light can be converted into a chemical equivalent, this again into heat, heat into motion, and indeed a fixed quantity of one force always and only into an equivalent quantity of another. In like manner also the quantity of matter has remained unchanged from the beginning; not the least particle or molecule can be annihilated or created out of nothing, and only in the transformation of perishable bodies are the molecules formed into ever new combinations. What we distinguish as natural forces are only movements of molecules, for the least particles of matter out of which bodies are composed are not inseparably united to each other, but are loosely held together and in continuous whirling and undulatory motion; according to the swiftness and width of undulation of the molecule will this motion of our nerves be regarded now as sound, now as heat, then as light or as colour. Moreover, the chemical union of the elements of matter, the attractive power of gravitation in all the bodies of the universe, are but varied forms of this universal motive force. The unity and permanency of substance with its two attributes, matter and force, and their innumerable modifications, which go to form the bodies of the universe, were in the first instance enunciated as a philosophical maxim by the great thinker Spinoza. Now it is established as a philosophic fact by means of exact measure and weight.

Again, on the inner organisation of the system of the universe has unexampled light been thrown by the wonderful researches which were begun in 1859 by two men, united by the closest bonds of a friendship which bore rich fruit for science. After the light of the sun had, in the third decade of this century, been brought into the service of art by Nièpce and Daguerre, Bunsen and Kirchhoff* compelled it also to render service to chemistry and astronomy. Like those magicians of the legend, who, through the power of their knowledge, compelled the spirits of the elements to disclose their most recondite secrets, the genius of these men compelled the rays of light imprisoned in the spectrum apparatus to make revelation of things in the world of stars which the curiosity of men had deemed for ever inaccessible. Already had Kirchhoff ascertained what terrestrial elements were present in the sun's atmosphere, and what were not; quite recently has it been discovered that there is even present in the sun a substance (*helium*) which hitherto has been unknown on the earth. Moreover also, the inner structure of the sun, the distribution of its incandescent, liquid, and gaseous parts, its luminous and coloured envelope, the nature of its spots and protuberances—all this is no longer a playground for fantastic imaginings, but the subject of exact research. Since the great eclipse of 1868, Lockyer and Janssen, Zöllner, Huggins, and Father Secchi have observed, day after day, storms, whirlwinds, flame-sheaves, outbursts of burning hydrogen to the height of 20,000 miles: thus has been developed an entirely new science—the meteorology of the sun. Moreover, on other obscure regions of the heavens, on the physical and chemical conditions, even on the laws of the movements of the fixed and double stars, on nebulæ and milky ways, on planets and comets, on zodiacal and northern lights, has spectrum analysis thrown its enlightening rays. No less by rigorous mathematical method, through which astronomy, even at an earlier period, had been brought to a certain amount of perfection, has she in the most recent time enjoyed an unexpected triumph, by solving, through the researches of Schiaparelli, the riddle of the comets, in being able to recognise the identity of their nature with that of the swarms of shooting-stars whose remarkable brilliancy long ago made them universally known.

(*To be continued.*)

* In connection with this discovery it would have been a graceful act on the part of our author to have referred to the names of Stokes and Stewart.—Ed.

EXPLORATION OF THE SOUTH POLAR REGIONS

III.

AT the conclusion of the last article the drifting seaweed was referred to as an important element in enabling us to ascertain the state of the sea about the Antarctic regions. Let us now see whether the conditions of temperature, so far as they have yet been determined, are in harmony with the ideas already developed. By reducing the ascertained directions for all the months of the year to a mean, there is obtained for the maximum of the temperature a curve which coincides with the intersections of the following meridians and parallels of latitude:—

33°	S. lat. and	33°	E. long.	44°	S. lat. and	65°	E. long
35	,,	35	,,	46	,,	67	,,
37	,,	40	,,	47	,,	68	,,
38	,,	43	,,	48	,,	70	,,
39	,,	47	,,	49	,,	71	,,
40	,,	50	,,	50	,,	73	,,
41	,,	55	,,	51	,,	73	,,
42	,,	60	,,	52	,,	74	,,
43	,,	63	,,	53	,,	75	,,

A glance at a map shows that this curve leads into the midst of the ice-free field, and is only distorted somewhat from its regular course by Kerguelen Island. This curve can be followed even as far as Macdonald Island, which is of high importance, inasmuch as it can be proved from direct observation that a higher temperature of the water exists in these regions, as Dr. Neumayer himself has witnessed. When he, in December and January, 1856-57, was sailing about 53° S. lat., he proved from hourly observations that there was an influx of a warm current between 62° and 72° E. long.

