,, ,,	,, ,,	,,	1800	37·2	,,	,,	,, ...	
492.	,, ,,	,, ,,	,, ,,	,,	2400	38·8	,,	,,	,, ...	
493.	,, ,,	,, ,,	,, ,,	,,	3600	39·8	,,	,,	,, ...	

Table II.—Southern Hemisphere (continued).

I.	II. Date.	III. South Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr.			VIII. Name of observer.	IX. Remarks.
						At depth.	Surface.	Air.		
494.	6 Mar., 1841...	64° 51′	164° 45′ E.	S. Ocean	3600	37°2	29°2	31°	James Ross.....	No soundings.
494*a*	12 Feb., 1840...	64 57	112 16 E.	S. Ocean	1500	30·5	.....	31	Wilkes.....	Near the ice-barrier. No soundings.
495.	3 Jan., 1842...	66 34	156 22 W.	Antarctic O.	6300	39·6	28	31·1	James Ross.....	In the pack.
496.	3 Mar., 1842...	67 28	174 27 W.	Ant. Ocean ...	900	34·2	33	32·3	James Ross.....	No soundings. Not far from icebergs.
497.	,, ,,	,, ,,	,, ,,	,, ,,	1800	35·5	,,	,,	,, ...	
498.	,, ,,	,, ,,	,, ,,	,, ,,	2700	37·5	,,	,,	,, ...	
499.	,, ,,	,, ,,	,, ,,	,, ,,	3600	38	,,	,,	,, ...	
500.	7 Jan., 1841...	68 17	175 21 E.	Ant. Ocean ...	900	37·5	28	28	James Ross.....	Not far from icebergs. Approaching the Antarctic continent.
501.	,, ,,	,, ,,	,, ,,	,, ,,	1800	38·2	,,	,,	,, ...	
502.	,, ,,	,, ,,	,, ,,	,, ,,	2700	39·2	,,	,,	,, ...	
503.	,, ,,	,, ,,	,, ,,	,, ,,	3600	39·8	,,	,,	,, ...	
504.	2 Mar., 1841...	68 27	167 42 E.	.....	2400	36	28·2	27	James Ross.....	Ditto. No soundings.
505.	3 Mar., 1843...	68 32	12 49 W.	Ant. Ocean ...	900	33	30·8	29·4	James Ross.....	Between Louis Philippe Land and Enderby Land. No soundings in 24,000 feet.
506.	,, ,,	,, ,,	,, ,,	,, ,,	1800	35·5	,,	,,	,, ...	
507.	,, ,,	,, ,,	,, ,,	,, ,,	3600	38·7	,,	,,	,, ...	
508.	,, ,,	,, ,,	,, ,,	,, ,,	4500	39·4	,,	,,	,, ...	
509.	,, ,,	,, ,,	,, ,,	,, ,,	5400	39	,,	,,	,, ...	
510.	,, ,,	,, ,,	,, ,,	,, ,,	6300	39·5	,,	,,	,, ...	
511.	9 Feb., 1842...	70 39	174 31 W.	Ant. Ocean ...	900	32·1	28	27·9	James Ross.....	To the N.E. of S. Victoria Land. Near the pack: no soundings.
512.	,, ,,	,, ,,	,, ,,	,, ,,	1800	35	,,	,,	,, ...	
513.	,, ,,	,, ,,	,, ,,	,, ,,	2700	35·8	,,	,,	,, ...	
514.	,, ,,	,, ,,	,, ,,	,, ,,	3600	37·6	,,	,,	,, ...	
515.	18 Jan., 1841...	72 57	176 6 E.	Ant. Ocean ...	900	33·8	30	31	James Ross.....	In the parallel of Mt. Sabine, S. Victoria: no soundings.
516.	,, ,,	,, ,,	,, ,,	,, ,,	1380	34·6	,,	,,	,, ...	
517.	15 Feb., 1842...	75 6	172 56 E.	Ant. Ocean ...	1740	32	30	25·1	James Ross.....	Off S. Victoria Ld.: in soundings.
518.	1 Feb., 1841...	77 5	171 33 W.	Ant. Ocean ...	900	33	32	27 ?	James Ross.....	Off the perpendicular ice-barrier. Appearance of land beyond: in soundings.
519.	,, ,,	,, ,,	,, ,,	,, ,,	1500	33·2	,,	,,	,, ...	
520.	29 Jan., 1841...	77 47	176 43 E.	Ant. Ocean ...	900	33	31	28	James Ross.....	13 miles off the ice-wall. Soundings in 2460 feet.
521.	,, ,,	,, ,,	,, ,,	,, ,,	1800	34·2	,,	,,	,, ...	
522.	23 Feb., 1842...	77 49	162 36 W.	Ant. Ocean ...	1740	30·8	28·5	25	James Ross.....	Off the perpendicular ice-barrier. Appearance of land beyond.

Addenda.—Omitted Observations of Capt. Kellett.

Depth in feet.	13 Dec., 1845.—19° 10′ S.; 77° 17′ W. Temperature			20 Jan., 1846.—0° 18′ S.; 83° W. Temperature	
	At depth.	Surface.	Air.	At depth.	Surface.
60	66° F.	68° F.	65° F.	75° F.	76° F.
120	65	,,	,,	70	,,
180	63	,,	,,	67	,,
300	60	,,	,,	65·5	,,
600	55	,,	,,	62·5	,,
1200	51	,,	,,	54	,,
1800	52	,,	,,	51	,,
2400	46	,,	,,	48	,,
3000	46	,,	,,	47	,,

TABLE III.—SUBMARINE TEMPERATURES OF INLAND SEAS*.

The Mediterranean.

I.	II. Date.	III. Position.	IV. Depth in feet.	V. Temperature in degrees of Fahr.			VI. Name of observer.	VII. Remarks.
				At depth.	Surface.	Air.		
		WESTERN DIVISION.						
1.	8 Oct., 1780...	Off Port Fino, near Genoa	944	55°8	69°	66°	Saussure	Thermometers left down 12 hours.
2.	16 „ „ ...	Off Cape della Causa, near Nice...	1918	55·8	68·5	„	„	
3.	22 Mar., 1829...	41° N. lat. 5°·20 E. long.	3204	54·7	58·5	57·6	D'Urville	
4.	23 „ „ ...	41° N. lat. 2°·20 E. long.	1602	54·7	57·1	58·1	„	
5.	27 Apr., 1826...	40° N. lat. 4°·50 E. long.	1602	54·5	56·9	62·3	„	
6.	27 „ „	Two miles N. of Alboran.....	293	56·3	61·3	59·6	„	
7.	5 May, „	Straits of Gibraltar	1068	54·2	64·1	65·3	„	Between the coast of France and Straits of Gibraltar.
8.	8 „ „	Five miles E. of Ceuta	1335	57·4	63	63·6	„	
9.	21 „ „	Anchorage of Algesiras	106*	56·5	59·2	63·8	„	
10.	22 „ „	„ „	106*	61·3	60·5	65·9	„	
11.	26 „ „	„ „	119*	58·3	60·8	60·8	„	
12.	3 June „	„ „	112*	59·2	62·7	66·5	„	
13.	26 June, 1831...	Between Mahon and Algiers	6408	55·4	69·8	75·2	Bérard.....	Between the Balearic Isles and Algeria.
14.	27 „ „	„ „	3204	55·4	73·7	74·3	„	
15.	23 July, 1832...	14 miles N.E. of Bougie	3850	55·7	79·7	83·2	„	
16.	9 Aug., „	10 miles N. of Bougie	267	56·3	79·7	81·6	„	
17.	23 „ „	8 miles E.N.E. of Bougie.....	267	55·4	80·8	89·9	„	
18.	23 Oct., „	40°·41 N. lat. 2°·10 E. long.....	373	58·8	70·8	73·7	„	
19.	„ „	„ „	213	61·8	72	75·2	„	
20.	„ „	„ „	106	69	68	72	„	
21.	15 Nov., 1831...	Off Cape St. Martin.....	3204	55·4	67·1	60·7	„	
22.	23 „ „	„ „	4005	55·4	58·3	59	„	
23.	July, 1844...	Between Marseilles and Algiers ...	3	73·4	74·5	...	Aimé	Mean of July (evening) observations. The mean temperature of the air in July is 75°.
24.	„ „	„ „ ...	33	68	„	...	„	
25.	„ „	„ „ ...	49	66·2	„	...	„	
26.	„ „	„ „ ...	65	65·5	„	...	„	
27.	„ „	„ „ ...	82	64·4	„	...	„	
28.	„ „	„ „ ...	98	63·5	„	...	„	
29.	Mar., 1844...	„ „ ...	3	57·4	57·5	...	Aimé	Mean of March (evening) observations. The mean temperature of the air in March is 58°·1.
30.	„ „	„ „ ...	6½	57·2	„	...	„	
31.	„ „	„ „ ...	33	57	„	...	„	
32.	„ „	„ „ ...	46	56·8	„	...	„	
33.	„ „	„ „ ...	59	56·6	„	...	„	
34.	„ „	„ „ ...	72	56·6	„	...	„	
35.	1841–1844 ...	Between Marseilles and Algiers; exact position not specified ...	82	61·3	64·7	64·4	Aimé	These numbers give the mean annual temperatures resulting from the total of his observations.
36.	„ „	„ „	164	58	„	„	„	
37.	„ „	„ „	328	56·7	„	„	„	
38.	„ „	„ „	656	55·4	„	„	„	
39.	„ „	„ „	1148	54·6	„	„	„	

* A few observations of D'URVILLE, marked thus, have F affixed in the original. Possibly this may mark "Fathoms;" but in the absence of information the reduction is for "Brasses," which is the measure he otherwise used.

Table III.—Inland Seas (continued).

The Mediterranean (continued).

I.	II. Date.	III. Position.	IV. Depth in feet.	V. Temperature in degrees of Fahr. At depth.	Surface.	Air.	VI. Name of observer.	VII. Remarks.
		Western Division (continued).						
40.	9 May, 1857...	38° 36′ N. lat. 13° 41′ E. long....	720	58·8	61·6	61	Wüllerstorf.....	Between the Straits of Messina and Straits of Gibraltar.
41.	11 „ „	38° 51′ N. lat. 10° 36′ E. long....	750	57·2	60	62	„	
42.	15 „ „	37° 56′ N. lat. 3° 47′ E. long....	750	56·4	62·2	64·5	„	
43.	„ „	„ „ ...	648	61·2	„	„	„	
44.	19 „ „	36° 2′ N. lat. 4° 2′ W. long....	750	59·2	62·6	63·2	„	
45.	24 „ „	36° 8′ N. lat. 5° 21′ W. long....	60	60·1	59·2	63·5	„	
46.	30 „ „	36° 7′ N. lat. 5° 22′ W. long....	270	58·4	61·5	64·8	„	
47.	2 June, „	36° 33′ N. lat. 4° 34′ W. long....	72	56·4	57·6	66·2	„	
		Eastern Division.						
48.	4 May, 1857...	39° 33′ N. lat. 18° 51′ E. long....	180	58·2	61	61	Wüllerstorf.....	Between the Ionian Islands and Sicily.
49.	„ „	„ „ ...	300	60·1	„	„	„	
50.	5 „ „	38° 21′ N. lat. 16° 56′ E. long. ...	150	60·8	61·5	60·5	„	
51.	July, 1845...	Egina Gulf	12	82	.....	88	Spratt	A mile and a half from shore.
52.	„ „	„ „	60	78	.....	„	„	
53.	„ „	„ „	120	69	.....	„	„	
54.	„ „	„ „	210	62	.....	„	„	
55.	„ „	„ „	450	56	.....	„	„	
56.	„ „	„ „	780	55·5	.....	„	„	
57.	„ „	„ „	12	80	.....	84	Spratt	Three miles from shore.
58.	„ „	„ „	60	76	.....	„	„	
59.	„ „	„ „	120	69	.....	„	„	
60.	„ „	„ „	210	61	.....	„	„	
61.	„ „	„ „	330	57	.....	„	„	
62.	„ „	„ „	1260	55·5	.....	„	„	
62*a*.	23 July, 1846...	N. Division of Archipelago	30	76	.....	86	Spratt (*u*)	Between Eubœa and Skyros.
62*b*.	„ „	„ „	60	69	.....	„	„	
62*c*.	„ „	„ „	150	62	.....	„	„	
62*d*.	„ „	„ „	300	58	.....	„	„	
62*e*.	„ „	„ „	600	55	.....	„	„	
63.	Aug., 1847...	Off Nio	1080	55·5	.....	86	Spratt	Four miles from shore.
64.	„ „	Off Andros	1200	55·5	.....	„	„	Seven miles from shore.
65.	25 July, 1847...	Grecian Archipelago.....	60	74	78	86	Spratt	Southern division of Greek archipelago.
66.	„ „	„ „	120	74	„	„	„	
67.	„ „	„ „	360	64	„	„	„	
68.	„ „	„ „	540	64	„	„	„	
69.	„ „	„ „	720	56	„	„	„	
70.	20 Sept., 1852...	Off Crete	60	72	75	76	Spratt	North coast of Crete.
71.	„ „	„ „	300	59	„	„	„	
72.	„ „	„ „	720	56	„	„	„	
73.	14 June, 1860...	Off Crete	60	68	73	80	Spratt	About 50 miles west of Cerizotta, on the N.W. coast of Crete.
74.	„ „	„ „	120	68	„	„	„	

TABLE III.—INLAND SEAS (continued).

The Mediterranean (continued).

I.	II. Date.	III. Position.	IV. Depth in feet.	V. Temperature in degrees of Fahr. At depth.	Surface.	Air.	VI. Name of Observer.	VII. Remarks.
				°	°	°		
75.	14 June, 1860*	Off Crete	180	68	73	80	Spratt	About 50 miles west of Cerizotta, on the N.W. coast of Crete.
76.	„ „	„ „	300	63	„	„	„	
77.	„ „	„ „	600	59¾	„	„	„	
78.	„ „	„ „	1200	59¾	„	„	„	
79.	„ „	„ „	7440	59½	„	„	„	
80.	25 Aug., 1860...	Off East End of Rhodes	60	81	82	88	Spratt	About 2 or 3 miles from the coast.
81.	„ „	„ „	120	79½	„	„	„	
82.	„ „	„ „	180	78½	„	„	„	
83.	„ „	„ „	300	77	„	„	„	
84.	„ „	„ „	600	73	„	„	„	
85.	May, 1861...	Between Malta and Tripoli	1770	62	62	68	Spratt.	
86.	21 Feb., 1861...	Gulf of Syrtis	120	62	61	64	Spratt	About 200 miles west of Benghazi.
87.	„ „	„ „	300	62	„	...	„	
88.	„ „	„ „	1740	62?	„	...	„	
89.	27 Feb., 1861...	Gulf of Syrtis	300	61	60	56	Spratt	180 miles S.E. of Malta. No soundings in 6000 feet.
90.	„ „	„ „	600	61½	„	„	„	
91.	6 April, 1861...	Arabs Gulf W. of Alexandria	120	61½	62	68	Spratt	Near the coast.
92.	„ „	„ „	1800	59½	„	„	„	
93.	April, 1861...	Off the coast of Egypt	120	61½	63	65	Spratt	Off Alexandria.
94.	„ „	„ „	1620	59½	„	...	„	
95.	15 Nov., 1861...	Off the coast of Egypt	180	71	73	69	Spratt	Off Arabs Tower, west of Alexandria.
96.	„ „	„ „	300	68	„	...	„	
97.	„ „	„ „	480	64	„	...	„	
98.	„ „	„ „	600	62½	„	...	„	
99.	15 Feb., 1861...	65 miles from Malta	180	59½	60	57	Spratt (*u*)	S.W. of Malta.
100.	„ „	„ „	600	59¼	„	...	„	
101.	15 Feb., 1861...	55 miles S.W. of Malta	300	59	59½	...	Spratt (*u*)	
102.	„ „	„ „	900	59	„	...	„	
103.	15 Feb., 1861...	150 miles S.S.W. of Malta	120	60	60	...	Spratt (*u*)	Between Malta and Tripoli.
104.	„ „	„ „	300	59½	„	...	„	
104*a*	11 June, 1860...	150 miles E. of Malta	60	72½	74	75	Spratt (*u*)	Between Malta and the Greek archipelago.
105.	„ „	„ „	120	69	„	...	„	
106.	„ „	„ „	180	63	„	...	„	
107.	„ „	„ „	300	59¾	„	...	„	
108.	„ „	„ „	600	58½	„	...	„	
109.	„ „	„ „	7200	58¾	„	...	„	
110.	17 Nov., 1853...	SEA OF MARMORA	60	55½	55⅞	61	Spratt (*u*)	Near entrance.
111.	„ „	„ „	300	54	„	„	„	N. of Marmora Island.
112.	17 Nov., 1853...	Sea of Marmora	60	55	56	60	Spratt (*u*)	10 miles distant from the preceding. Soundings in 1320 feet.
113.	„ „	„ „	300	54½	„	„	„	
114.	5 May, 1854...	BLACK SEA, Bourgas Gulf	60	49	52	68	Spratt (*u*)	On W. coast. In soundings.

* The observations of Admiral SPRATT before 1860 were made on mud brought up from the bottom. Those in and after 1860 were made with SIX's self-registering thermometer.

TABLE III.—INLAND SEAS (continued).

Red Sea.

I.	II. Date.	III. North Latitude.	IV. Longitude of Greenwich.	V. Sea.	VI. Depth in feet.	VII. Temperature in degrees of Fahr. At depth.	Surface.	Air.	VIII. Name of observer.	IX. Remarks.
115.	March and Apr., 1858	° ′ 13 19	° ′ 42 53 E.	Red Sea	570	° 74·5	° 85	° ...	Pullen (*u*)	Near Strait of Bab-el-Mandeb.
116.	March and Apr., 1858	15 18	41 43 E.	„ „	240	77	86	...	„	Near the Islands of Dhalak.
117.	„ „	16 59	40 5 E.	„ „	300	77	86	...	„	Between Ras Debeer (Nubia) and Ghumfooda, on the Arabian coast.
118.	„ „	17 49	40 2 E.	„ „	3342	70·5	80	...	„	
119.	„ „	18 3	38 57 E.	„ „	1392	70·5	86	...	„	
120.	„ „	20 57	37 29 E.	„ „	1800	71	83·5	...	„	Off Jeddah.
121.	„ „	22 1	38 16 E.	„ „	2552	71	78	...	„	
122.	„ „	23 30	36 58 E.	„ „	4068	70·5	77·5	...	„	Between Berenice and Yembo.
123.	„ „	27 33	Jubal Strait	„ „	2892	70	72	...	„	Top of Red Sea.

Sea of Okhotsk.

