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THE VOYAGE SOUTHWARD OF THE "DISCOVERY."*

I. LONDON TO MADEIRA.

By HUGH ROBERT MILL, D.Sc., LL.D., Sec. R. Met. Soc.

I HAVE been privileged to take only a small part in the preparations for the *Discovery* expedition, and the report of my work requires few words, even if a brief account of the voyage as far as Madeira is included.

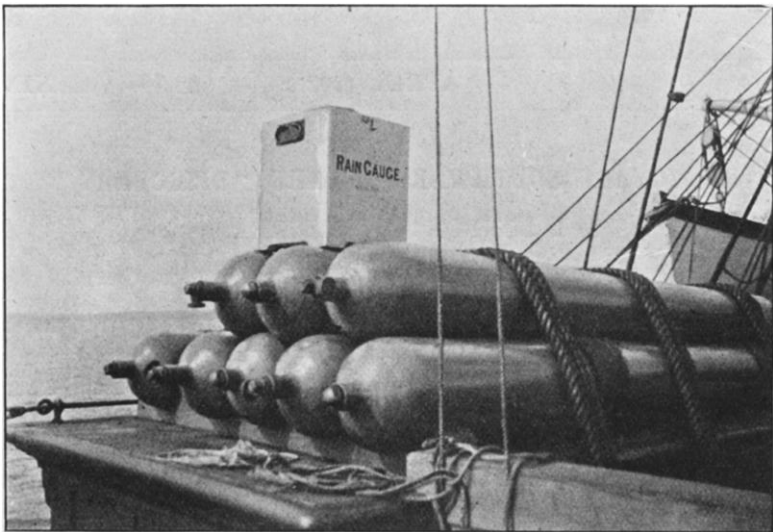
On July 27, 1901, I was asked by Captain Scott and Mr. George Murray to accompany the *Discovery* on the first short stage of her voyage, in order to instruct the observers on board in the methods of oceanographical work. From having been a member of the meteorology sub-committee, I was already aware of the plans so far as the investigation of atmospheric conditions was concerned. After acquainting myself with the apparatus and material which had been provided for the study of the sea, I joined the *Discovery* in Stokes bay on August 3, she having left the Thames on July 31.

The time before sailing was fully occupied in the completion and adjustment of some of the apparatus, and seeing to the stowing of all the instruments and chemicals in the physical laboratory, so that they should not be endangered by the rolling of the ship.

On August 5 the *Discovery* moved across the Solent and anchored off Cowes. Sir Clements Markham, Mr. Longstaff, Sir Leopold McClintock, Sir Allen Young, Admiral A. H. Markham, and Mrs. Scott were on board, and at 11.30 a.m. their Majesties the King and Queen and H.R.H. Princess Victoria paid a private visit of inspection. The genuine interest

* Papers read at the Royal Geographical Society, February 24, 1902.

which the royal party took in the ship and in every department of the scientific work was most gratifying and stimulating to every one on board. They not only visited every part of the vessel, but inquired the use of each piece of apparatus shown to them, and watched its working with the keenest attention. The Queen was particularly attracted by Forel's xanthometer (an instrument for measuring the colour of the sea by comparison with a graduated series of solutions ranging from pure blue to yellowish-green), and, after seeing how it was used, herself explained the method to the King. The presentation of signed portraits to the wardroom mess, and of the Royal Victorian Order to Captain Scott as a mark of the King's confidence in him, gave