With respect to the higher temperature in the Pacific Ocean, it suffices to mention the circumstance that there exists on the Falkland and Campbell Islands a richer vegetable and animal life than is the case on other islands in the same latitude of the hemisphere. The unusual mildness of the regions is to be ascribed to the neighbourhood of the Australian continent, as well as to the prevailing west and north-west winds. If, on the other hand, a much poorer flora is found on Kerguelen Island than on the Auckland Islands, and if we should be at first inclined to regard this as evidence against the milder influx of warm currents, it should not be forgotten that Kerguelen does not enjoy the warming influence of a great continent, since it lies in the midst of the Indian Ocean, almost equidistant from the two nearest continents, and more than double the distance of the Auckland Islands from Australia. Both around New Zealand and near Kerguelen and south from Cape Horn, the cachelot (*Physeter macrocephalus*), which, it is known, seeks out the warmer waters, is found in abundance.

Dr. Neumayer quotes Bellinghausen's valuable journal for March 12, 13, and 14, 1820, from which it appears that at least as far south as 61° S. lat., under the meridian of 73·5° E. long., the sea is free from ice. Besides, it appears from his description that both in the sea and in the sky exists an active animal life, and the coruscation of the sea was observed for the first time by him in high latitudes. The occurrence of this phenomenon proves the existence of a very large quantity of organic remains which have been carried in this direction —a fact which, in conjunction with the other phenomena, Dr. Neumayer thinks has a positively demonstrative force.

After the slight sketch of the general phenomena of ice and currents, and the distribution of the warm districts lying immediately to the north of the south polar regions, it will be of interest to take a glance at the results of the several expeditions, with especial reference to the various meridians. If we understand by these results, in the first place, the greatest latitudes reached, and then the greatest stretches navigated inside the polar circle, we shall find, in reference to the former, the following points:—

Cook came to	71°	15′	S. lat. in	109°	0′	W. long. in	Jan. 1774
Wilkes	,,	70	0	,,	103	0	,,	,,	March 1839
Bellinghausen	70	0	,,	93	0	,,	,,	Jan. 1821
Bellinghausen	69	30	,,	77	0	,,	,,	Jan. 1821
Weddell	,,	74	15	,,	34	17	,,	,,	Feb. 1823
Morrell(?)	,,	71	0	,,	50	0	,,	,,	March 1823
Ross	,,	71	30	,,	14	51	,,	,,	March 1843
Ross	,,	78	4	,,	173	0	E.	,,	Feb. 1841
Ross	,,	78	11	,,	161	27	W.	,,	Feb. 1842

The first group of most southerly points refers to the regions west of Graham's Land, which according to Dr. Neumayer's theory, is rendered milder so far as climate is concerned, by one arm of the South American current; the second group contains the results of attempts to the east of Graham's Land, and the third, of the journeys of Ross to Victoria Land. Thus then, where the warm currents run towards the south, it is possible to penetrate farthest, and where also, in the regions around the polar circle the girdle of pack-ice is broken through, an open sea is seen in the high south, such as has been described by Ross and Weddell.

With regard to the regions where it is possible to cruise through great stretches inside the polar circle, we find that the most considerable stretch has been navigated between the meridian 30° W. and 50° E. long., where Bellinghausen, Biscoe, and to some extent also Moore, have shown satisfactorily that the land could nowhere extend much farther north than 70°. Also between 70° and 160° W. long. has a large part of the region inside the polar circle been sailed through, and it may with tolerable confidence be surmised that no land of any extent exists there, and that what land there is can extend northwards only a little beyond 70°. From the researches of Ross we learn that from 160° W. and 160° E. long. to far beyond the 70th parallel of latitude no land of any extent exists, while the Americans inform us of a great continent in the neighbourhood of the polar circle between 155° and 95° E. long. Whether this refers only to several island groups connected by ice, or to an actual coast of great extent, cannot, in the present condition of research, be decided.