124.	May, 1804.....	46	144 E.	Sea of Okhotsk	360	32	34·6	...	Horner	Near the N. coast of Japan.
125.	August	53	144 E.	„ „	480	30	55·8	...	Horner	Off the north end of Saghalien.
126.	August	53	152 E.	„ „	84	44·6	46·4	...	Horner	Between the Island of Saghalien and the coast of Kamtschatka.
127.	„	„	„	„ „	96	36·5	„	...	„	
128.	„	„	„	„ „	108	31·6	„	...	„	
129.	„	„	„	„ „	126	29·3	„	...	„	
130.	„	„	„	„ „	180	29	„	...	„	
131.	„	„	„	„ „	360	29	„	...	„	
132.	„	„	„	„ „	660	29	„	...	„	
133.	„	„	„	„ „	690	29	„	...	„	

Explanation of Map.

PLATE 65.

This Map is reduced, so far as relates to the hydrographical details, from the last edition of the Admiralty 'Chart of the World for Tracks.'

On this the observations recorded in Tables I., II., and III. are laid down according to the latitude or longitude given by the original observers. A few corrections have been made in the Tables since the Map was engraved. In the case of these or any other discrepancies*, the Tables give the correct reading. In the Mediterranean only a portion of the numbers (without the initials) are given for want of space.

The numbers in the Map correspond with those in the Tables, and the name of the observer is indicated by initial letters as under. The name of the ship is added for convenience of reference: the fuller particulars and titles will be found in the text, § II., in the order of date.

A. Armstrong	Voyage of the 'Investigator'	1850–54.
a. Abel	On the Voyage of the 'Alceste'	1817.
B. Beechey	Voyage of the 'Blossom'	1825–28.
B. Belcher	Voyage of the 'Sulphur'	1836–46.
„ „	Voyage of the 'Samarang'	1843–46.
Bl. Blosseville	See D'Urville	1828.
Ba. Bache	United States Coast Survey for 1854	1854.
C. Cook	Voyage of the 'Resolution' and 'Adventure'	1772–75.
c. Chimmo	See note, p. 610	1868.
cr. Craven	See Bache	1855.
D.† D'Urville	Voyage de 'L'Astrolabe'	1826–29.
d. Dayman	Voyage of the 'Rattlesnake'	1846–47.
Ds. Dunsterville	See Maury.	
E. Ellis	On a Voyage to the Coast of Africa	1749.
F. Franklin & Buchan	Voyage of the 'Dorothea' and 'Trent'	1818.
F. FitzRoy	Voyage of the 'Adventure' and 'Beagle'	1826–36.
f. Forster	Voyage of the 'Resolution'	1772–75.
G. Graah	Expedition to the East Coast of Greenland	1828.
H. Horner	See Krusenstern's Voyage	1803–6.
I. Irving	See Phipps's Voyage	1773.
K. Kotzebue	Voyage of the 'Rurick'	1815–18.
„ „	Voyage of the 'Predpriatie' (see Lenz)	1823–26.

* The whole group of observations to the west and north of Spitzbergen are placed rather too far (from ½° to 1°) north.

† D should have stood for Dayman and U for D'Urville; as it is, U stands for D'Urville in the north hemisphere and D in the south hemisphere.

K.	Kellett	Voyage of the 'Herald'	1845–51.
k.	Kündson	Voyage of the 'Queen'	1859.
Kr.	Krusenstern . . .	Voyage of the 'Neva' and 'Nadeshda' . . .	1803–6.
L.	Emil. Lenz . . .	With Kotzebue on his 2nd Voyage	1823–26.
L.	Ed. Lenz	On Voyages in the 'Atcha'	1847–49.
M.	Martins & Bravais .	Voyage de 'La Recherche'	1838.
Ma.	Maury	Physical Geography of the Sea . . . . edit.	1857
P.	Parry	Voyage of the 'Alexander'	1818.
,,	,, ...	Voyage of the 'Hecla' and 'Griper'	1819–20.
,,	,, ...	Voyage of the 'Fury' and 'Hecla'	1821–23.
,,	,, ...	Voyage of the 'Hecla'	1827.
P.	Pullen	On the Voyage of the 'Cyclops'	1857–59.
	Phipps (see Irving) .	Voyage toward the North Pole (the 'Racehorse')	1773.
p.	Péron	Voyage sur les Corvettes 'Le Géographe,' 'Le Naturaliste,' et 'Le Casuarina'	1800–4.
pr.	Pratt	On a Voyage to India	1840.
R.	John Ross . . .	Voyage of the 'Isabella'	1818.
R.	James Ross . . .	Voyage of the 'Discovery' and 'Research' . .	1839–43.
Ro.	Rodgers	See Maury	1855.
S.	Scoresby	Various Voyages (the 'Esk' and 'Baffin') . .	1810–22.
S.	Sabine	With Ross in 1818, and Parry in 1819 . . .	1819.
Sh.	Shortland . . .	On the Voyage of the 'Hydra'	1868.
T.	Du Petit-Thouars .	Voyage de 'La Vénus'	1836–39.
U.	D'Urville . . .	Voyage de 'L'Astrolabe' (see D)	1826–29.
V.	Vaillant	Voyage de 'La Bonite'	1836–39.
W.	Wüllerstorf . .	Voyage of the 'Novara'	1857–59.
W.	Wauchope . . .	See notes, pp. 595 & 601	1816 & 1836.
Wi.	Wilkes	United States Exploring Expedition (the 'Vincennes' and 'Peacock')	1839–42.
Wa.	Walker	On the Voyage of the 'Fox'	1858.

The other numbers in *italics* mark (in feet) the further depth to which some of the soundings have been carried. Where they have reached the bottom a stop (.) is added; where, on the contrary, the soundings have not reached the bottom, the sign + is added.

The many other voyages for scientific purposes sent out by the English, French, and American governments during the period here described contain many very numerous meteorological observations, but no observation on submarine temperatures, unless I have inadvertently overlooked any.

Explanation of Sections.

PLATES 66, 67, & 68.

The position of the sections will be found on the Map, and the initials attached to the numbers have the same reference on both.

In the absence of observations in the direct line of section some of those at a short distance on either side are included.

The vertical lines indicate the position and depth of the temperature-soundings, and the figures in italics connected with them give the temperature at the surface and at depths in degrees of Fahrenheit. The other figures on the top line mark the degrees of latitude. The stronger figures in italics relate to the probable position of the bathymetrical isotherms generally.

The separate numbers at depths indicate the depth in feet to which soundings have been made in any latitude, the sign + showing that no bottom has been reached.

All the observations used in the Sections have been subjected to correction for pressure, as adopted p. 612, viz. by making a deduction of 1° Fahr. for every 1700 feet of depth, exclusive of the observations of Lenz, Du Petit-Thouars (such of them as are given in parentheses in the Tables), Martins, Pullen (in part), and those of Ross, Parry, and Sabine of 1818–19, which are taken, for reasons before given, as recorded by the original observers. It is possible that in some instances (as, for example, James Ross) a larger correction might be necessary, and that in the Antarctic seas the isotherm of 35° F. should be replaced by one of 33° or 32°*; but this will not much affect the correction for the more numerous observations at lesser depths.

All the depths are given, for the sake of uniformity, without correction for angle of rope, as that could only possibly be known in but few cases. The importance, however, of a correction for this also will be evident by reference to the large allowances which Du Petit-Thouars† has often thought it necessary to make in his soundings, the corrected readings being given between parentheses. Only in 21 cases does he record "the angle of the line from the vertical" as 0; in the other 38 cases he found it to vary from 10° to 67°; and he estimated the difference caused by the latter extreme case as equal to a reduction of the observed depth of 5872 feet to a corrected depth of 2296 feet. The want of information on this point is one reason for taking, as we have done, a minimum correction for pressure.

Where the observations are sufficiently numerous the bathymetrical isotherms are laid down in continuous lines. The dotted lines indicate the probable prolongation of the isotherms, on the supposition that there are no disturbing causes; but it must be borne in mind that the isotherms (the lower ones especially) are liable to rise with every

* Should some of the observations of the 'Challenger' be found to correspond in position with any of those recorded in these pages, they will furnish a measure whereby to correct these or those of other observers.

† See also the corrected depths of Lenz (*antè*, p. 599) and of Wauchope, 1816, and Sabine, 1822 (Tables).

important irregularity (banks, shoals, &c.) in the bed of the ocean, and the upper isotherms may be variously deflected by surface-drifts and currents.

It is probable that in some of these Sections (as, for example, in the North Pacific, Sect. 4, and in the South Atlantic, Sects. 1 & 2) the irregularities of curvature may be exaggerated, owing to the want of uniformity in the instruments used by the different observers, and by the necessity of using a general correction for all.

Very little was known before 1868 of the deep bed of the Atlantic. The few indications of the ocean-bed given in the sections are taken from notices in the several voyages above recorded and from MAURY. In the higher north latitudes we have the soundings of ROSS, KANE, SCORESBY, and MARTINS. In section No. 2 the greater depths of SCORESBY are in the sea west of Spitzbergen, and the lesser ones of MARTINS between Spitzbergen and Norway, which accounts for the break in continuity of depth.

The position of the bathymetrical isotherms and the indications of the sea-bed are confined strictly to observations anterior to 1868.

Prestwich

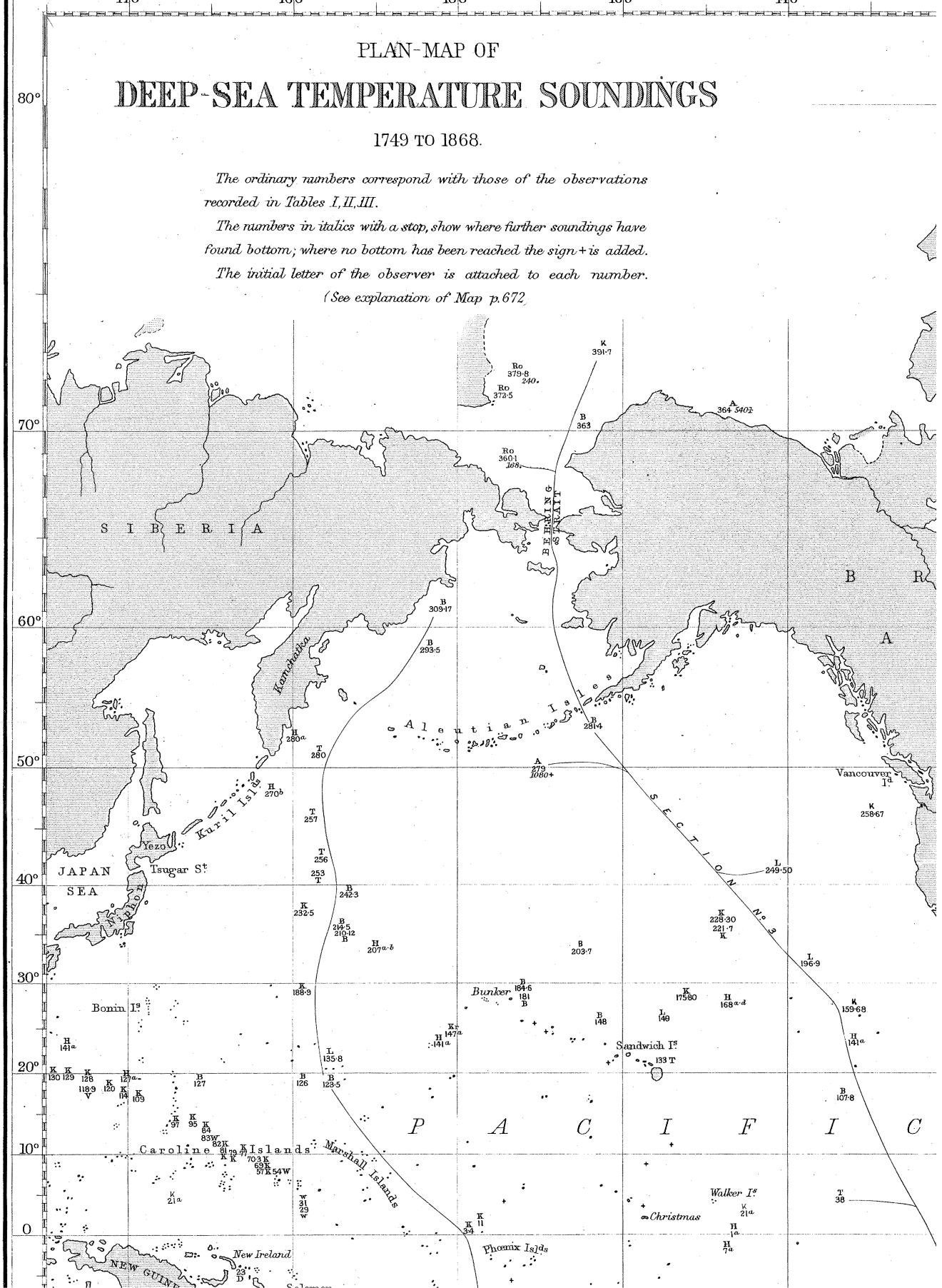
PLAN-MAP OF
DEEP-SEA TEMPERATURE SOUNDINGS
1749 TO 1868.

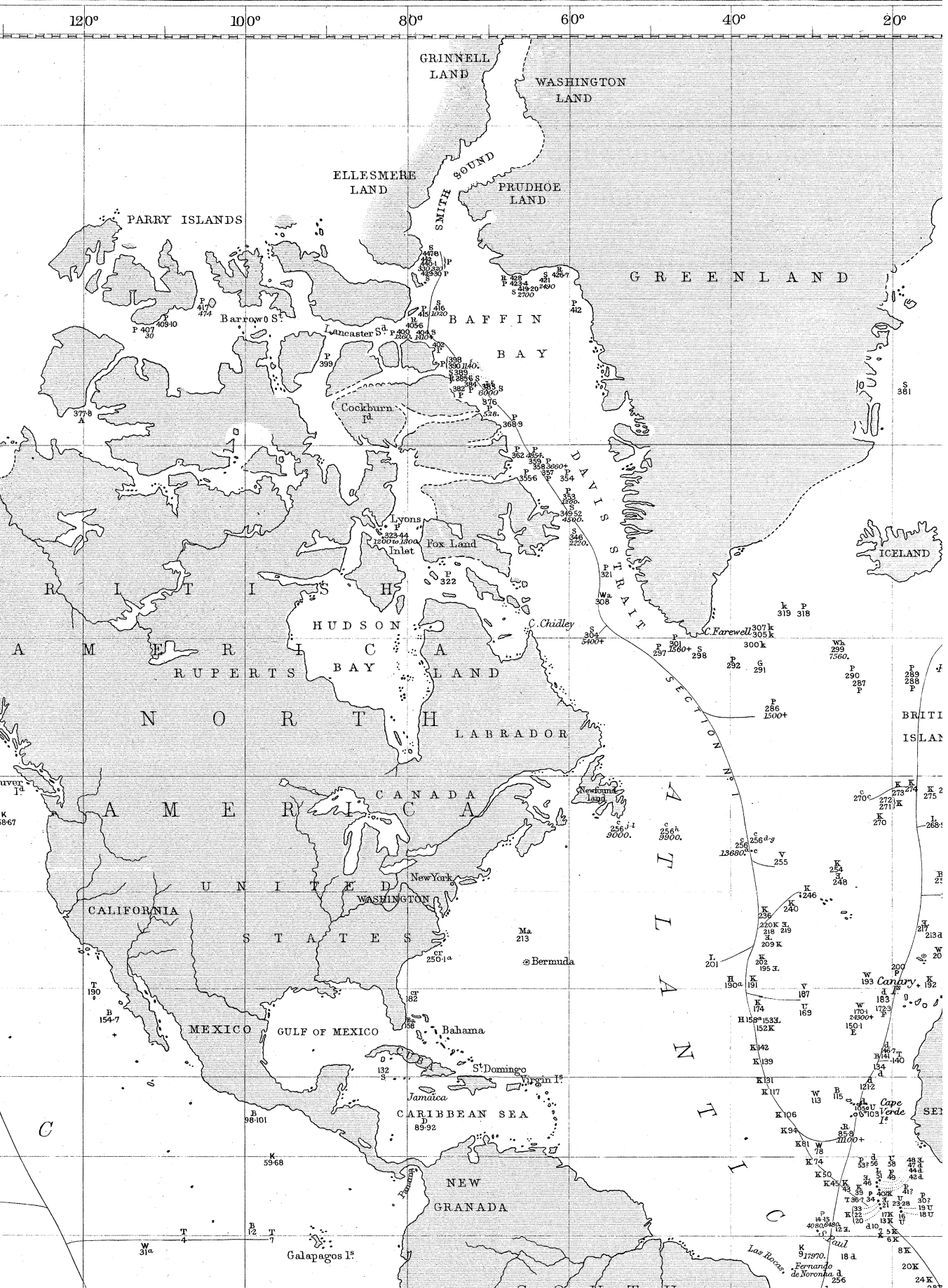
The ordinary numbers correspond with those of the observations recorded in Tables I, II, III.

The numbers in italics with a stop, show where further soundings have found bottom; where no bottom has been reached the sign + is added.

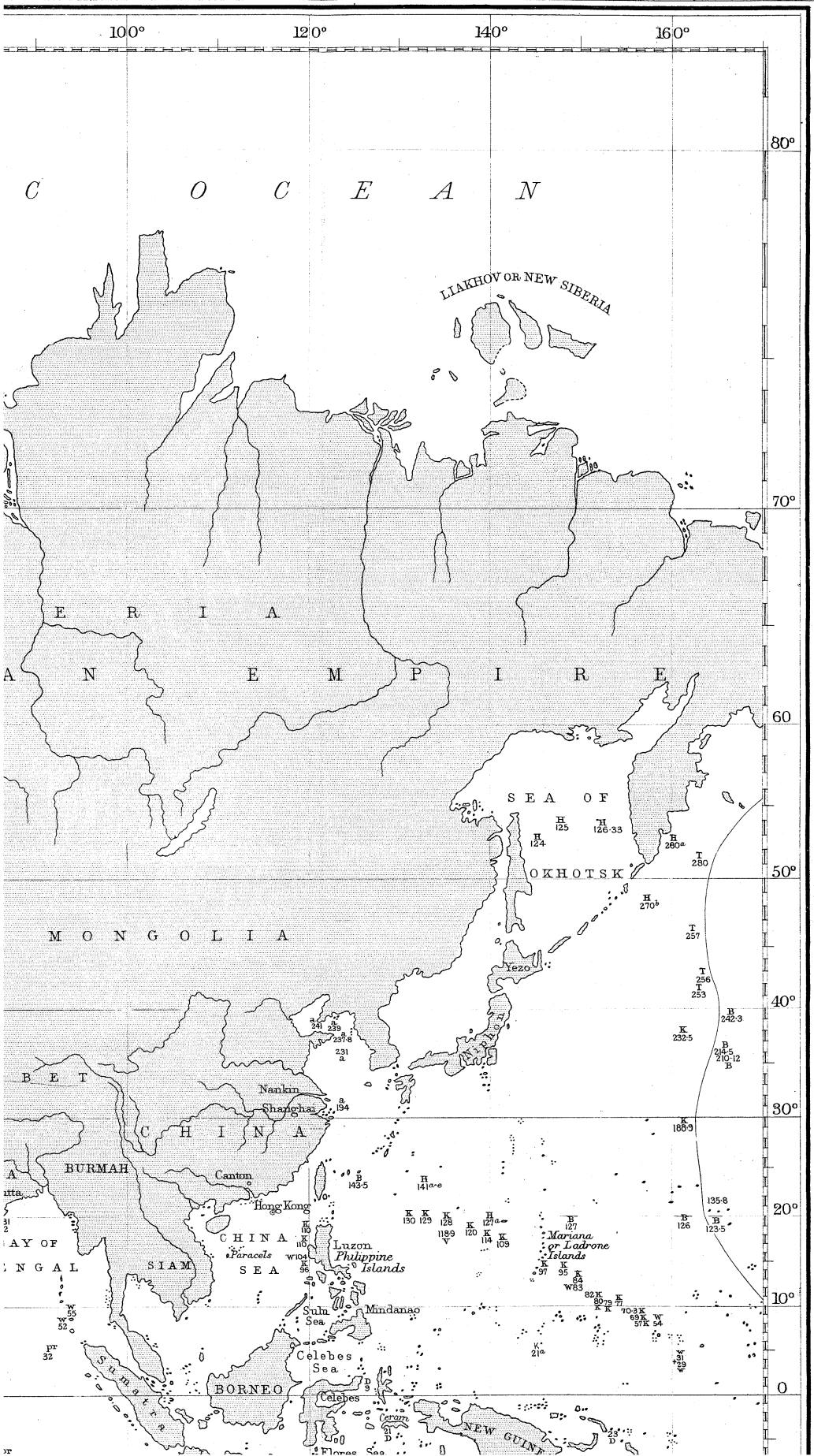
The initial letter of the observer is attached to each number.