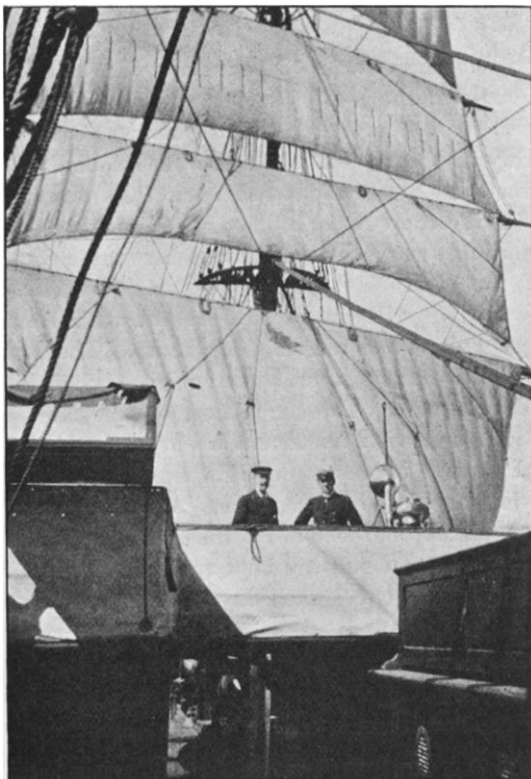
RAIN-GAUGE, PLACED ON THE HYDROGEN CYLINDERS ON THE PORT QUARTER OF THE *DISCOVERY*.

pleasure to all, and the friendly cordiality which characterized the King's brief speech of farewell to the ship's company will be a heartening memory in many a dreary hour of antarctic winter.

On August 6 the *Discovery* weighed anchor at noon, and proceeded down channel under steam in the teeth of half a gale of wind, stopping off Yarmouth, in the Isle of Wight, to land the last of the friends who had accompanied the explorers so far. Eight days were occupied in making the passage to Madeira. The weather was fine, although the sky was rarely altogether free from cloud, and there was only one night on which the sunset was sufficiently clear to show the interesting phenomenon of the green ray. This was on Sunday, August 11, when, as the upper edge of the sun touched the sea-horizon, a beam of yellow light, almost instantaneously passing through green to blue and dying

away in violet, was distinctly visible. It is remarkable that so few observers have noticed this very striking appearance, which must be visible every time the unclouded sun dips beneath a sharp horizon.

The *Discovery* arrived off Funchal, in Madeira, at 2 a.m. on August 15, and, after some slight repairs to the rigging, she started on the evening of the following day. A small tug towed the ship 4 miles out into the full strength of the trade-wind, and at 6.30 p.m. she was cast off, proceeding for the first time under sail unaided by



MAINMAST UNDER FULL SAIL.

steam. Half an hour later, just as the sun was setting on Friday, August 16, I took the last photograph of the departing vessel, and turned back to Madeira with many regrets.

So far as my limited experience went, the *Discovery* proved a particularly comfortable ship, for her rolling was remarkably easy compared with that of most steamers of her size. The officers and scientific staff shook down to their work at once, and the greatest harmony and good humour prevailed in the wardroom, and indeed

throughout the ship. I was never in pleasanter company, nor among men more honestly bent on doing their very best to make the most of the splendid opportunity presented to them. The essentially scientific turn of Captain Scott's mind impressed me strongly, and the rapidity with which he mastered the details of oceanographical and meteorological work was remarkable. His quiet firmness and tact in a difficult and unusually responsible command are equally striking. For the routine observations now most urgently required, I feel sure that the organization of the British Antarctic Expedition is not inferior to that of our German colleagues on the *Gauss*, or our Swedish fellow-workers on the *Antarctic*.

With regard to the work in departments of which I have special knowledge, I ought perhaps to pass over that in meteorology, as I had little to do with it on board. The Meteorological Office had done its work thoroughly in the provision of instruments, and the officers who were to conduct the observations had been fully instructed at Kew Observatory. Still, a few remarks may be of interest.

