The Voyages of the *Discovery**

ABOUT forty years ago, the first *Discovery* lay abuilding in Stephen's yard at Dundee, for Captain Scott's Antarctic Expedition. She was built like a Dundee whaler, but of the finest African oak, and finished as a labour of love ; her timbers, spars and full barque-rigging were all as strong as Stephen and his men could make them ; but the old lines were not left unaltered, and when she put to sea she rolled terribly. The Hudson's Bay Co. got her later on, and the Colonial Office took her over when she was five and twenty years old and sent her on her first and last cruise to the Falklands and the South Georgian whaling-grounds. She found other Antarctic work to do under the Australian and New Zealand Governments, when our Colonial Office built a new ship under her old name, less beautiful, but equipped as no other ship had ever been for the naturalist and the hydrographer. A much smaller vessel was added later on, bearing the name of that great scientific navigator and whale-fisher William Scoresby. She was built as a "whale-catcher", to study and mark the whale at close quarters ; the Norwegian whaling-skippers at Walfisch Bay (when I happened once to pass thereby) thought they could have built her a great deal better ; but still she has marked her whales, and done good work in other ways.

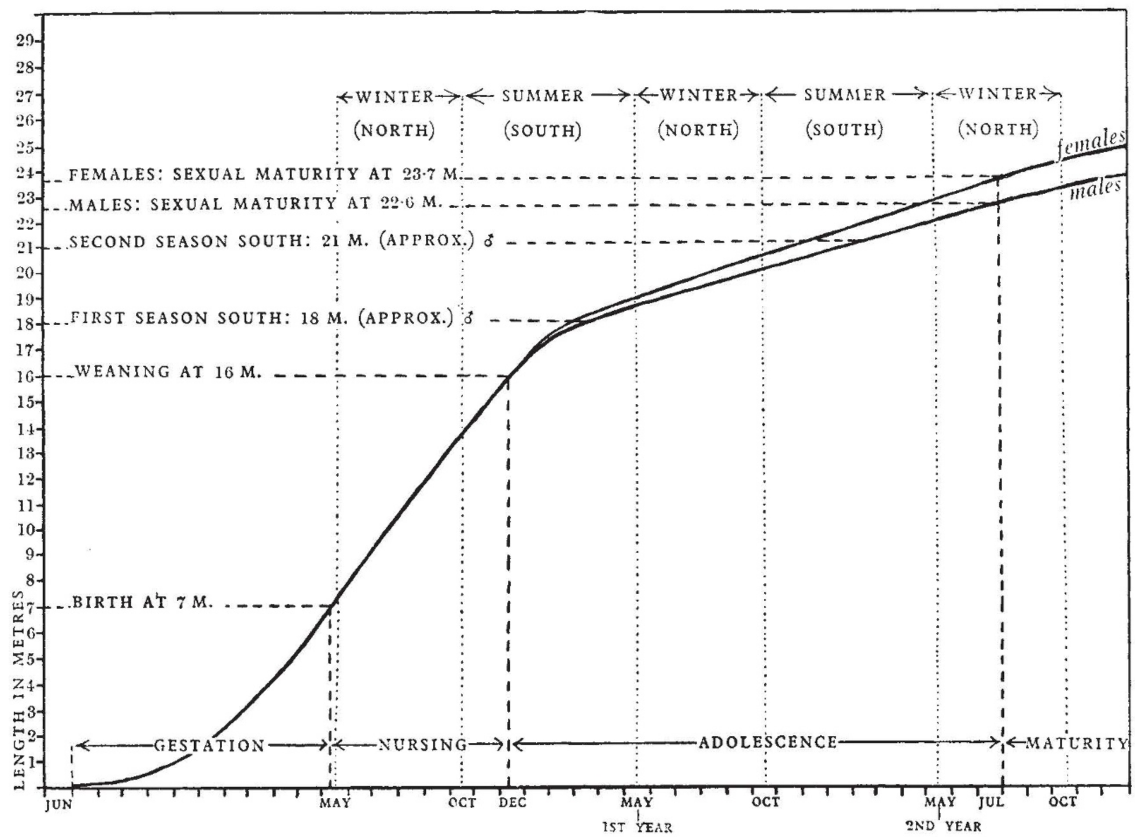

Fig. 1.

EARLY LIFE OF THE BLUE WHALE. FROM "REPORT ON THE PROGRESS OF THE DISCOVERY COMMITTEE'S INVESTIGATIONS".