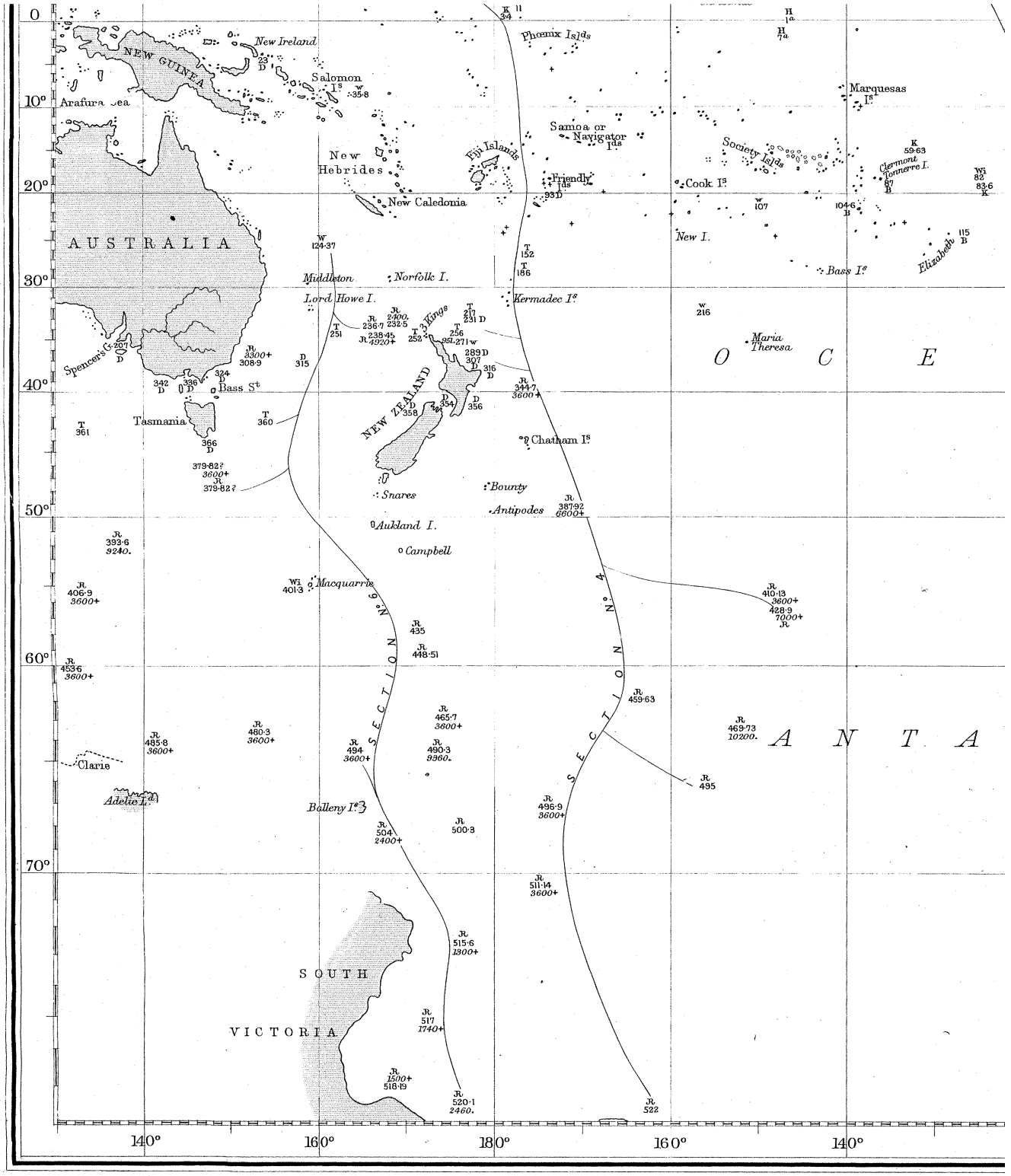
(See explanation of Map p. 672)



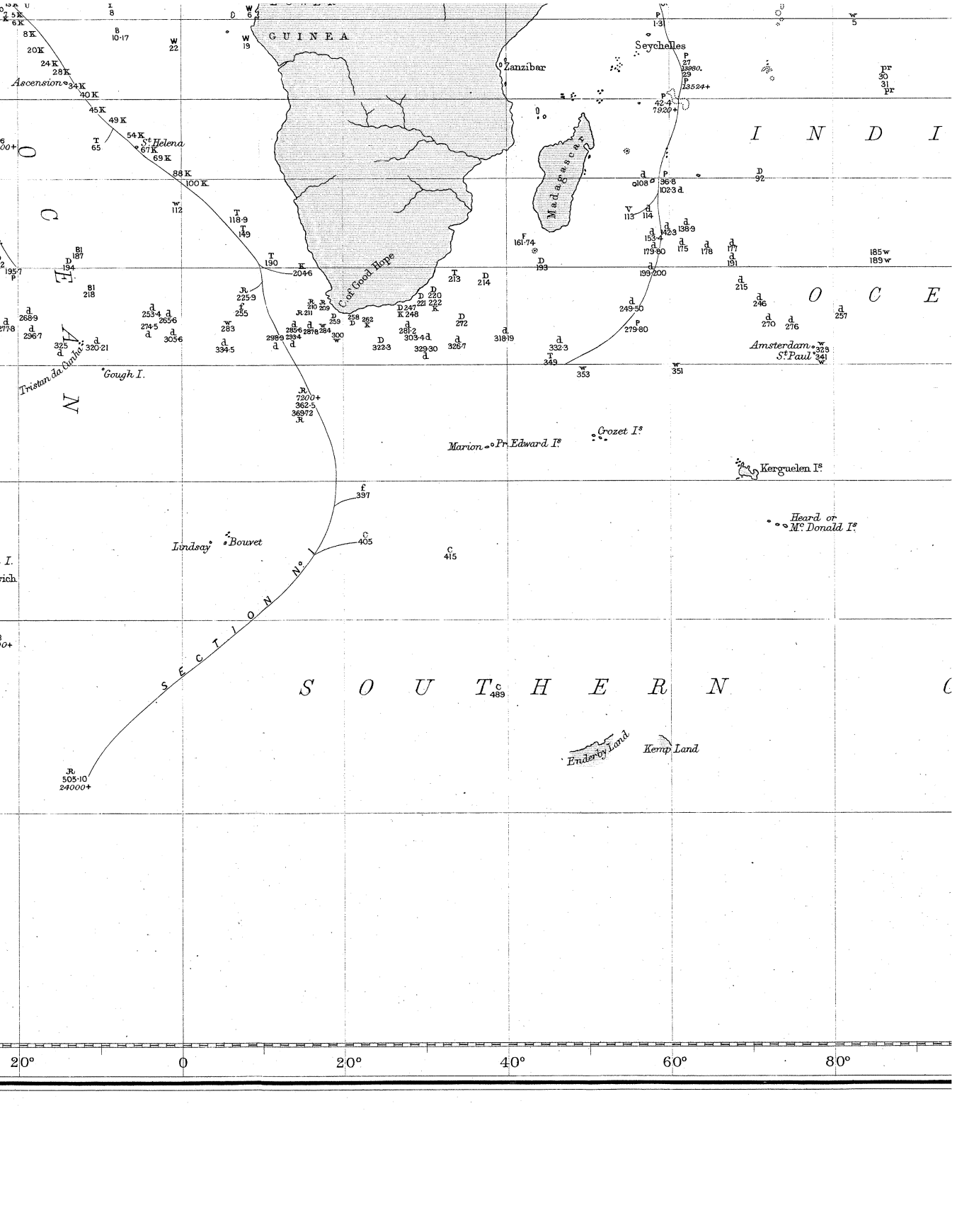

120°
100°
80°
60°
40°
20°
GRINNELL LAND
WASHINGTON LAND
ELLESMERE LAND
SMITH SOUND
PRUDHOE LAND
PARRY ISLANDS
GREENLAND
BAFFIN BAY
Barrow S.
Lancaster Sd.
Cockburn Id.
DAVIS STRAIT
ICELAND
Lyons Inlet
Fox Land
HUDSON BAY
RUPERTS LAND
C. Chidley
C. Farewell
BRITISH ISLANDS
NORTH AMERICA
LABRADOR
CANADA
Newfound land
SECTION No. I
ATLANTIC
UNITED STATES
CALIFORNIA
NewYork
WASHINGTON
Bermuda
Canary
MEXICO
GULF OF MEXICO
Bahama
St. Domingo
Virgin Is.
Jamaica
CARIBBEAN SEA
Cape Verde Is.
NEW GRANADA
Panama
Galapagos Is.
Las Rocas
Fernando de Noronha
Trinidad

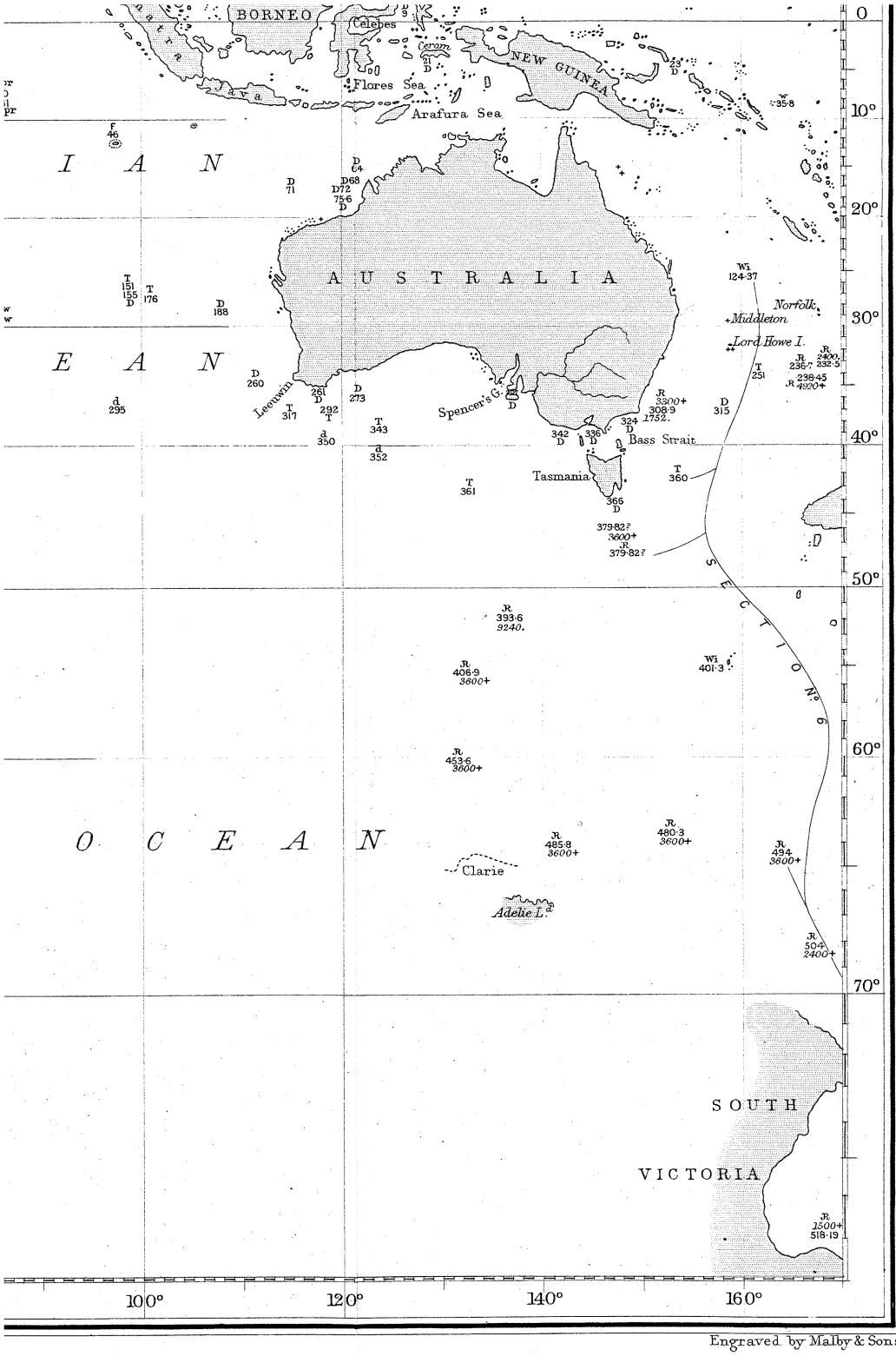

20°
0
20°
40°
60°
80°
ARCTIC
SPITZBERGEN
NOVA ZEMBLA
KARA SEA
Jan Mayen
North Cape
LAPLAND
SWEDEN
NORWAY
SECTION No. 2
ICELAND
SIBE
RUSSIA
St Petersburgh
Rockall
NORTH SEA
BRITISH ISLANDS
PRUSSIA
AUSTRIA
FRANCE
SPAIN
BLACK SEA
CASPIAN SEA
MEDITERRANEAN SEA
MOROCCO
ALGERIA
TRIPOLI
Alexandria
Suez
PERSIA
TIBE
Canary Is.
SAHARA OR GREAT DESERT
NUBIA
RED SEA
ARABIA
SCINDE
INDIA
Calcutta
Bombay
ARABIAN SEA
BAY OF BENGAL
Madras
Ceylon
Maldive Is.
Aden
Socotra
SECTION No. 5
Cape Verde Is.
SENEGAMBIA
GUINEA
SIERRA LEONE
ABYSSINIA
AFRICA
LOWER GUINEA
Seychelles
Zanzibar


100°
120°
140°
160°
80°
70°
60°
50°
40°
30°
20°
10°
0
C O C E A N
LIAKHOV OR NEW SIBERIA
E R I A
A N E M P I R E
SEA OF
OKHOTSK
M O N G O L I A
Yezo
B E T
Nankin
Shanghai
C H I N A
BURMAH
Canton
Hong Kong
CHINA SEA
Paracels
SIAM
Luzon
Philippine Islands
Mariana or Ladrone Islands
Sulu Sea
Mindanao
Celebes Sea
BORNEO
Celebes
Ceram
NEW GUINEA
SUMATRA


0
10°
20°
30°
40°
50°
60°
70°
140°
160°
180°
160°
140°
NEW GUINEA
New Ireland
Salomon Is
Arafura Sea
AUSTRALIA
New Hebrides
New Caledonia
Fiji Islands
Phœnix Isds
Samoa or Navigator Isds
Friendly Isds
Cook Is
Society Isds
Marquesas Is
Clermont Tonnerre I.
New I.
Bass Is
Elizabeth
Middleton
Norfolk I.
Lord Howe I.
Kermadec Is
Kings
Maria Theresa
Spencers G.
Bass St
Tasmania
NEW ZEALAND
Chatham Is
Snares
Bounty
Antipodes
Auckland I.
Campbell
Macquarrie
Clarie
Adelie L.
Balleny Is
SECTION No. 6
SECTION No. 4
SOUTH VICTORIA
A N T A
O C E


SOUTH
AMERICA
BRAZIL
PERU
PARAGUAY
URUGUAY
CHILI
LA PLATA
Lima
Bahia
Rio Janeiro
Buenos Ayres
Monte Video
Valparaiso
Galapagos Is
Waihou
Easter I.
Salas y Gomez
Felix
Ambrose
Masafuera
Juan Fernandez
Chiloe I.
Rio de la Plata
Las Rocas
St. Paul
Fernando de Noronha
Ascension
Trinidad
Martin Vaz
Falkland Is
C. Virgins
Magellan St.
Staten I.
Cape Horn
Diego Ramirez
Dougherty
Shag Rks
S. Georgia
Clerks
Traverse I.
Sandwich Land
S. Orkneys
Elephant I.
South Shetlands
I. Philippe Land
Graham Land
Petra I.
Alexander I.
SECTION No. 2
ANTARCTIC
OCEAN
12.0°
10.0°
8.0°
6.0°
4.0°
2.0°