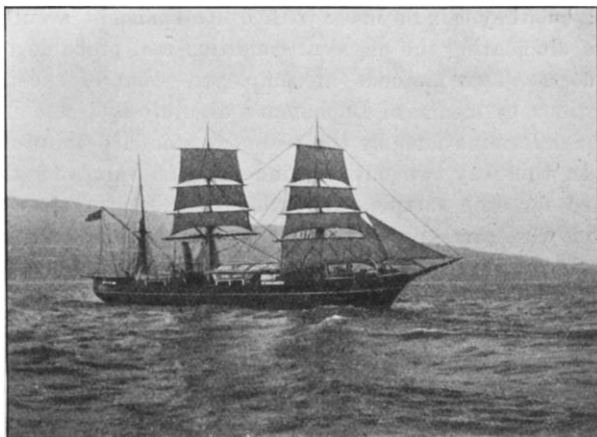
For the routine observations, a form of Stevenson screen is erected on the wall of the botanical laboratory on the port side, and when the ship is under way there will always be a current of air blowing through the gangway between it and the magnetic house. The screen contains a wet and dry bulb thermometer, a mercurial maximum, and a Sixe's maximum and minimum. The barometer, on the Kew pattern, was in the magnetic house, with its cistern about 12 feet above the water-line (though I believe it was afterwards moved), and a barograph is kept at work in one of the companions. A thermograph and a hair hygograph are placed on the outer walls of the magnetic house, and the three recording instruments are kept running to Greenwich time, a mark being made on the curve each day at local noon, so that a local time-scale may be afterwards applied. As the ship's time will be changed daily by amounts varying from a few minutes up to perhaps an hour or more, it would of course be impossible to adjust the recording instruments to follow it. The temperature readings are checked by means of an Assmann's Aspiration Psychrometer, and sling thermometers are also provided for comparison. Rainfall observations are made by means of a marine rain-gauge on Dr. Black's pattern, the placing of which was a matter of some difficulty, on account of the way in which any part of the vessel may be sheltered when she is under sail. The method finally adopted was to place the rain-gauge upon the cylinders containing gas for the balloon, on the top of the small deck house aft, on the weather side, shifting it whenever the ship changes her tack. The result will not be a perfect record, but it will be a fair test of the value of a rain-gauge at sea.

The surface temperature of the sea is taken each time the instruments on board are read, a small canvas bucket being used from the

bridge for the purpose of drawing a sample of water. Once daily, at noon, the colour of the sea-water is measured by means of Forel's colour-scale, or xanthometer. As this observation requires a keen colour-sense, it has been placed in charge of Dr. E. Wilson, the artist of the expedition.

The whole of the meteorological work on board is under the special charge of the first officer, Lieut. Charles Royds, R.N., who has had considerable experience in observing.

For reaching great elevations in the air, reliance is to be placed on kites, and for this purpose light aluminium meteorographs have been provided for attachment to the large box-kites of Hargrave's pattern. While in the Bay of Biscay, an experiment was made in flying a couple of small box-kites tandem-fashion from the ship, and they were found



THE *DISCOVERY* LEAVING MADEIRA.

to rise readily and maintain their altitude steadily for nearly an hour when the ship was running before the wind, and therefore in the least favourable condition for the experiment. No instruments were attached, and the only difficulty found was that the kites descended too abruptly.

It was interesting, on the voyage out, to see how, as the ship left the region of the variable westerly winds and entered that of the steady Trades, the barograph traces lost the irregular ups and downs characteristic of British weather, and settled into the uniform semi-diurnal wave of the tropics, each day reproducing the gently rising and falling curve of the day before.

The thermometers supplied for use on shore, or during the wintering, were graduated so as to be capable of showing temperatures lower than any that have yet been recorded in nature. For measuring wind-pressures, Mr. W. H. Dines supplied one of his pressure-tube

anemometers, with a special adjustment fitting it for use in extreme cold. A sunshine-recorder has also been designed which will admit of a continuous record when the sun remains above the horizon during the whole twenty-four hours.