The old and new *Discovery* and their little sister-ship have been at work on and off pretty steadily for twelve years in the fierce cold and almost constant gales of Antarctic seas. Their one main object was to study, for the sake of the whale-fishery, the natural history of the several whales,

* Report on the Progress of the Discovery Committee's Investigations. Pp. 52+11 plates. (London : Colonial Office, 1937.) 3*s*. 6*d*. net.

their movements and migrations, the things on which they feed, the waters in which they live and move; physical oceanography, chemistry and all the biological sciences have their part in the story of the whale. The Basque harpooneers in the Bay of Biscay killed out the Atlantic whales, one by one, until no more were seen for near a hundred years; the New Bedford men chased the Sperm whale all round the world, with ever-lessening catches; the Dundee ships in Davis Straits pursued the dwindling Greenland whale to the very verge of extinction. But the modern whaler, with his Svend-Foyn gun, his explosive bullets, and his 'floating factories', kills a hundred whales to the old harpooneers' one; and it was plain to see that, plentiful as whales were on their southern feeding-grounds, they could not outlast the insatiable pursuit for ever. The aim of the *Discovery* was "to furnish a basis for the rational regulation of whaling"; in other words, to tell the commercial world how far greed might safely go. The whale is a very different thing, say, to a codfish, which lays, year by year at random, its million eggs; the whale nurses its single child for months with all solicitude, but men of business slaughter it as the Red Men killed the buffalo, and no humanitarian considerations enter the case.

The Blue whale, or Sibbald's whale as it was until lately called (after the old Edinburgh physician of three hundred years ago), is the largest and most valuable, the Fin whale (or common rorqual) the most abundant whale in the Antarctic; the rarer Humpback was the first to show grave signs of depletion. Some 10,000 Blue whales are killed every year down in the Antarctic, besides a good many more (younger on the whole) on the South African coast; and, if the numbers killed do not yet become noticeably less, the mean size falls away, little by little and year by year. The whales do not live so long, their 'expectation of life' grows significantly less; worse still, the mean size over the whole catch is falling below that of first maturity—a larger and larger proportion of the remaining stock no longer breed at all! The Blue whale is about 21 ft. long at birth, nearly 60 ft. long (so it is said) at a year old, and the females are sexually mature a little over two years old, when they are about 79–80 ft. long. This very rapid growth and very early maturity (on which the hopes and prospects of the fishery largely depend) are vouched for by the *Discovery* naturalists, and are in harmony with Norwegian estimates; they are novel, and unexpected, and extremely interesting determinations. Papers by Dr. Stanley Kemp, Dr. N. A. Mackintosh, Mr. J. F. G. Wheeler and Mr. A. Laurie on the Blue and Finner whales, their rate of growth, their age at maturity, their migrations, their estimated numbers, their curious physiology of respiration and all else about them, are here as large instalments of the work which the *Discovery* set out to do.

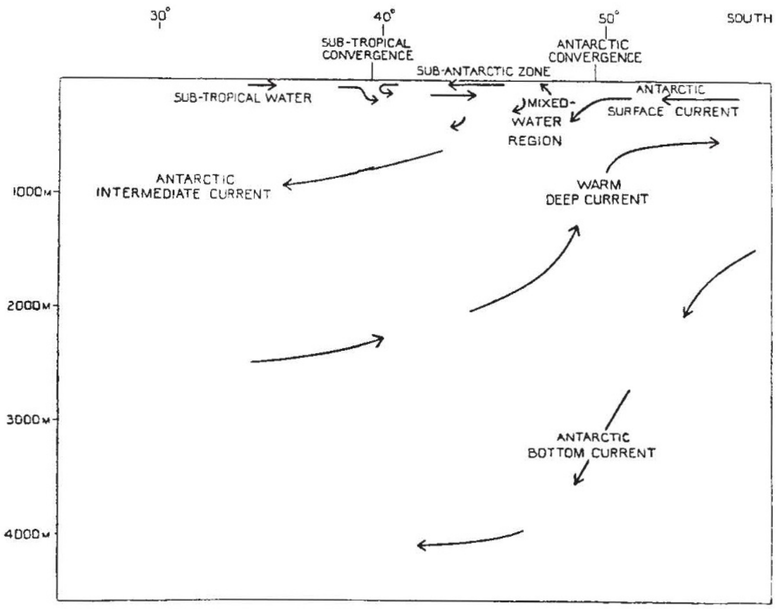

Fig. 2.

OCEANIC CIRCULATION IN THE SOUTHERN HEMISPHERE. FROM "REPORT ON THE PROGRESS OF THE DISCOVERY COMMITTEE'S INVESTIGATIONS".