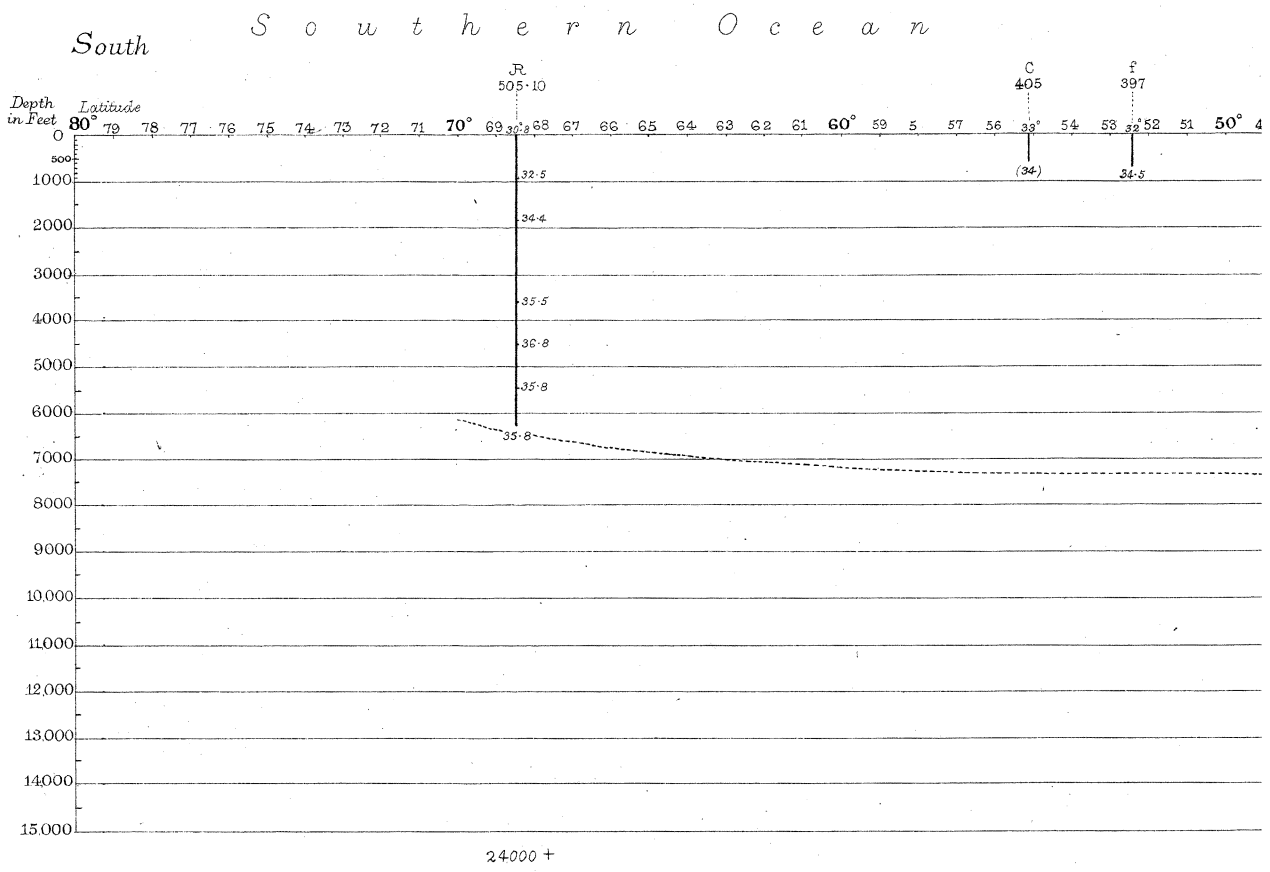

GUINEA
Zanzibar
Seychelles
Ascension
St Helena
Madagascar
C. of Good Hope
I N D I
O C E
A T L
N
Tristan da Cunha
Gough I.
Marion
Pr. Edward Is
Grozet Is
Kerguelen Is
Amsterdam
St Paul
Heard or
Mc Donald Is
Lindsay
Bouvet
SECTION N° I
S O U T H E R N
Enderby Land
Kemp Land
20°
0
20°
40°
60°
80°



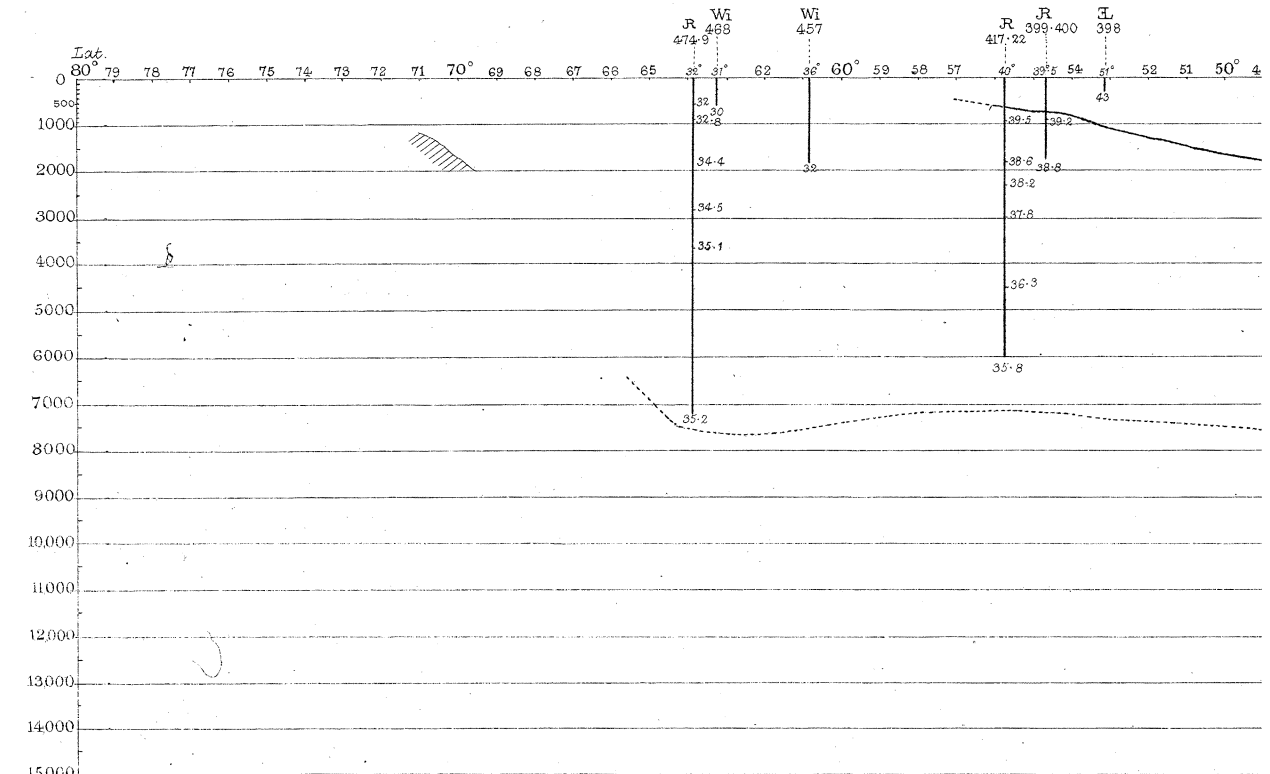
Engraved by Malby & Sons.

Prestwich.

1. From

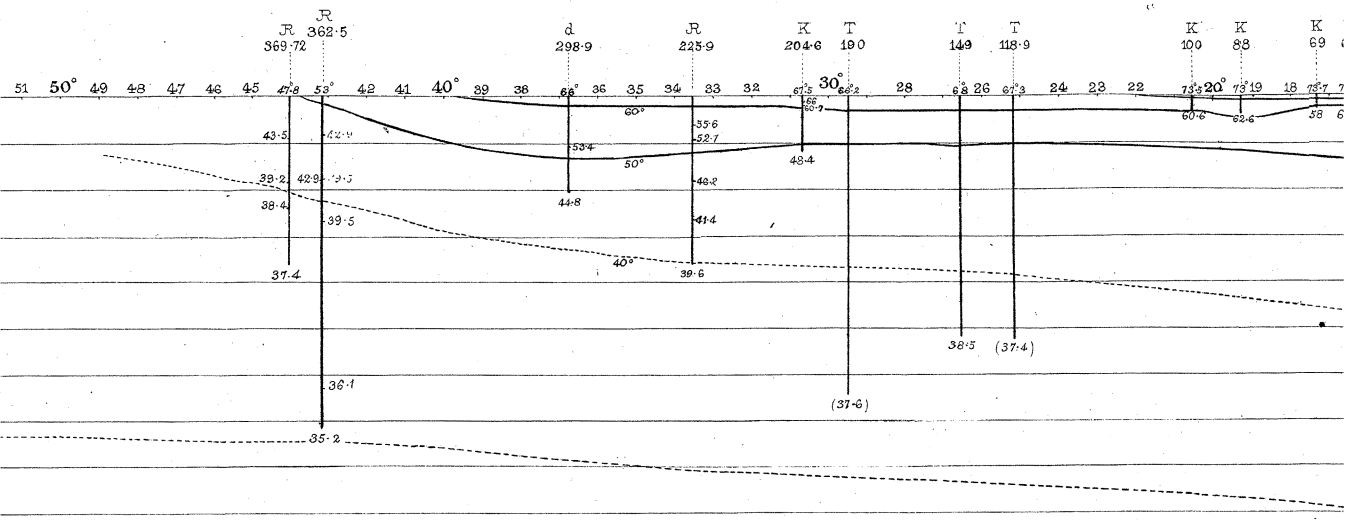


2. From th



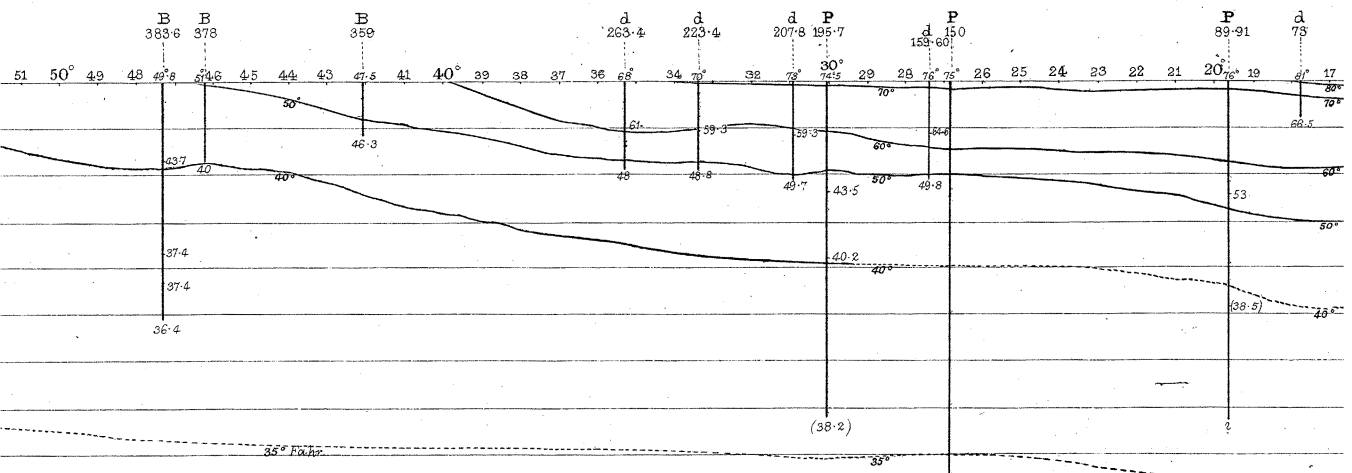
rom the Antarctic Ocean in Longitude 12° W.,

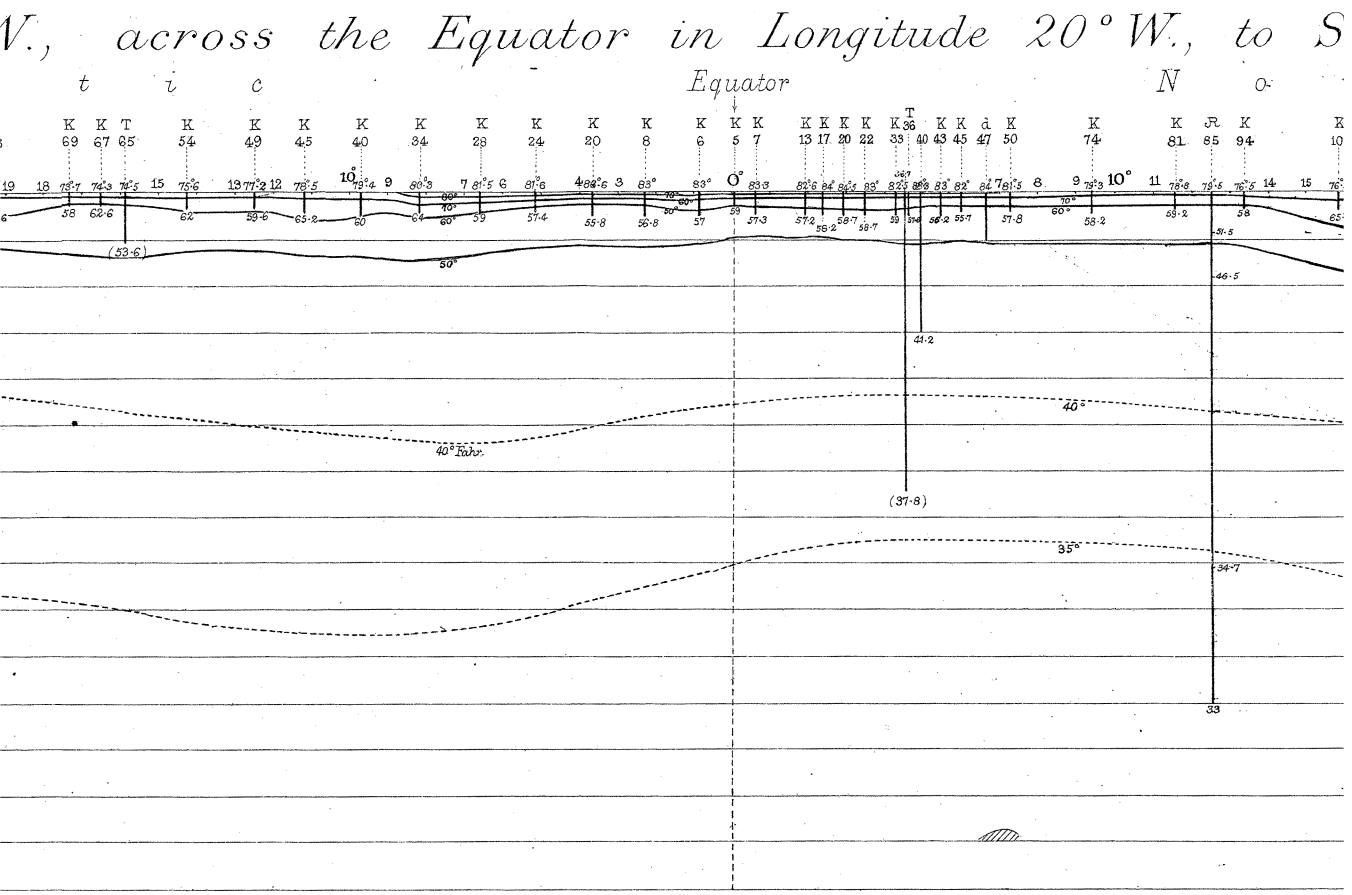
S o u t h A t l a n t

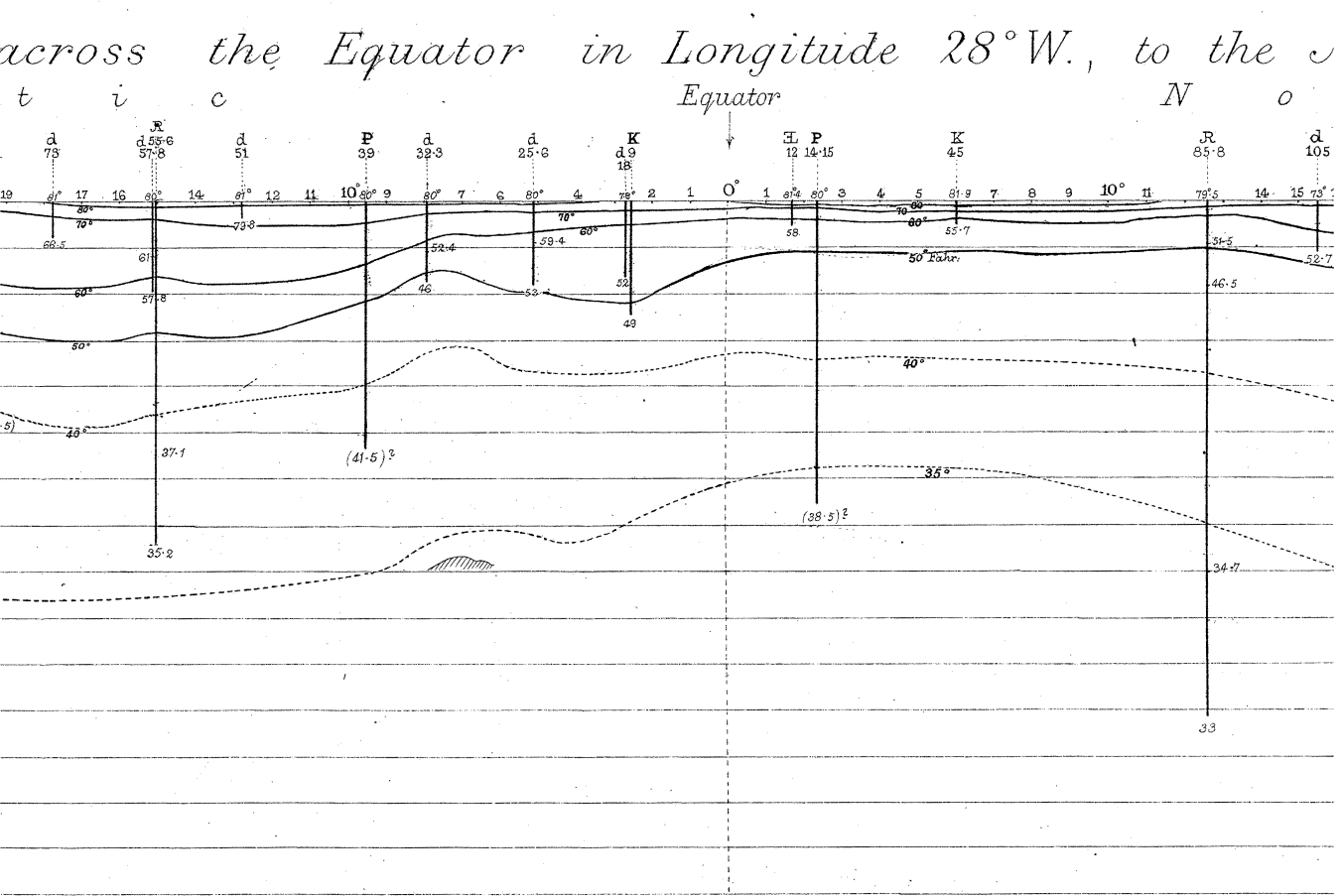


the South Shetland in Longitude 52° W., acro

S o u t h A t l a n t

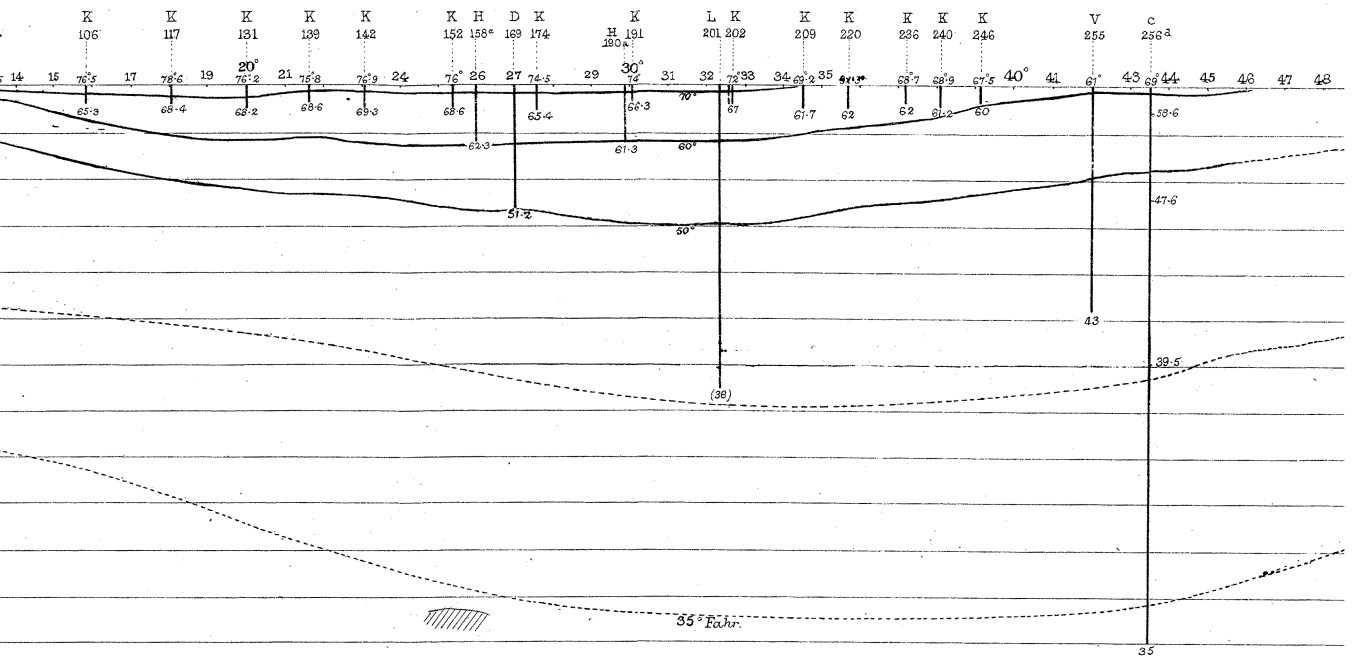



V., across the Equator in Longitude 20° W., to S
t i c
Equator
N o
(53·6)
50°
46·5
41·2
40°
40° Fahr.
(37·8)
35°
34·7
33


across the Equator in Longitude 28° W., to the
t i c
Equator
N o
70°
60°
50° Fahr.
46·5
40°
37·1
(41·5)²
35·2
(38·5)²
35°
34·7
33

