less than 2 per cent. of the stars are within observational reach. But whatever the actual total, it is clear that the number of stars beyond the range of the largest telescopes is many times that accessible to observation.

The total amount of starlight is little affected by questions as to the number of stars in the system. For the distribution given above, the stars brighter than the twentieth visual magnitude, comprising but 3 per cent. of the total, contribute 98 per cent. of all the starlight. The integrated visual light for the whole sky is the equivalent of 1076 stars of visual magnitude 1·0 on the international scale. The corresponding numbers found by Yntema and van Rhijn from measures of the brightness of the sky are 1350 and 1440, the unit being referred to the Harvard scale. The outstanding difference corresponds to about 0·3 mag. Since the stars of about the twelfth apparent magnitude contribute the largest amount of light, no reasonable correction to the magnitude scale will wholly account for the difference.

## The Expedition of the R.R.S. *Discovery*.

THE Royal Research Ship *Discovery*, which is leaving England at the end of the present month, will be engaged for the next two years in oceanographical investigations in the South Atlantic and Antarctic. The ship, which is barque-rigged with auxiliary steam, was built in 1901 for the late Captain Sir Robert Falcon Scott, and was acquired on behalf of the Falkland Islands Government for the purpose of the present investigations in 1923. During the last eighteen months she has undergone extensive repairs, and changes have been made in her masting and sail-plan in accordance with experience obtained by Capt. Scott. She has been refitted throughout, and is now completely equipped for the investigations for which she is intended.

The cost of the expedition will be met entirely from public revenues raised in the Dependencies of the Falkland Islands, and the work will be controlled, subject to the instruction of the Secretary of State for the Colonies, by an executive committee, constituted as follows: Mr. E. R. Darnley (Colonial Office, chairman); Sir Sidney Harmer (British Museum, vice-chairman); Sir J. Fortescue Flannery, Bt. (consulting naval architect); Mr. H. T. Allen (Colonial Office); Mr. J. O. Borley (Ministry of Agriculture and Fisheries); Capt. J. D. Nares (Admiralty), and Mr. J. M. Wordie (Royal Geographical Society): Mr. H. Horsburgh (technical assistant); Mr. E. W. Baynes (secretary).

The scientific officers of the expedition are: Dr. Stanley Kemp (Director of Research); Messrs. A. C. Hardy, J. E. Hamilton, N. A. Mackintosh, J. E. G. Wheeler, L. H. Matthews, and E. R. Gunther (zoologists); Messrs. H. F. P. Herdman and A. J. Clowes (hydrologists). Messrs. Mackintosh, Wheeler, Matthews, and Clowes are at present serving at the shore station, South Georgia. The marine staff includes: Commander J. R. Stenhouse (captain); Lieut.-Commander W. H. O'Connor (chief officer); Lieut.-Commander J. M. Chaplin (second officer and surveyor); Eng.-Lieut. W. A. Horton (chief engineer), and Lieut.-Colonel E. H. Marshall (surgeon).

The principal object of the expedition is to obtain information bearing on whales, more especially on those species which form the basis of the industry now flourishing at South Georgia and in the South Shetlands. Although the whale fisheries in these places are controlled by Government regulations, very little is known of the habits and migrations of the animals and of the reasons for the fluctuation in their abundance. It is, indeed, not yet certain whether the closely similar Arctic and Antarctic whales are specifically identical. There is, therefore, much information to be acquired before a satisfactory basis for the control of the industry can be found.

In connexion with the investigations, a laboratory has been established in Cumberland Bay, South Georgia, where examination is being made of the whales captured at the adjacent whaling station. At this laboratory good progress has already been made, for, although the building was only completed in February, 181 whales had been examined by April 10.

Work on the *Discovery* will mainly be directed towards obtaining information on oceanographic conditions in the waters frequented by southern whales, and routine observations on the hydrography and plankton will be made throughout the voyage. On the whale feeding-grounds intensive work will be undertaken and a close study made of the euphausians, which occur seasonally in great abundance, and constitute the principal, if not the only food of southern rorquals. Plankton nets will be employed at all depths, the smaller hauled vertically and the larger, up to a diameter of 4½ metres, horizontally. New apparatus for opening and closing horizontal nets will be tried, together with a mechanism designed to allow of a number of vertical nets being operated on a single line. A very large midwater trawl, with three otter boards, 250 feet in length and with a mouth area of about 1500 square feet, will be used in an attempt to obtain large pelagic organisms, particularly cephalopods, which would be able to avoid smaller nets. Depth recorders, of pressure gauge and thermometer types, will be used to check the depths at which towed nets are fishing. For work on the bottom the ship is provided with dredges of various kinds, traps similar to those designed by the Prince of Monaco, the Petersen grab, and both beam and otter trawls, but the latter will ordinarily be used only on the coastal banks where fish in commercial quantities are likely to be found.