The *Discovery's* hydrographic work has proved peculiarly interesting, and Mr. G. E. R. Deacon deserves especial congratulation. Oceanography had its roots in the *Challenger* Expedition, its seeds were sown by Humboldt and Maury, but the tree only began to grow apace some thirty or forty years ago; it was then that Nansen told us something of the peculiar oceanographic interest of the polar seas. The *Challenger* had given us, as a first approximation, the simple story of a bottom-current, cold and heavy, flowing towards the equator, while a surface-current, salt and warm, streamed over it to the pole. That the great oceans show a more complex stratification than this was indicated even by the *Challenger* observations, as Merz saw long afterwards; but the Edinburgh physicists were cautious men, and had been afraid to trust to what seemed the too complicated evidence of their own thermometers.

Now the *Discovery*, following on the *Meteor's* work, gives us a new story just a little less simple than the old, telling of four water-layers in the oceanic circulation instead of two. Starting out from the Weddell Sea, toppling to begin with over the edge of the plateau, down to the bottom and away northward, goes a current of cold heavy water. Lying over this and creeping slowly southward, a mass of warm salt water lies ; it rises up over the Antarctic current as this plunges down to the depths on its northward way, but it does not come to the surface, for there is other Antarctic water there with a density so far reduced by melting ice as to float, cold as it is, over the warm deep current. Then over all comes the fourth layer, of tropical or subtropical water, very salt but very warm, flowing southward over all the Antarctic waters.

The whole case, simple as it is, is not quite so simple as that ! For our two surface-waters, the hot and the cold, the salt and the fresh, one going south and one coming north, meet somewhere, and when two water-masses meet things happen. You may see almost anywhere near the shore, especially in an estuary when the tide is coming in, a line of frothy turbulent water, marked out by a flotsam of sticks and straws ; this is the *Schaumrand*, as Otto Petterson called it. Such a *Schaumrand* on a prodigious scale, visible from miles away, marks somewhere about 50° S. the so-called "Antarctic Convergence", the meeting of the warm and cold surface-waters. Here the south-going current is turned back or carried down, and mixes with the Antarctic surface-water which meets it, to form, some way below, the cold northward intermediate current. Thus in the farthest south we have *three* layers of water—cold, warm and cold again ; but farther north there are *four* layers, tropical or subtropical ocean-water drifting southward over the other three.

From this easy beginning the story goes on and gathers interest. It is one of Deacon's remarkable discoveries that the Weddell Sea, and that alone, is the source of all the heavy bottom-water, heavy with cold and undiluted by melting ice ; from the Weddell Sea the drift creeps along at the bottom of the great oceans, and is traceable even as far as the Bay of Biscay. But there are parts of the Antarctic Ocean so barred by shoals or submarine walls as to be shut off from the main current-system. Ross's Sea has a northern wall so high that the warm deep current does not enter it at all. So Ross's Sea becomes filled up with Antarctic water, extremely cold, and also extremely salt because much water has been removed to form pack-ice ; and the fauna of Ross's Sea has (I believe) its consequent peculiarities.

Surface-currents coming northward from the far south hug the west coasts of the great continents, and the most important and best-known of these, which the *William Scoresby* has specially investigated, is the Peru or Humboldt Current. It flows for more than 2000 miles along by Chile and Peru, now slow, now swift, now narrow and widening out again, even to a breadth of some 200 miles. It seems to arise about 40° S., in one of those convergences or divergences of which we have spoken, where cool and moderately saline water of Antarctic origin wells up from below the warm water of the equatorial counter-current, as indeed it continues to do for all its length along the western edge of the continent. The cold water comes up teeming with nutrient salts ; it breeds a plankton-fauna of the richest kind ; and this supports a population of whales, and of fishes preyed on by innumerable sea-birds the guano of which is sent all over the world. This cold current dominates the situation, but now and then persistent northerly winds check it or thrust it aside. Then comes *el Nino*, a new warm current upsetting the old equilibrium ; the fish die in millions, the water stinks, the birds starve, the guano industry cries aloud. On the west coast of South Africa, at Walfisch Bay and Swakopmunde, the same phenomena occur.