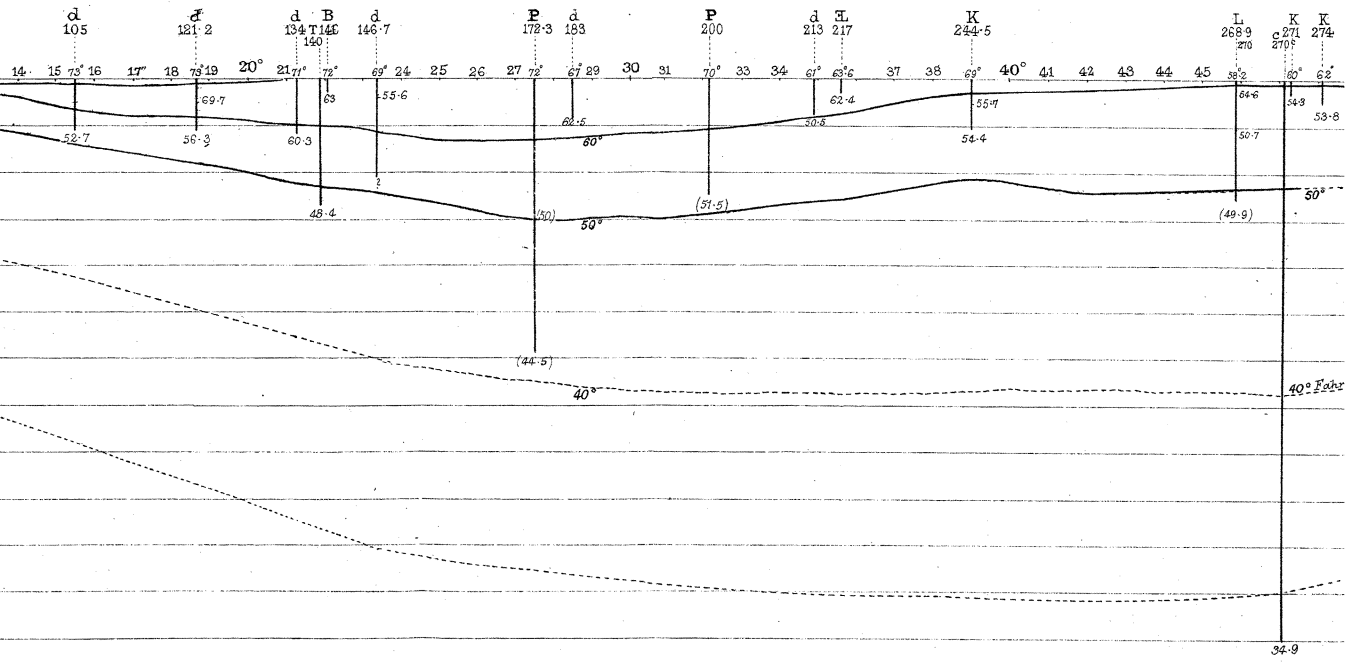
o Smith Sound, Baffin Bay, in Longitude 76° W.

o r t h A t l a n t i c

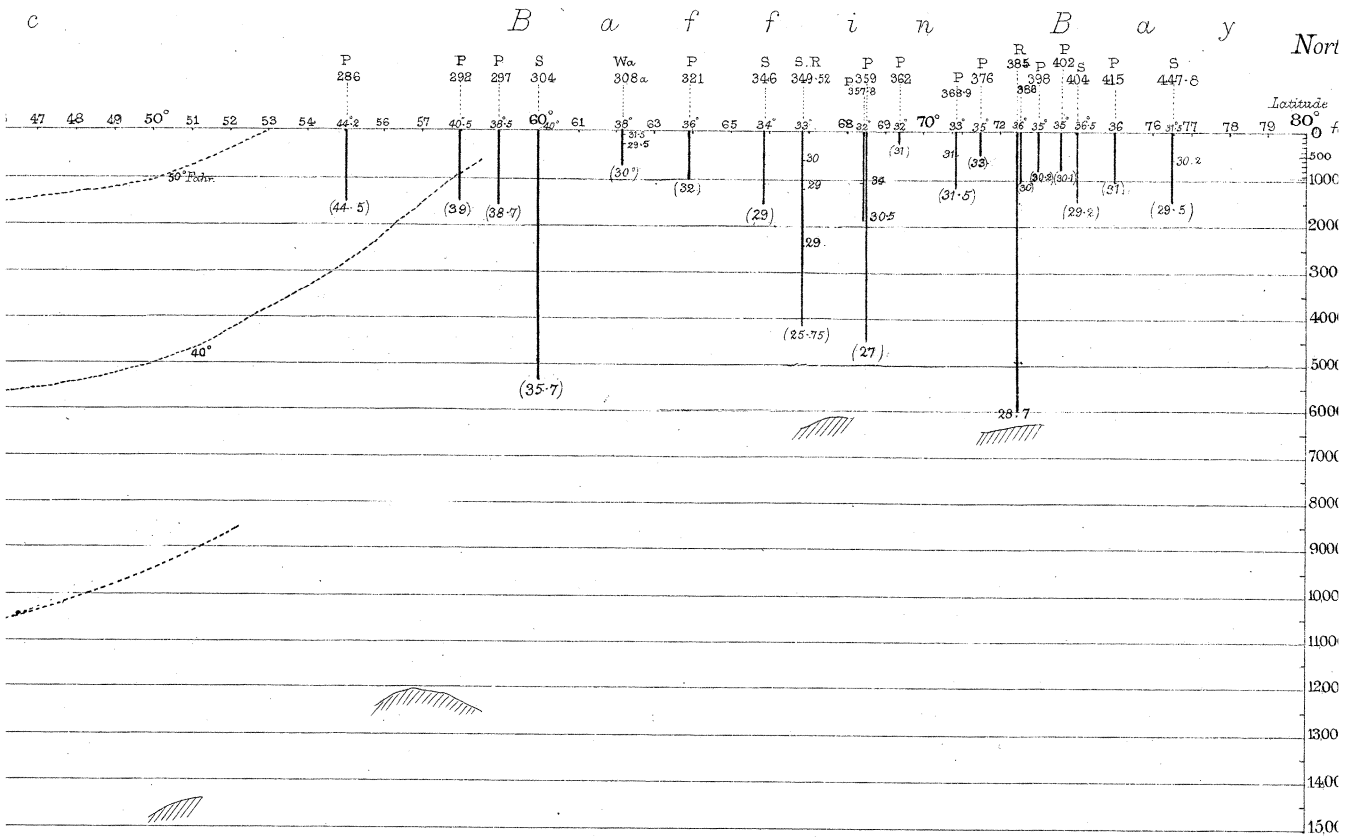


he Arctic Ocean North of Spitzbergen in Long. 12

o r t h A t l a n



W.


c
B a f f i n B a y
Nort
Latitude
50° Fahr.
40°

g. 12° E.

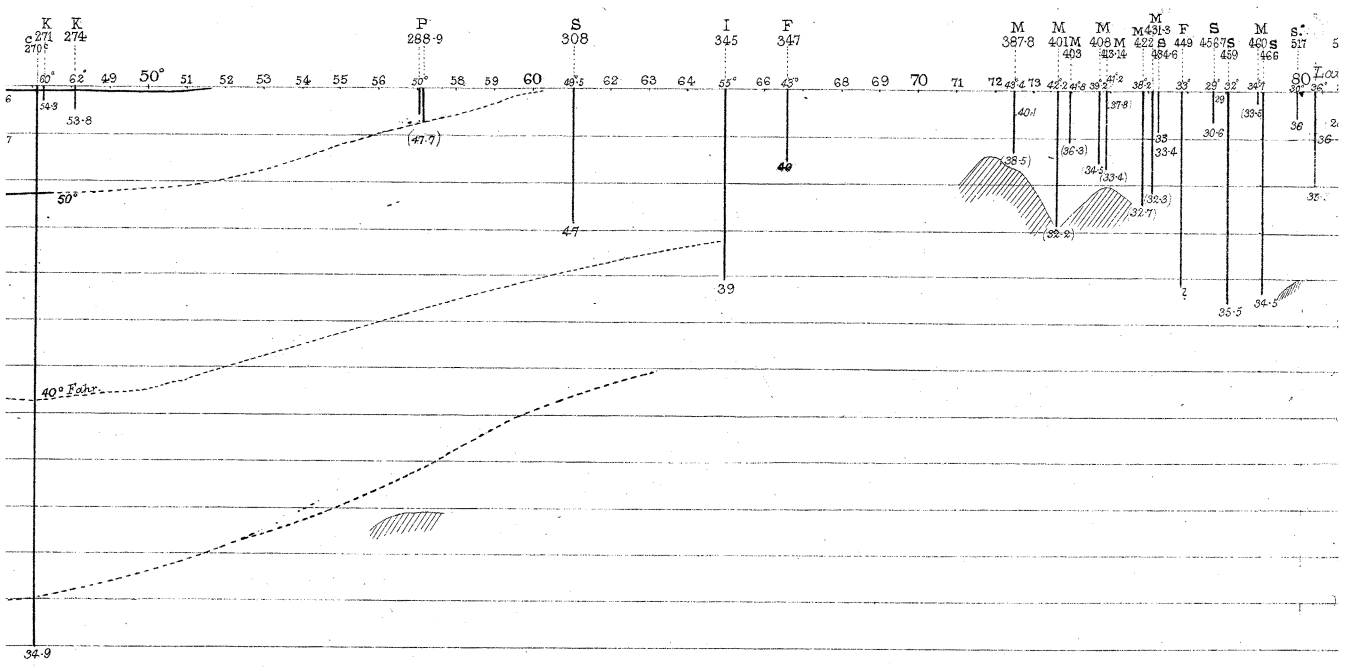
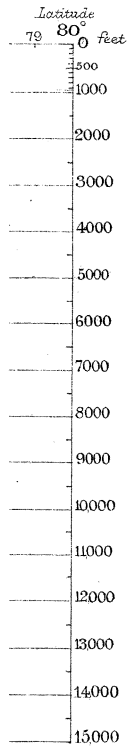
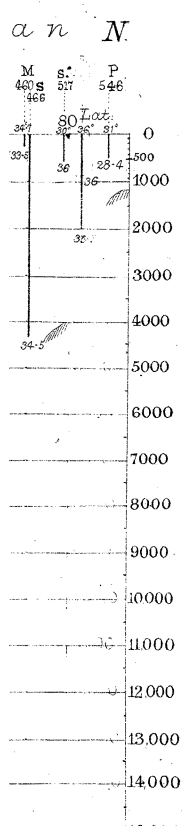

t i c
A r c t i c O c e a n
50°
40° Fahr.

Plate 66.

North



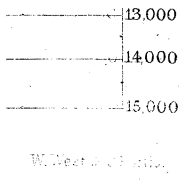



14000
15000

AT LA

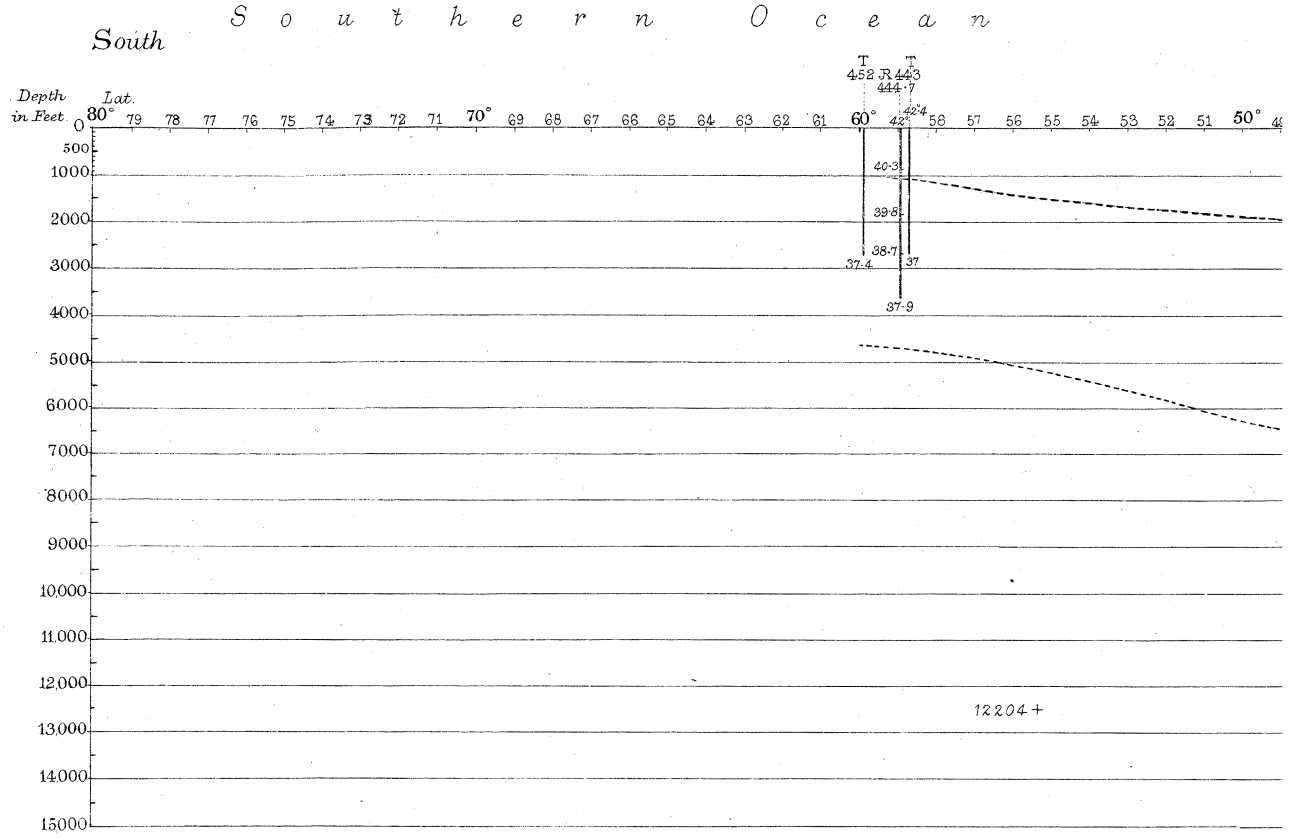
LANTIC TEMPERATURE – SECTI

TIONS.

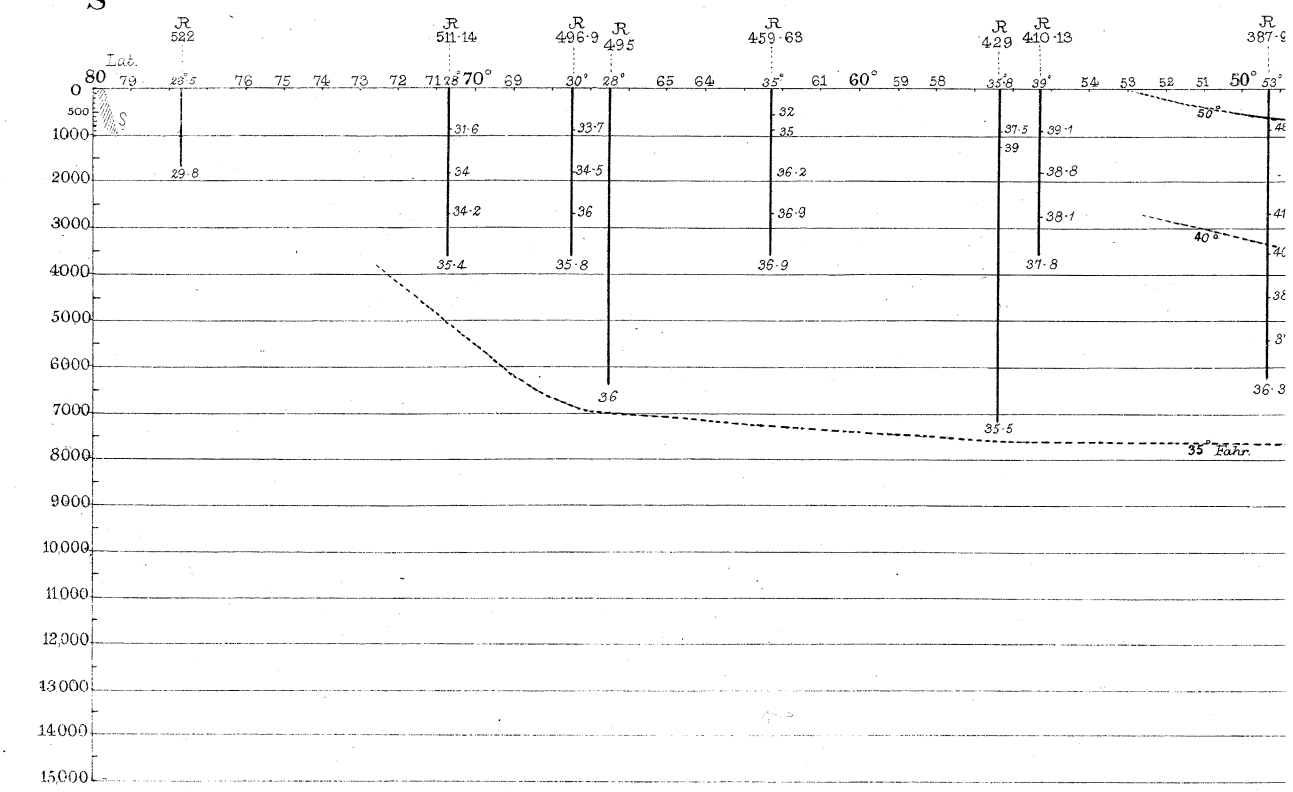

13,000
14,000
15,000

Prestwich.