Oceanographical research in the antarctic area is of particular importance, as all the evidence which is at present available points to the Southern ocean as the mainspring of the circulation of all the seas of the globe. It is desirable, therefore, to have observations connecting the temperate and tropical oceans with the Southern. This was attempted on the voyage of the *Discovery* by regular observations of the temperature and salinity of the surface water twice daily. The determinations of salinity on board a small vessel cannot possibly be made with the minute degree of exactness properly insisted on in a laboratory on shore; but they can be made with quite sufficient accuracy for the purpose of elucidating the physical condition and probable movements of the water. Two methods are employed—that of specific-gravity determinations by means of Buchanan's absolute hydrometer, and that of chlorine determinations by the use of a standard solution of silver nitrate. In this way two entirely independent values for the salinity are obtained for each sample. The physical laboratory in which these observations were carried on at first, is possessed of one great advantage for work in polar regions, for its proximity to the galley ensures that it is always warm; but in the tropics this was so little of a benefit that I understand the work was removed to one of the cabins. This laboratory also became inconveniently crowded with iron apparatus of all kinds, as it lies outside the non-magnetic area within which the zoological and botanical laboratories stand, and these are consequently not allowed to contain so much as a file or an iron wire bottle-brush.

Lieut. E. H. Shackleton undertook the salinity determinations, and proved a very apt and enthusiastic pupil. The record of his work from Madeira to Cape Town, which I have seen, bears every mark of care and accuracy. In the absence of a trained chemist, it seemed inexpedient to attempt the collection and analysis of the gases of sea-water, or determinations of alkalinity or ammonia. It may be mentioned that the distilled water required for the various solutions is provided on board, thanks to the care with which Mr. Skelton manages the distilling plant in the engine-room. The chemicals for standard solutions were weighed on shore, and each quantity separately sealed up in a glass tube. Mr. Ferrer, the geologist, had received instruction from Prof. Letts in the use of a special apparatus for determining the amount of carbonic acid in the atmosphere, which he fitted up in the physical laboratory; but the difficulties in the way of carrying out the work are very great. All chemical work at sea has to be performed under difficulties, and is only possible in a very carefully planned laboratory adapted structurally to the special work that is to be

undertaken, so as to ensure sufficient light and secure resting-places for every piece of apparatus, however small.

The appliances for deep-sea work, most of them supplied by the Admiralty, comprised an ample supply of Miller-Casella thermometers, a certain number of Negretti and Zambra's reversing thermometers in Magnaghi frames, and several Challenger-type water-bottles for collecting samples at various depths. Most reliance will, however, be placed on the Pettersson-Nansen insulating water-bottle, which secures a sample of water and enables the exact temperature to be taken simultaneously. Three of these beautiful pieces of apparatus have been supplied, and they are expected to yield most important information as to the distribution of temperature and salinity with depth. I have also sent out a water-bottle on my own pattern for use in shallow water, for which it has certain special advantages.

Convenient cases for holding the thermometer and water-bottles, to be fixed on the after wall of the wardroom companion, were designed on board and made by the ship's carpenter, so that the instruments could be kept safely and conveniently on deck ready for use. Lieut. M. Barne takes charge of the deep-sea apparatus.

The Lucas sounding-machines of large and small size appear to be very well suited for their work; but the steam-gear for working the wire lines had not been fully tested while I was on board.

In this brief sketch reference has only been made to the parts of the work which came under my personal notice, or as to which I gave written instructions to supplement those contained in the 'Antarctic Manual.' I have said nothing as to the captive balloon, the platinum resistance thermometer, the whole magnetic equipment under Lieut. Armitage's charge, the physical apparatus to be used by Mr. Bernacchi, or about many branches of research which will be taken up if time and opportunity permit. And I have said nothing of the arrangements for biological work under the charge of my old friend Dr. Koettlitz and Mr. Hodgson. Over the arrangement of this department Mr. George Murray, the scientific director, personally presided, and I am indebted to him, as to all the officers and to every member of the scientific staff, for much kindness and the most hearty help in all my work on board.

II. FROM MADEIRA TO THE CAPE.

By GEORGE MURRAY, F.R.S.

THE first observation of general interest which I find in my scientific diary after leaving Madeira is under date August 22, obs. lat. $17^{\circ} 22'$ N., long. $20^{\circ} 7\frac{1}{2}'$ W. It is as follows: "The morning opened with every