The following figures show the mean latitudes reached on the several meridians:—

From	10°	W.	long. to	50°	E.	long.	70°	S. lat.	has been reached.
,,	60	E.	,,	,,	90	,,	63	,,
,,	90		,,	,,	170	,,	66	,,
,,	170		,,	,,	160	W.	78	,,
,,	160		,,	,,	110	,,	67	,,
,,	110		,,	,,	50	,,	70	,,
,,	50		,,	,,	10	,,	74	,,

According to these numbers, the place where the least advance has been made towards the Pole, between 60° and 90° E. long., is the very part where the condition of the current would prove favourable to a voyage southwards. The question now forces itself upon us, what may be the reason for this, and whether a determined attempt under the meridian of Kerguelen would not lead to the penetration of the polar circle? Leaving out of sight Morrell's doubtful voyages, we see from the following the farthest distance reached at the place in question:—

Bellinghausen's highest S. lat.	63·°	in March	1820
Biscoe's	,,	62·2	,, 1831
Kemp's	,,	63·5	,, 1833-3
Moore's	,,	64·3	,, 1845

With the exception of Kemp, all these made their way into the region in question in the direction of the parallel of latitude. Other voyagers until late in the season have frequented that part of the Indian Ocean, some even to the end of March. It is therefore evident, from the narratives of these voyagers, that, according to Dr. Neumayer's notion, no attempt has yet been made in the direction most highly favourable.

It should be especially noted here that, south of the 60th parallel of latitude, in the Austral summer, easterly and south-easterly winds prevail, which, towards the end of the season, frequently blow severe storms. It is, therefore, advisable to search the region to be explored from east to west, in order to find out the most direct possible course towards the south, in order to cut through in the shortest possible time the pack-ice, of the position of which in these regions we have got no idea.

Interesting is the course (says Dr. Neumayer) of the two isothermal lines of 0° (the freezing point of the air) for January, February, and for July, August. The isothermal line for the Austral summer assumes the figure of an ellipse, whose smaller axis falls nearly in the direction of the meridian, passing through Graham Land and Sabrina Land from 60° W. to 130° E. long.; the greater axis goes through 20° E., 160° W. long., in the latter case through Victoria Land, which stretches far towards the Pole, and, in the former through a stretch of the Antarctic Sea, which is discovered as far as to 70°, and in which land has been conjectured to exist, but has not been seen, and according to Morrell, will not be found. Does not the bending towards the equator show the completely oceanic character of the greater axis? The limiting bend of this isothermal for the extreme seasons in the direction of the greater axis, and also the greater bend near the small axis, are unfavourable to the assumption of great stretches of land between Enderby and Graham Lands. With this consideration is connected the further question, whether the fact that the bending towards the equator is considerably less in the Pacific than in the Atlantic Ocean is not to be explained by the existence of Victoria Land, to which there is no equivalent on the opposite side. The

consequence of such a conclusion would be that Enderby Land and Kemp's Land, in whose neighbourhood it has already been assumed that no considerable land would be found, would be islands, and that between Kemp's Land and Termination Land chances of penetrating towards the south would be greater than under the meridian of New Zealand.

Dr. Neumayer appends the following sketch of the plan upon which he thinks any South Polar expedition should be conducted :—