3. From the Southern

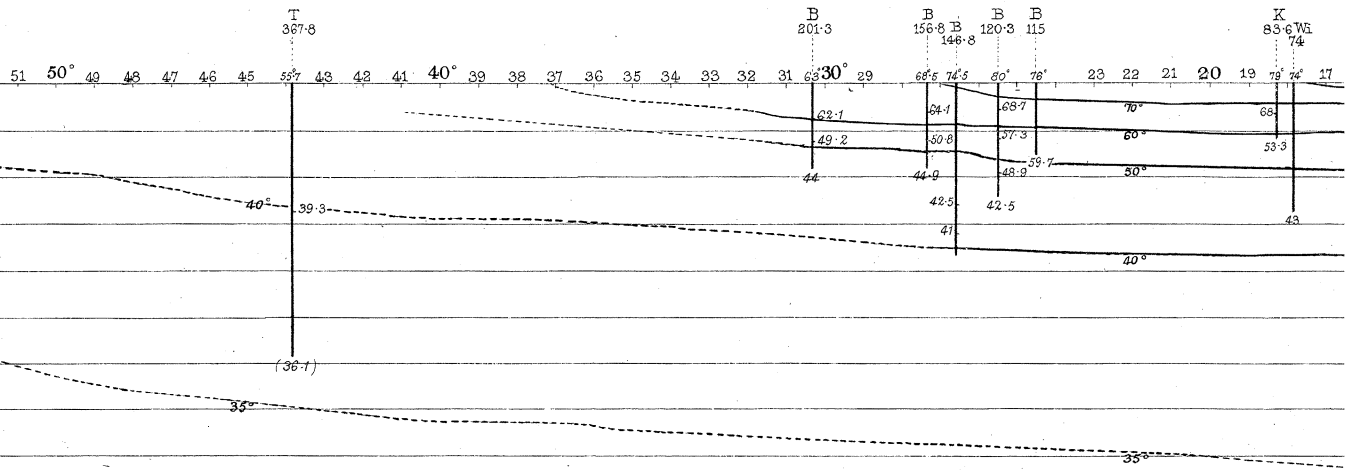


4. From the Antarctic



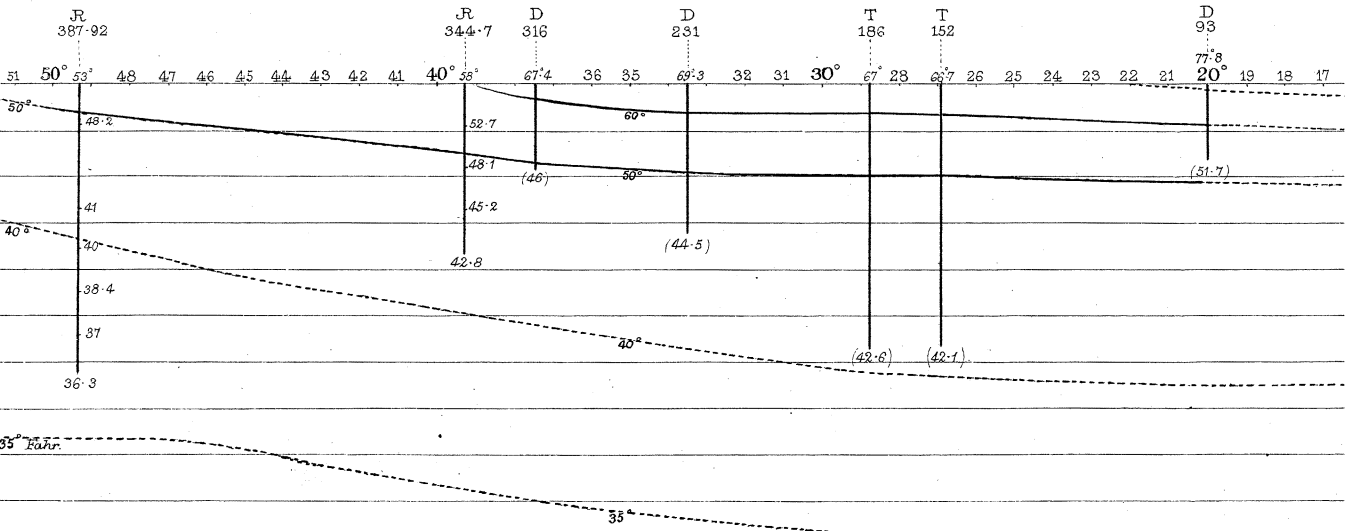
hern Ocean S. W. of Cape Horn, Longitude 80° W., a

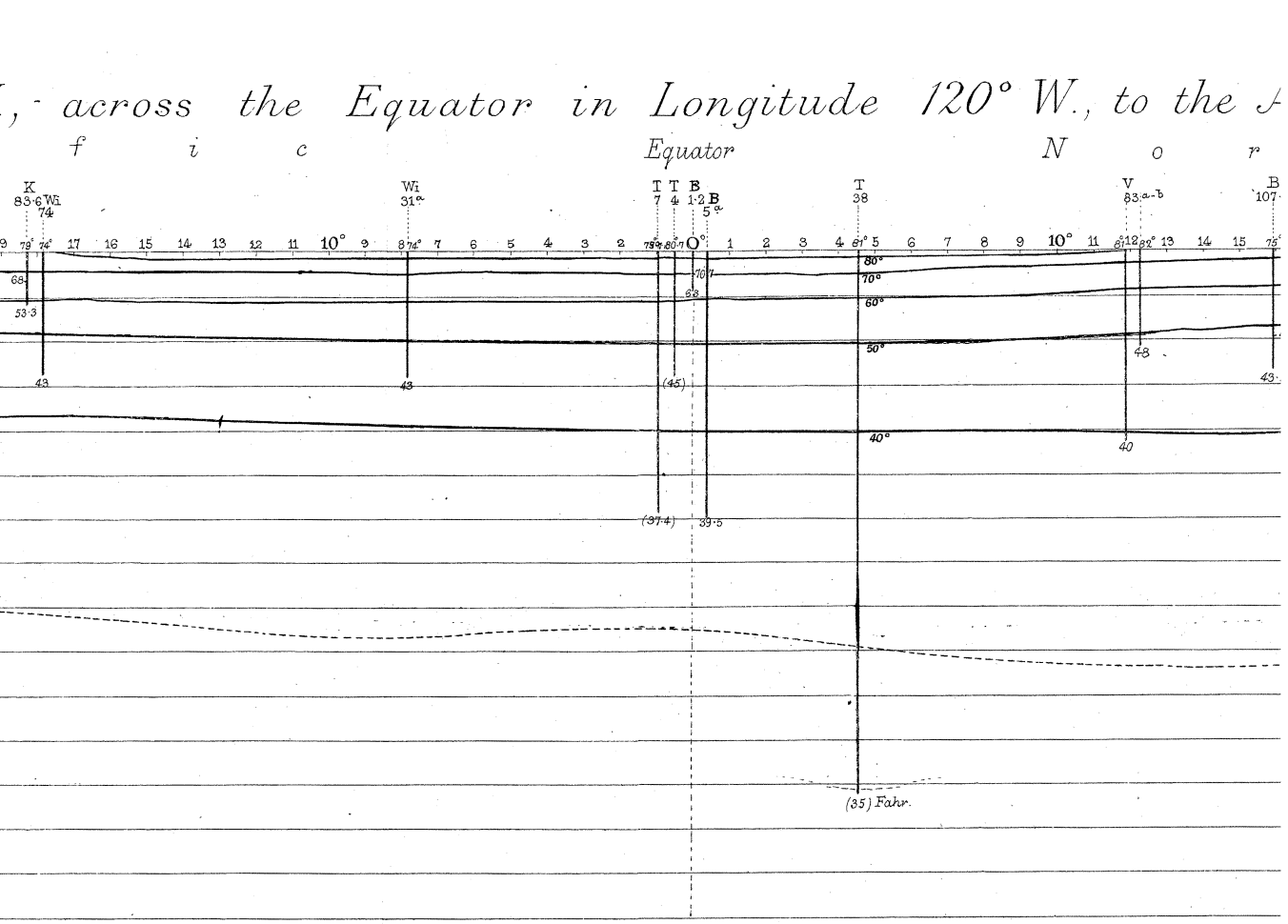
S o u t h P a c i f

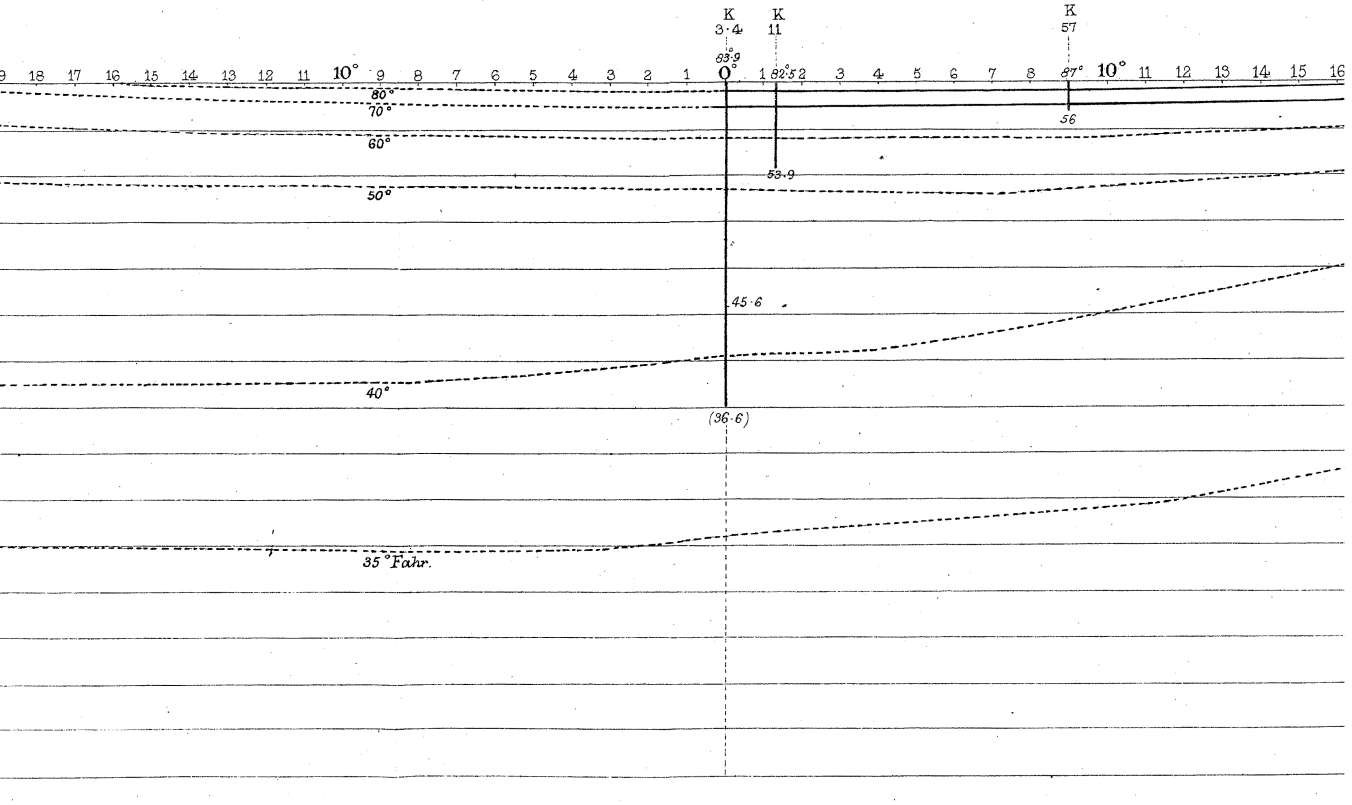


rctic Continent in Longitude 160° W., across the

S o u t h P a c i

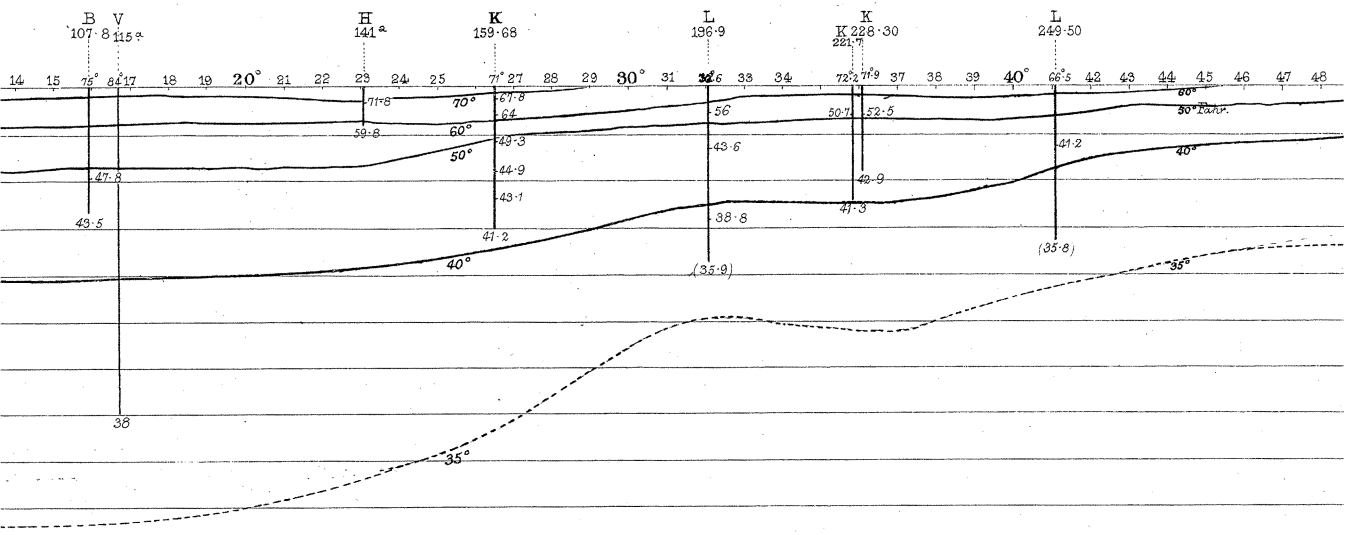



K 83·6 Wi 74
Wi 31ª
T 7 T 4 B 1·2 B 5ª
T 38
V 83 a-b
B 107
Equator
80°
70°
60°
50°
40°
68
53·3
43
43
(45)
70·7
68
48
43
(37·4)
39·5
40
(35) Fahr.


K 3·4 K 11
K 57
Equator.
80°
70°
60°
50°
40°
63·9
53·9
56
45·6
(36·6)
35° Fahr.

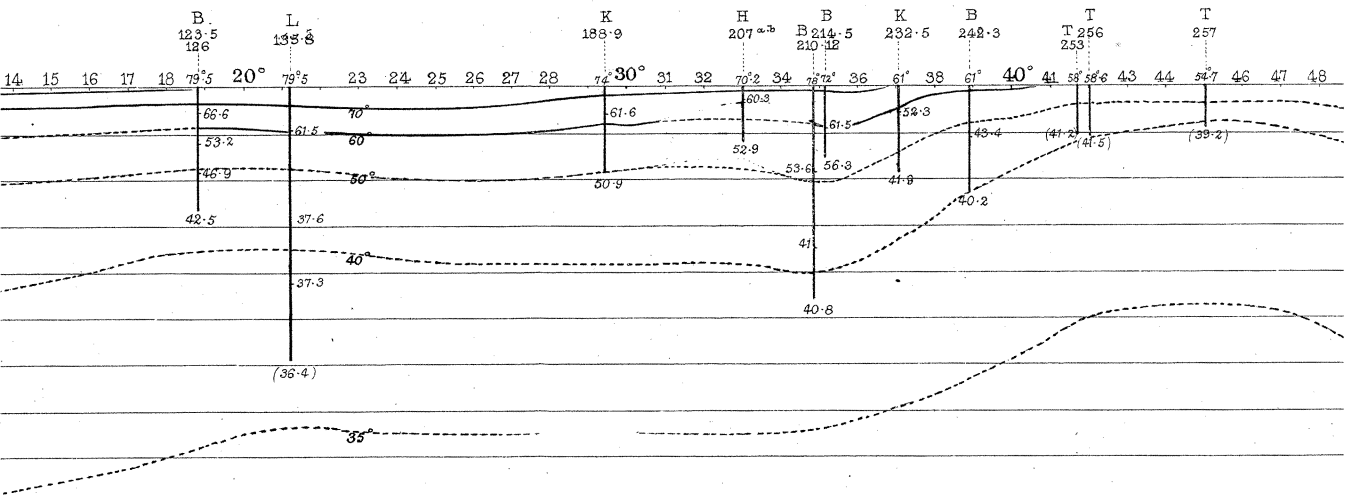
he Arctic Ocean, North of Behrings Strait in Longit

r t h · P a c i f



of Kamtschatka in Longitude 176° E.