The deck equipment for biological and hydrographic work comprises a large trawling winch carrying 5000 fathoms of tapered warp on one reel and 1000 fathoms of trawl warp on the other. An auxiliary reel with 3500 fathoms of 6 mm. wire is driven from this winch. For vertical nets and hydrographic appliances there are four smaller reels, driven by three engines and all fitted with 4 mm. wire. Two of these reels carry 3500 fathoms of wire for deep observations and two carry 500 fathoms for observations at lesser depths. A Lucas sounding-machine is installed with various attachments for the collection of bottom samples, and a dynamometer, accumulators, metre recorders, an electric centrifuge, and other subsidiary apparatus are provided. There are two laboratories on the ship, one on the upper and one on the main deck, completely equipped for biological and hydrographic work.

Adequate photographic apparatus and a dark room are provided.

The ship is well supplied with apparatus for taking observations while under way. Two sets of echo-sounding gear, for shallow and deep water, have kindly been lent by the Admiralty, and a distance thermograph, designed to give a continuous record of surface temperature, has been fitted. The Knudsen full-speed water-bottle will provide water-samples at some distance below the surface, and it is hoped that a new piece of apparatus, designed by Mr. A. C. Hardy, will furnish a continuous record of the more important organisms in the plankton.

The *Discovery* is not equipped with harpoon guns of the commercial type, but will carry smaller patterns, with which it is expected that Cetacea up to 25 feet in length can be obtained. Observations on living whales will be made whenever possible, and it is hoped that valuable information on their migrations will result from marking experiments. The form of mark has been adopted after repeated tests on the shooting-range with a target made of whale blubber, and after practice on living whales made by Prof. Hjort and a member of the *Discovery* staff who accompanied him. The mark is similar in form to a large drawing-pin, with three barbs on the shank, and is made of annealed cast-iron and silver-plated. The pin is $2\frac{1}{2}$ inches in length and the disc nearly 2 inches in breadth, with a number stamped on it, together with an inscription offering a reward for return to the Colonial Office. Posters and leaflets are being circulated to all the whaling stations of the world giving instructions for the return of the marks, together with the required information. The mark is placed on the end of a light wooden shaft, and is fired from an ordinary 12-bore gun. With this apparatus good practice has been made at ranges up to 70 yards, and the marks embed themselves well even with the target at an oblique angle. The pin is not long enough to penetrate the blubber, and the operation of marking is thought to be quite painless. It is feared that the *Discovery* may be too slow and unhandy to mark whales in any considerable number, but whale-marking will form a large part of the work of a small auxiliary vessel, of high speed and built on the lines of a whale-catcher, which is now under construction.

Geographical exploration is not included in the programme of the expedition, but it is hoped that the echo-sounding gear will provide valuable data in Antarctic waters, and every effort will be made to improve our knowledge of the coast-line and to survey harbours frequented by the whaling community. The second officer of the ship is a qualified surveyor, whose services have been lent by the Admiralty.

Work will begin in the Gulf of Guinea, which is thought to be the northern limit of migration of southern whales. Observations will be made on the plankton and hydrography of this region, and the whaling stations on the West African coast will be visited. After touching at Cape Town a course will be laid for South Georgia *via* Tristan da Cunha and the Falkland Islands. On reaching South Georgia a close survey will be made of the whaling grounds, and, as at present arranged, in January 1926 the ship will make a passage to the South Shetlands by way of the South Sandwich group, proceeding still farther south to the Neumayr Channel if ice conditions are favourable. In March a return will be made to South Georgia, a line of stations being made between Graham Land and Cape Horn if weather permits. A fresh survey of the whaling grounds is then contemplated, and later in the year, during the Antarctic winter, the ship will possibly return to the African coast. Operations in the second year will depend largely upon the results obtained during the first.

## Obituary.

### M. CAMILLE FLAMMARION.

THE death of Camille Flammarion at the age of eighty-three years removes from the world of astronomy one of its greatest ornaments, and one of the most picturesque figures in French scientific circles generally. It is difficult to contemplate astronomy in France without the guiding hand of its beloved "maître," whose "élèves" are counted in all branches of society in all lands.

Camille Flammarion might be described as the apostle of popular astronomy. His numerous literary works had for object primarily the popularisation of astronomical study in all its manifold branches, and it is upon the record of success achieved by those works that his reputation as a scientist should stand or fall. Throughout his life this was a passion with him, kept constantly in view, and meeting with extraordinary success in the birth of the Société Astronomique de France in 1887. This notable Society, recognised by the Republic ten years later as being of public utility, now comprises thousands of members of all nationalities, united by a common love of the sky.

Flammarion was not content to spread abroad the gospel of astronomy by book and pamphlet. He believed in the practical application of his theories for the spread of a universal knowledge of the sky. Although he was not openly impatient of the restraint imposed on the professional astronomer by the routine of the national observatories, which exist chiefly for the many problems involved in the determination of time and position, it is common knowledge that this branch of astronomy appealed to him very little. His interest lay principally in the discussion of the physical facts observed through the telescope, a much more picturesque branch of the science. He was frankly proud of the scientific independence of his observatory at Juvisy and its freedom from official restraints and controls.

With most modern observatories nowadays devoting special attention to the study of the physical and vital constitution of the celestial bodies, astrophysics has definitely taken its place alongside mathematical astronomy, and it is not going too far to claim that this extension of activity is due in large measure to the demand which arose from the interest created by Flammarion in his efforts towards what the French call the "vulgarisation" of astronomy.

In the year 1882 an unknown admirer, M. Méret,