1. A wooden sailing-vessel with auxiliary screw of at most 300 tons, thoroughly strengthened at the bow and properly arranged on the upper deck, should be sent out on such an expedition. 2. The ship should be equipped with all the most approved appointments and the most recent and best scientific apparatus suitable for the observation of phenomena of all kinds. 3 Men eminent in each of the principal branches of science should be chosen to accompany the ship, which should first make for the Cape of Good Hope, where all the necessary scientific arrangements and testing of instruments could be made. The Cape, indeed, might be considered as the real starting point of the expedition. 4. For the purpose of regular observations, soundings, and so forth, the expedition should set out about the beginning of the year from the Cape for the various groups of islands visited by Cook and Ross, making for Christmas Haven in Kerguelen, overhauling the observations which have been arranged for now thirty years, and attempting to fix the geographical position of as many points as possible. 5. On the Macdonald Islands, as they stretch farther to the south in this quarter (53° 5·5′ S. lat., 73° 17·2′ E. long.), a depôt should be established, the chief purpose of which should be to maintain an ample stock of coals for the use of the expedition, to convey which from the Cape a transport vessel would be useful. Besides a strongly-built astronomical magnetic observatory should be erected here, which would serve as a basis of observation for the operations of the expedition in the south ; for these islands are the outmost fore-posts of the Antarctic regions. 6. The ship could carry on its soundings and researches into the currents, the ocean-bed, &c., with diligence, and go as far south as the season would permit without danger. In December the attempt should be made to cross the polar circle, to force through the girdle of pack-ice, and begin research in the polar regions proper. 7. An attempt should be made, with all energy and circumspection, to winter inside the polar circle, when possibly a suitable harbour might be found on Kemp or Enderby Land. By this means the data for the winter climatology of the Antarctic regions would be ascertained, for which Science has sighed so long. On this position of observation a small contingent of eight or ten men and a whaling-boat should be left, furnished with every means for the preservation of their health and the furthering of scientific knowledge. After establishing this station, the ship itself should return to the Macdonald Islands, and pass the winter, as far as the season will permit, in pursuing scientific labours. 8 By the approach of the favourable season in September and October the work could be again transferred to the sea, and particularly a thorough survey of the Macdonald group should be made. In December the ship would again make for the south, take up the observers on Kemp's Land, and then proceed to further researches until the end of the favourable season urges a return to the Macdonald Islands. 9. At the conclusion of its work the expedition could sail for Melbourne, where the necessary arrangement of the observations could be made. 10. During the sojourn of the expedition in and around the Macdonald group, it might be arranged that a series of Australian-bound ships of all nations should from time to time sail southward and visit the island, which, during the Austral summer would be a matter of little difficulty. In this way a regular connection with Europe would be maintained, and intelligence could, now that we have telegraphic communication between Melbourne and England, reach Europe from the Macdonald Islands in from fourteen to eighteen days. Should the latter group, contrary to all expectation, prove unsuitable to a long stay, then must Christmas Haven in Kerguelen (48° 41′ 1″ S. lat. and 69° 3′ 35″ E. long.) be chosen for the purpose. Should an expedition be fitted out in connection with that for the observation of the Transit of Venus, the above plan would require to be materially modified.

Dr. Neumayer concludes with some sensible remarks on the qualifications necessary to form an efficient leader of an expedition such as he proposes ; the man selected for the purpose must be both a seaman and a man of science, and no mere *dilettante* discoverer. Should such an expedition ever be organised, the importance of these considerations cannot be overrated.

FAYRER'S THANATOPHIDIA OF INDIA.

The Thanatophidia of India. Being a description of the Venomous Snakes of the Indian Peninsula, with an account of the Influence of their Poison on Life ; and a series of experiments. By J. Fayrer, M.D., &c. 1 vol. folio, coloured plates. (London : Churchill, 1872.)

THIS is a handsome work, got up in good style, printed in large clear type, and illustrated with a number of highly-coloured plates. It is intended to supply a want which the author has often heard expressed—"that of reliable information on the venomous snakes of India."

Dr. Fayrer divides his subject into several sections, the first relating to the zoological and anatomical character of the venomous serpents of India, the others treating of the statistics of deaths caused by their bites, of the mode of treatment of such cases, and of numerous experiments undertaken by the author with a view of ascertaining the influence of snake-poisons, and the value of certain reputed antidotes. On each of these subjects we will make a few remarks.

As regards the more strictly scientific portion of the volume, Dr. Fayrer informs us candidly that we are not to expect anything original. "The classification and definitions are chiefly taken from, or based on, Günther, or other authors of repute, the anatomical descriptions from Owen and Huxley ; and to those authorities I make my acknowledgments for much valuable information, remarking, at the same time, that I have carefully verified their descriptions by comparison with, and by dissections of, the snakes themselves." In this passage we think that it is not made sufficiently clear that the whole of the first section of Dr. Fayrer's work is based upon Dr. Günther's