o r t h · P a c i f i c

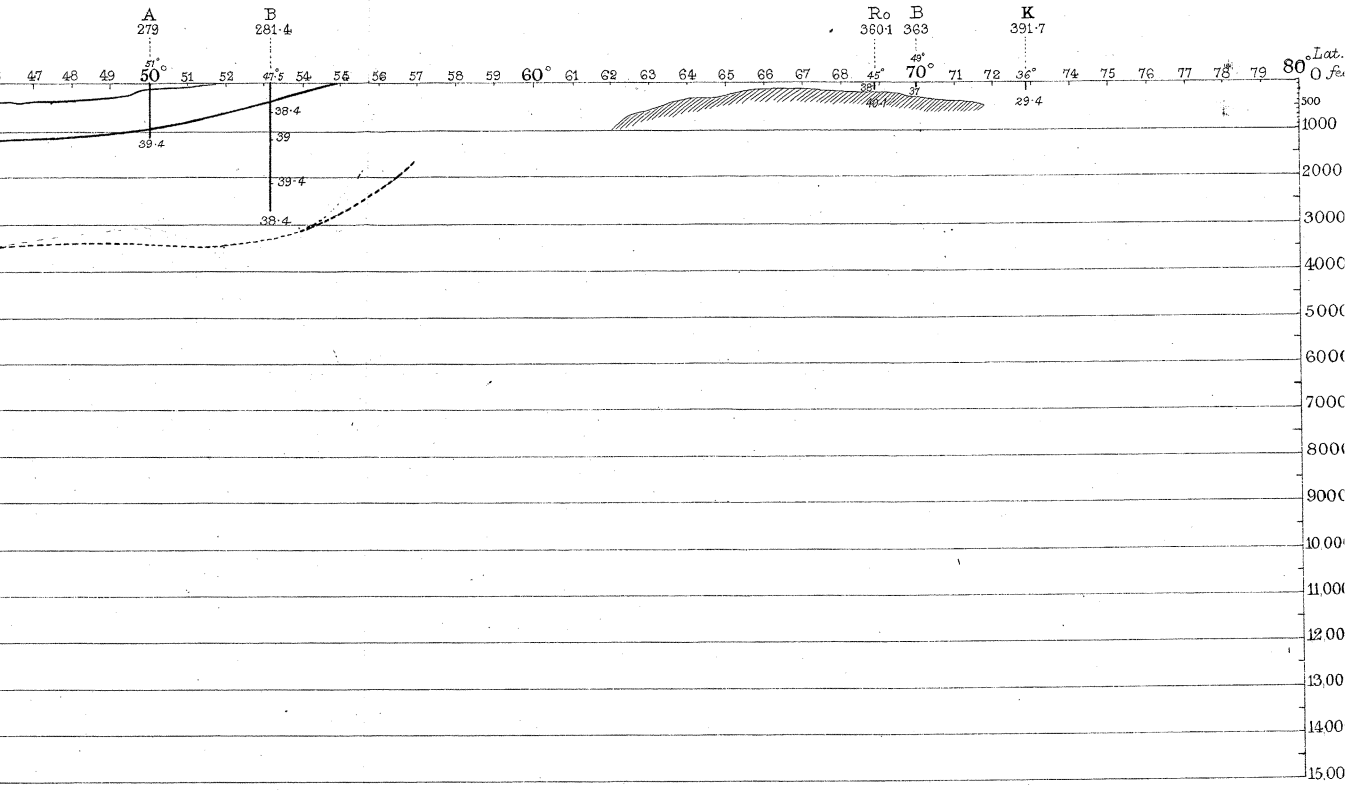


ngitude 164 W.

f i c

Arctic Ocean

North



c

N

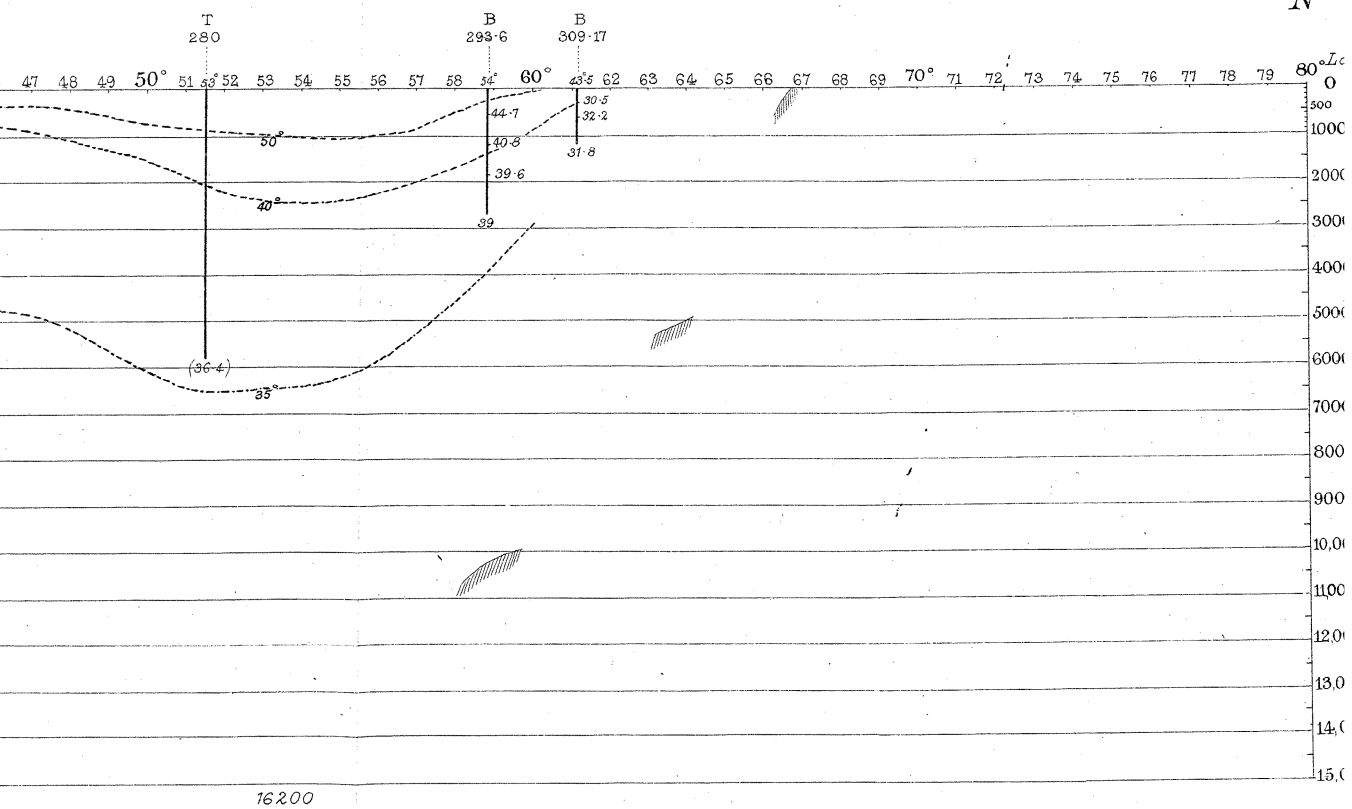
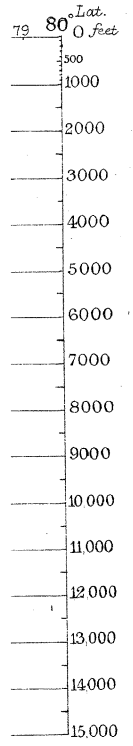
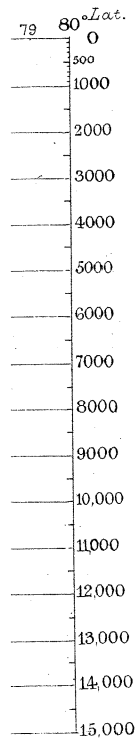


Plate 67.

North

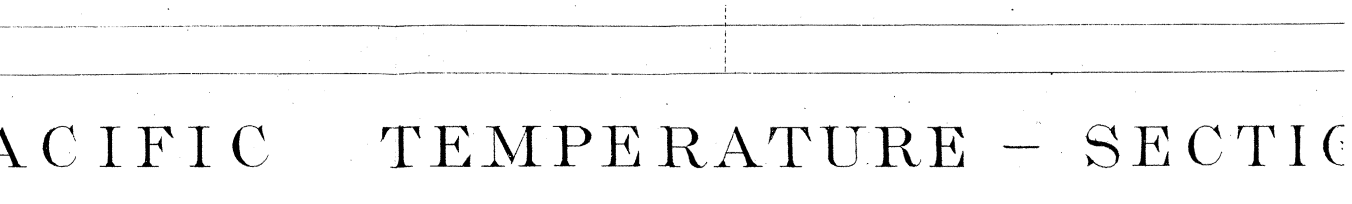


N

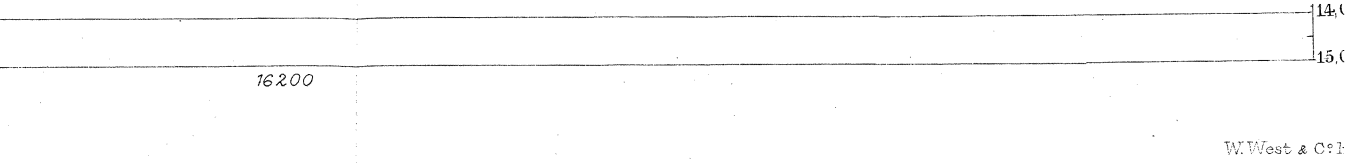



14000
15000

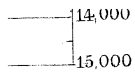
PAC


ACIFIC TEMPERATURE – SECTIO

TIONS.



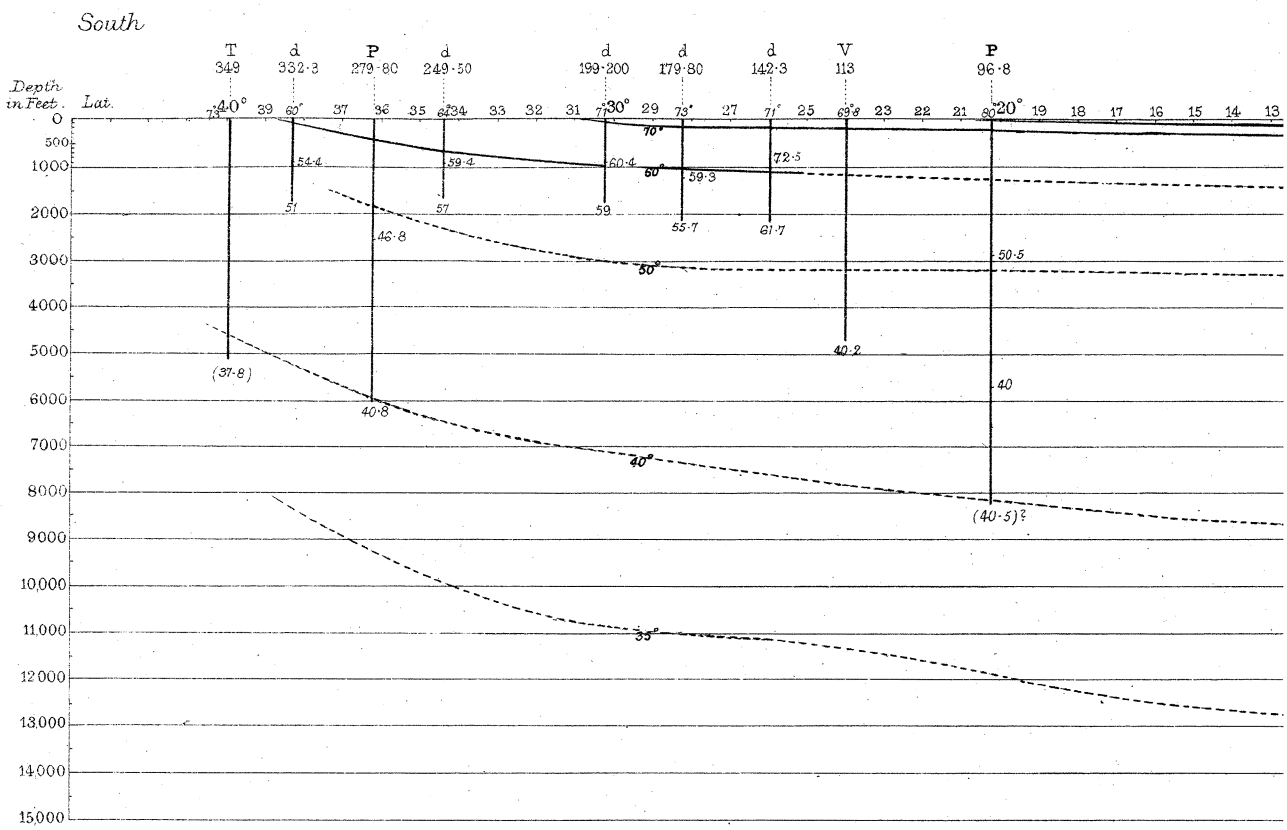
W. West & Co. l



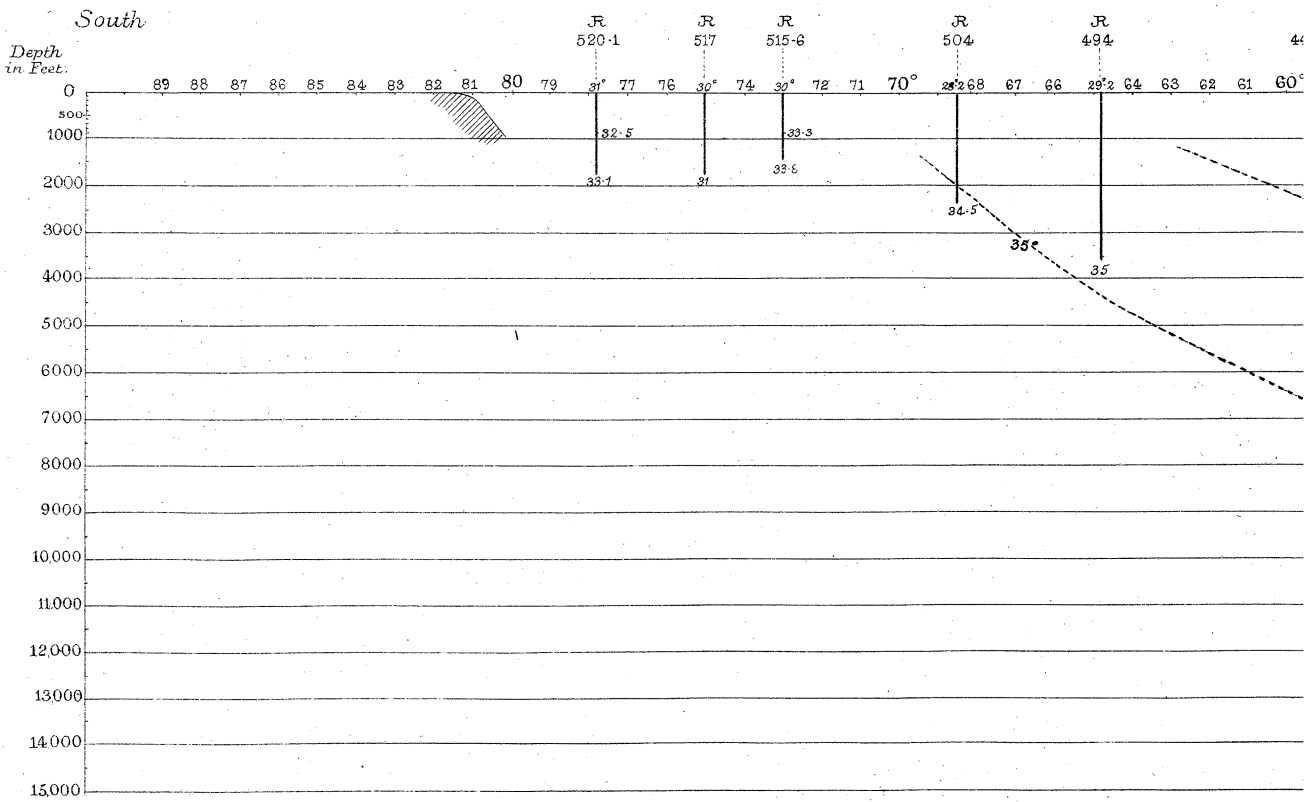
West & Co. lith.

Prestwich.

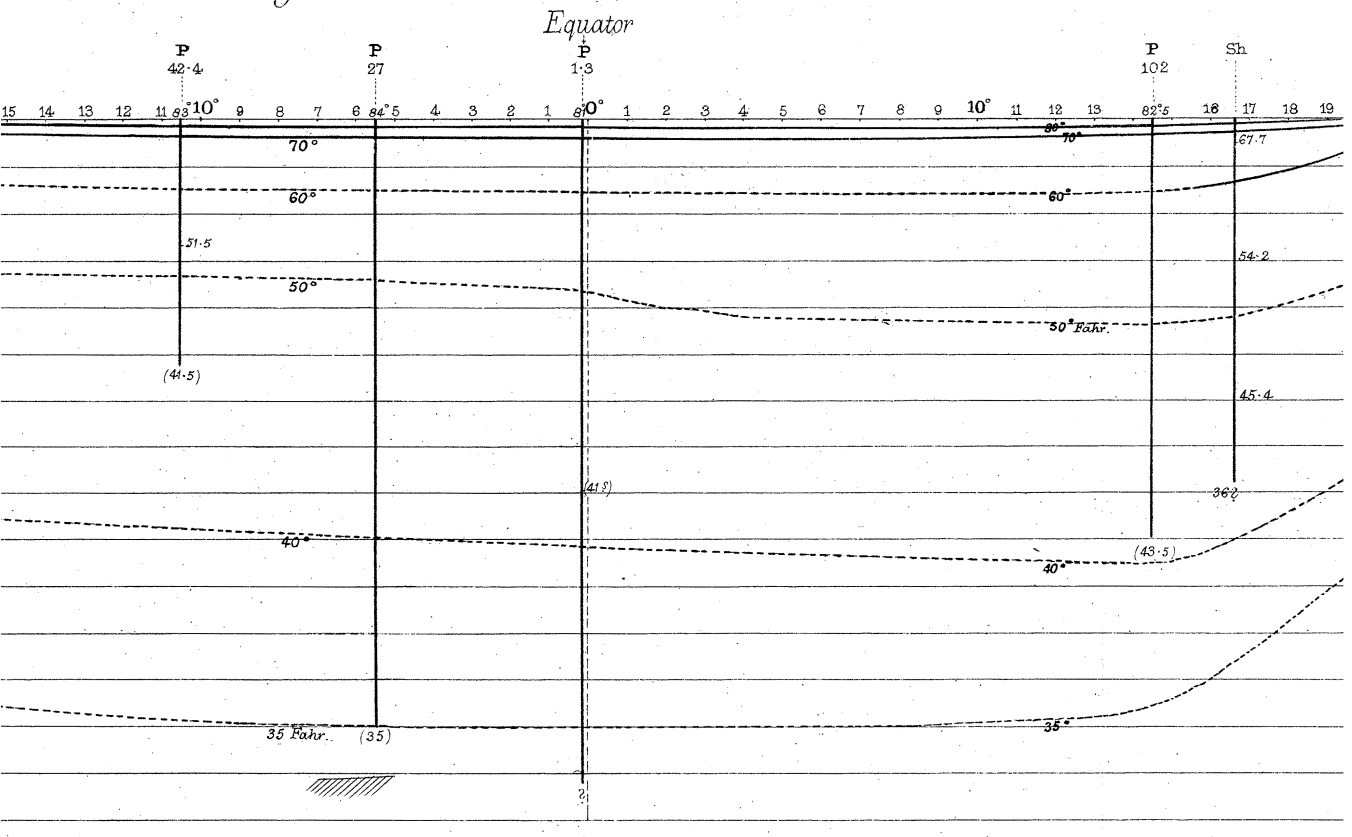
5. From the Indian Ocean Lat. 40° South,