After this fashion the *Discovery* reports lead us to many interesting things—interesting chemically and biologically—and arising out of the plain facts of oceanography. At the bottom of the Weddell Sea are found gypsum, calcium oxalate and calcium citrate, the last two especially being of obscure origin and unknown at the bottom of any other sea. A vast abundance of life, microscopic and macroscopic, strikes every naturalist in Arctic or Antarctic seas, and the coldest of Antarctic waters are the richest waters in the world. The biologist is apt to ascribe this abundance to superabundant oxygen, such as the cold waters can dissolve ; but that alone would not go far. The nutrient salts, the phosphates and nitrates, are the true limiting factors in the growth of that micro-vegetation with which the whole biological cycle begins. The tropical oceans are often very barren of these salts ; in our own latitudes there is never too much, and the burst of growth in spring uses up the supply leaving little or nothing to spare ; but the *Discovery* people have shown us that phosphates and nitrates are more abundant in the Antarctic Ocean than in any other seas, and that down there plant-growth is never checked for want of them. Plant-growth in the ocean is limited to a certain depth by its need of sunlight, so the water a little lower down tends to be rich in unused phosphates. In the neighbourhood of any great divergence these waters rise to the surface, and foster an unusual micro-vegetation there. At the edge of the continental shelf we meet with such rising waters, and have again a richer growth of plants and of creatures great and small to feed on them and one another.

A hundred years ago, Johannes Müller was using the first tow-net, about the time when Edward Forbes was borrowing for the first time a fisherman's oyster-dredge; but only now do we begin to understand properly the importance of the floating life of the sea. Its distribution, its seasonal abundance, its variation with temperature, its presence in this water and absence in that, the vast variety of organisms of which it is variously and with varying importance composed, all these things are a great part of the science of the sea and of our understanding of all the fisheries. Prof. A. C. Hardy of Hull (a most ingenious student of the plankton) and Mr. E. R. Gunther have written an interesting report on the ways and means by which plankton is dispersed and distributed, and how the gathering-places of the whales may be expressed in terms of plankton, and again of the phosphate supply. Dr. N. A. Mackintosh has demonstrated a seasonal circulation in the Antarctic plankton on a scale unrivalled elsewhere; the big Euphausias, staple food of the Blue whale, first made known by the *Challenger* and met with again by Dundee whalers who went far south unsuccessfully some forty years ago, are fully described by Dr. F. C. Fraser and Mr. Dilwyn John. But without saying more of the ship's company and their doings, let me just say that the *Discovery II*, with a great task to do and ample means to help to do it, has added largely and handsomely to natural knowledge, and given the ship's name an honourable place among voyages of exploration and discovery. There is one omission in the report before us. I have read it all through without encountering the name (save in a list of papers) of the leader and director of the Expedition, the distinguished author of the report.

D. W. T.

Tests in Common Use for the Diagnosis of Colour Defect*

By Dr. Mary Collins

TESTS for colour vision fall into two categories. In one type of test, transmitted light is used, in the other reflected light. While the former type of test is regarded as the more fundamental, the latter can be of great service for quick diagnosis of colour anomaly. Colour tests may be administered purely for theoretical purposes, or they may be applied for practical purposes, as selection tests for different vocations. This second function assumes its most important role in vocations in which lack of accurate discrimination between different coloured signals may involve human lives. This function is also of significance in other vocations in which the lack of colour discrimination, though not involving danger to the community, is highly disadvantageous to its possessor.

There seems to be no need at the present day to emphasize the importance of the recognition and detection of colour defect. It is, however, very illuminating to study some of the more recent investigations in the field, particularly those concerned with the incidence of red-green defect. The percentages given seem to be much higher than in the reports of the earlier investigations. It does not necessarily follow that the incidence of the defect is increasing; the indications are rather that detection is more accurate owing to the improvement of the test material. Out of 360 candidates applying for acceptance as apprentice printers, the percentage of red-green colour-blinds was 7·5, this figure being exclusive of the colour-weak and the anomalous.

It seems more or less agreed that red-green colour-blindness is a reduction system of normal colour vision, one cogent argument in support of this contention being that normal colour matches are valid for any type of dichromate. The colour-blinds lack something which the normal eye has, but have nothing which the normal eye does not possess. The individual with normal colour vision sees a spectrum composed of six or seven colours. The red-green colour-blind has a spectrum composed of only two colours, these two colours being yellow and blue. The acceptance of this fact was delayed for a long time, and it is doubtful if it is yet generally accepted. Herschel, in 1845, was the first to put forward the dichromic explanation of colour-blindness. He pointed out in his article on "Light" in the "Encyclopædia Metropolitana" that certain individuals could only distinguish two colours, and that these two colours were yellow and blue. Clerk Maxwell, among others, opposed this, for he accepted the theory put forward at that time by Young and Helmholtz that colour-blinds were either red-blind, green-blind or violet-blind, and that the red-blind were blind to red,

* From the presidential address to Section J (Psychology) of the British Association, delivered at Nottingham on September 3.