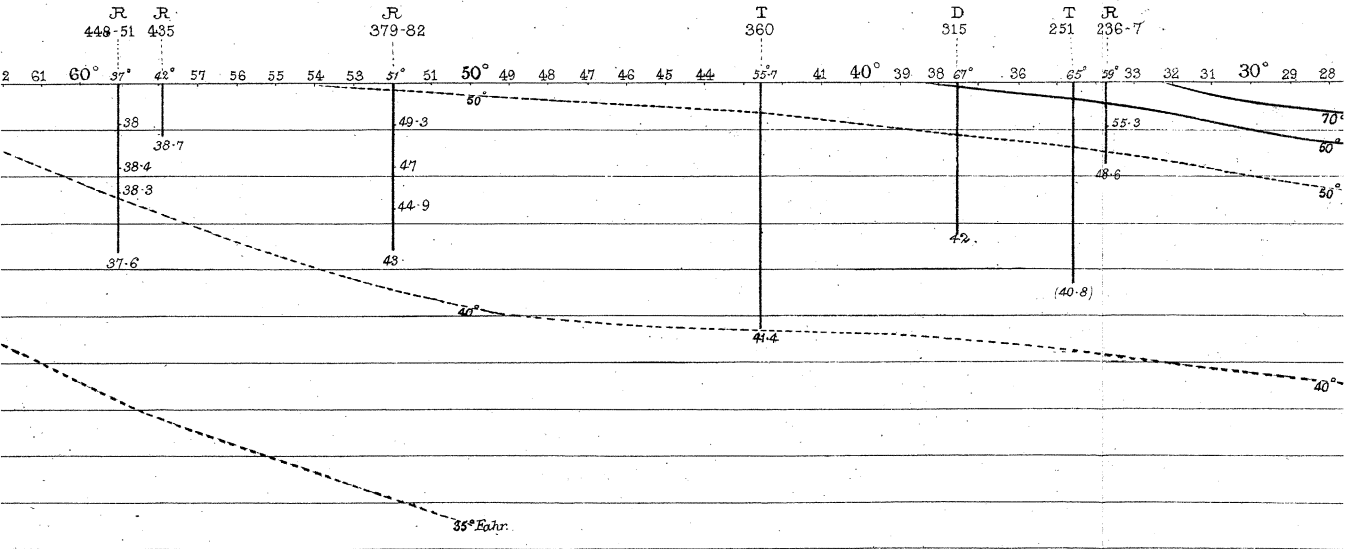
6. From South Victoria Land in Lat. 78° South



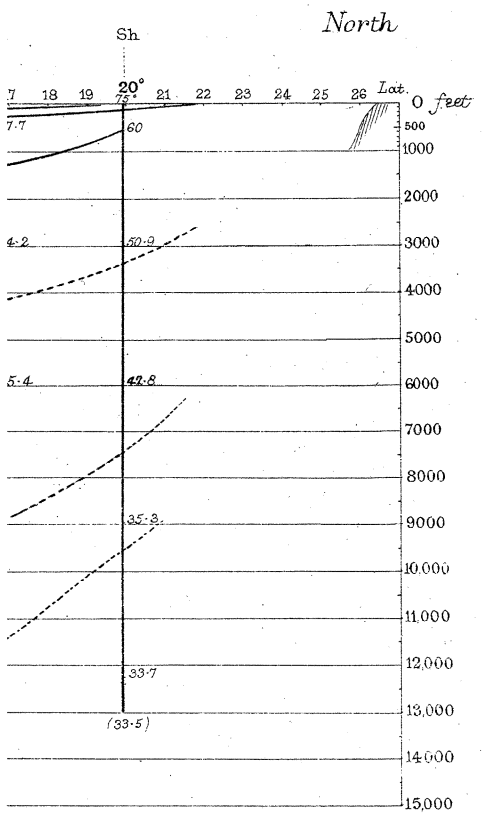
uth, and Long. 46° East, to the Arabian Sea in Lat. 20° N



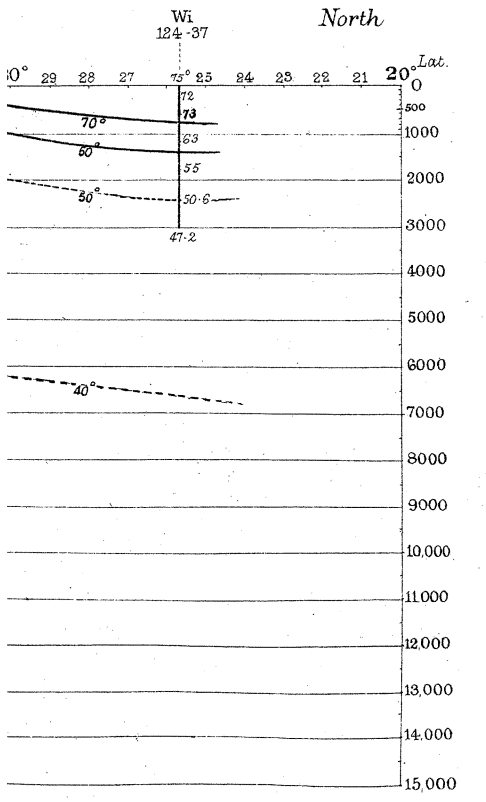
uth and Long. 180° East, to the East Coast of Australia in L

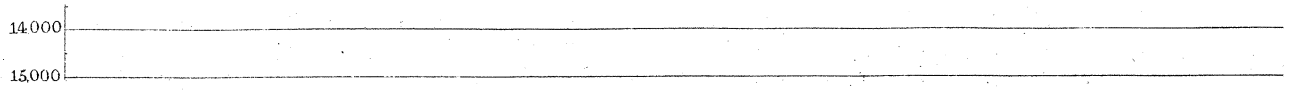


20° North.



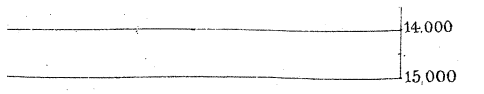
in Lat. 25° S.





TEMPERATURE – SECTIONS IN

S IN THE INDIAN AND SOUTHERN OCEANS.



W. West & Co lith.

PLAN-MAP OF

DEEP-SEA TEMPERATURE SOUNDINGS

1749 TO 1868.

The ordinary numbers correspond with those of the observations recorded in Tables I, II, III.

The numbers in italics with a stop, show where further soundings have found bottom; where no bottom has been reached the sign + is added.

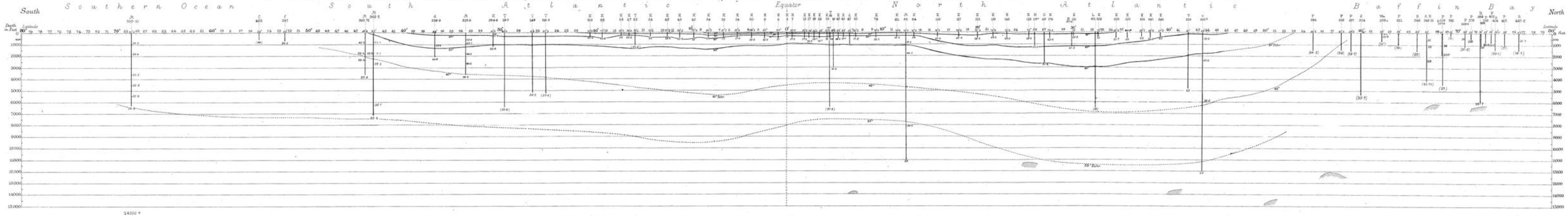
The initial letter of the observer is attached to each number.

(See explanation of Map p. 672

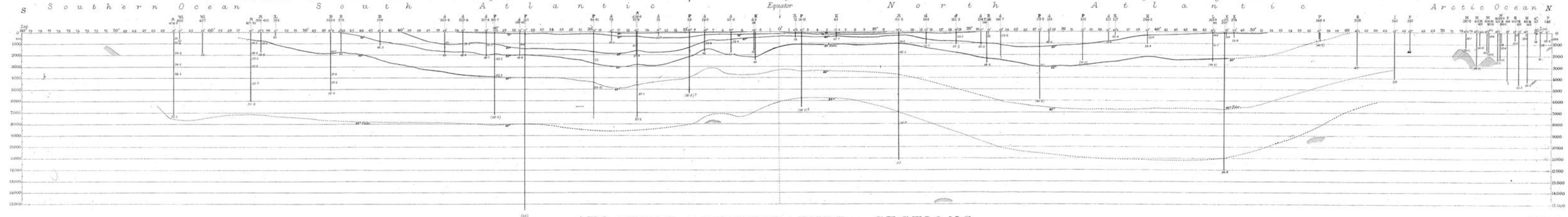
GRINNELL LAND
WASHINGTON LAND
ELLESMERE LAND
SMITH SOUND
PRUDHOE LAND
PARRY ISLANDS
GREENLAND
BAFFIN BAY
DAVIS STRAIT
ICELAND
SPITZBERGEN
NOVA ZEMBLA
KARA SEA
LIAKHOV OR NEW SIBERIA
LAPLAND
SIBERIA
HUDSON BAY
RUPERTS LAND
LABRADOR
BRITISH AMERICA
NORTH AMERICA
CANADA
UNITED STATES
CALIFORNIA
MEXICO
GULF OF MEXICO
CARIBBEAN SEA
NEW GRANADA
SOUTH AMERICA
PERU
BRAZIL
PARAGUAY
LA PLATA
CHILI
ATLANTIC OCEAN
NORTH SEA
BRITISH ISLANDS
NORWEGIAN SECTION
SWEDEN
RUSSIA
EUROPE
PRUSSIA
AUSTRIA
FRANCE
SPAIN
MEDITERRANEAN SEA
BLACK SEA
CASPIAN SEA
PERSIA
ALGERIA
MOROCCO
TRIPOLI
SAHARA OR GREAT DESERT
NUBIA
ARABIA
ABYSSINIA
SENEGAMBIA
GUINEA
SIERRA LEONE
AFRICA
LOWER GUINEA
ZANZIBAR
MADAGASCAR
SEYCHELLES
INDIAN OCEAN
SCINDE
ARABIAN SEA
BOMBAY
CALCUTTA
MADRAS
CEYLON
MALDIVE I.
BAY OF BENGAL
INDIA
BURMAH
SIAM
CHINA SEA
TIBET
MONGOLIA
SEA OF OKHOTSK
CHINA
CANTON
HONG KONG
BORNEO
CELEBES SEA
MOLUCCAS
PHILIPPINE ISLANDS
NEW GUINEA
ARAFURA SEA
AUSTRALIA
TASMANIA
NEW ZEALAND
NEW CALEDONIA
NEW HEBRIDES
SOLOMON
NEW IRELAND
CAROLINE ISLANDS
MARIANNE ISLANDS
PACIFIC OCEAN
JAPAN SEA
YEDO
KAMTSCHATKA
ALEUTIAN ISLANDS
SANDWICH I.
BONIN I.
GALAPAGOS I.
MARQUESAS
SOCIETY I.
COOK I.
NORFOLK I.
LORD HOWE I.
KERMADEC I.
CHATHAM I.
AUCKLAND I.
CAMPBELL
MACQUARIE
ANTARCTIC OR SOUTHERN OCEAN
SOUTH VICTORIA
SOUTH GEORGIA
SOUTH SHETLANDS
SANDWICH LAND
GRAHAM LAND
ALEXANDER I.
PETER I.
TRISTAN DA CUNHA
GOUGH I.
MARION
PRINCE EDWARD I.
CROZET I.
KERGUELEN I.
HEARD OR M.DONALD I.
AMSTERDAM
ST PAUL
ENDERBY LAND
KEMP LAND
CLARIE
ADELIE L.

Engraved by Malby & Sons

1. *From the Antarctic Ocean in Longitude 12° W., across the Equator in Longitude 20° W., to Smith Sound, Baffin Bay, in Longitude 76° W.*

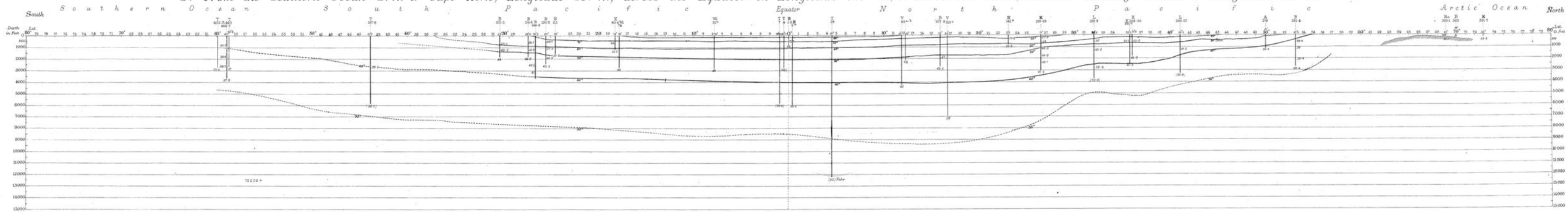


2. *From the South Shetland in Longitude 52° W., across the Equator in Longitude 28° W., to the Arctic Ocean North of Spitzbergen in Long. 12° E.*

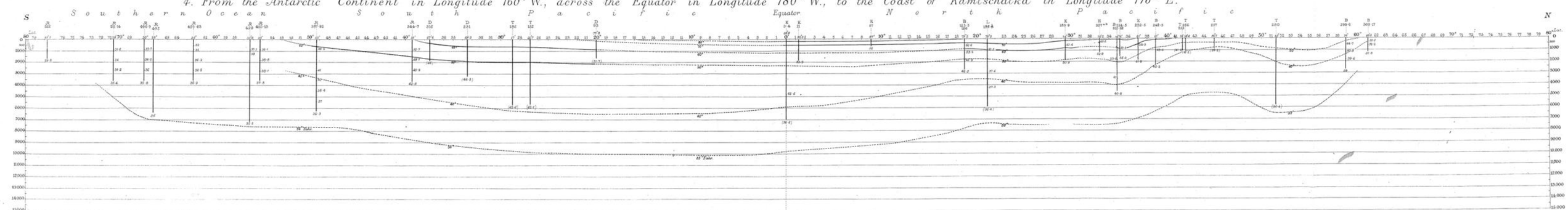


ATLANTIC TEMPERATURE – SECTIONS.

3. From the Southern Ocean S.W. of Cape Horn, Longitude 80° W., across the Equator in Longitude 120° W., to the Arctic Ocean, North of Behrings Strait in Longitude 164 W.

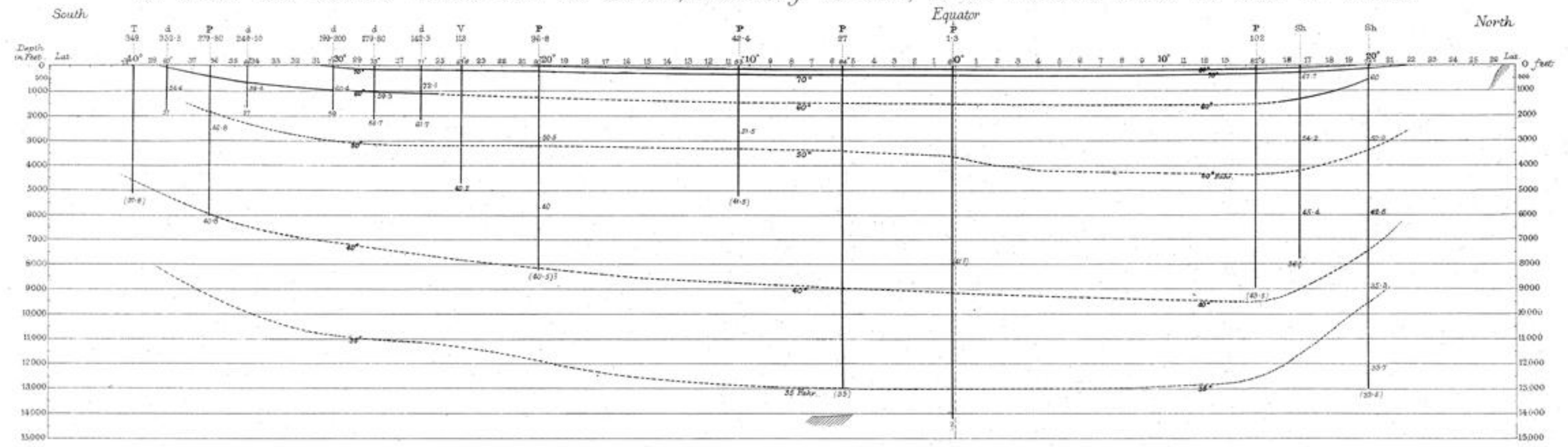


4. From the Antarctic Continent in Longitude 160° W., across the Equator in Longitude 180° W., to the Coast of Kamtschatka in Longitude 176° E.

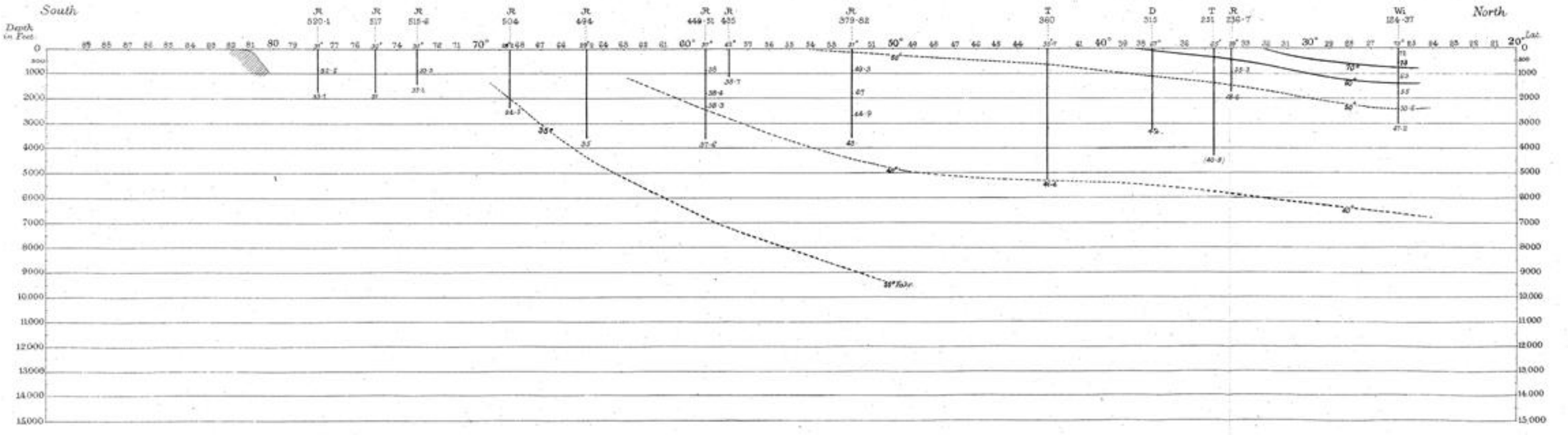


PACIFIC TEMPERATURE – SECTIONS.

5. From the Indian Ocean Lat. 40° South, and Long. 46° East, to the Arabian Sea in Lat. 20° North.



6. From South Victoria Land in Lat. 78° South and Long. 180° East, to the East Coast of Australia in Lat. 25° S.



TEMPERATURE-SECTIONS IN THE INDIAN AND SOUTHERN OCEANS.

W. West & C° lith.