The R.R.S. *Research*

FURTHER information is now available about the progress in the construction of the R.R.S. *Research*. It may be recalled that the purpose of this vessel is primarily the determination of the magnetic elements at sea, work that was formerly undertaken by the S.S. *Carnegie*, a non-magnetic ship operated by the Carnegie Institution of Washington. The *Carnegie* was unfortunately destroyed by fire, after an explosion, when loading petrol, at Samoa nine years ago. During the intervening period, the magnetic data in certain parts of the oceans have become uncertain; it is known that in some areas there have been considerable changes in the secular variations of the magnetic elements, which are not adequately controlled by recent observations. In certain areas, existing charts of the magnetic declination may be in error by four or five degrees. It is fitting that Great Britain, as the principal maritime nation, should accept the responsibility for the work formerly undertaken by the Carnegie Institution, by constructing and operating a non-magnetic ship.

As in the case of the *Carnegie*, the work of the *Research* will not be restricted to terrestrial magnetism. Certain work in meteorology, atmospheric electricity and oceanography will also be included.

The construction of the *Research*, which was authorized more than three years ago, has taken longer than that of a normal ship. The greatest care is being taken to eliminate, so far as is possible and practicable, all ferrous material from the hull, machinery and stores. The construction of a vessel of so specialized a nature necessarily gives rise to many problems. The Department of Terrestrial Magnetism of the Carnegie Institution of Washington has placed all the information obtained from the *Carnegie* freely at the disposal of the British Admiralty. This generous co-operation should greatly help to ensure the success of the *Research*.

The new non-magnetic ship will be larger than the *Carnegie*. Her loaded displacement will be 770 tons, the length on the water-line being 142 ft. 6 in. The hull is being constructed of teak planks on brass frames, subdivided by eight water-tight bulkheads, and will be copper sheathed. The keel, stem and stern posts are of teak and the false keel is of Canadian rock elm. The ship will have two masts and will be rigged as a brigantine, with a full sail area of about 12,000 sq. ft. Diesel oil engines, of 160 B.H.P., four-cylinder, two-stroke direct air reversing type, situated aft, driving a two-bladed feathering propeller, will give an endurance of 3,000 miles with a fuel supply of 14 tons of heavy oil. Much research work was carried out by the makers, Messrs. Petters of Yeovil, to reduce the quantity of steel in the engines to a minimum. A bronze alloy is being used extensively and the crank-shaft is of special non-magnetic steel. The anchors, cables and wire for rigging are of aluminium bronze.

The auxiliary machinery comprises two 9 H.P. and one 18 H.P. Diesel engines, for the dynamos, refrigerator, air-compressor and oceanographical winch. The latter will be driven from the auxiliary engines through line shafting and a fluid flywheel.

In order to reduce magnetic material to a minimum, consideration is being given to such matters as iron nails in packing cases, tin containers for food and cigarettes, cooking utensils, cutlery, razor blades, drums for paint and lubricating oil, and typewriter, all of which will be non-magnetic. Water ($37\frac{1}{2}$ tons) will be carried in specially designed teak tanks and there will be 120 cubic feet of cold storage.

The upper deck will carry two magnetic observatories, an atmospheric electricity laboratory and an oceanographical laboratory. The marine deflector for the determination of the horizontal intensity of the earth's magnetic field will be housed in the forward magnetic observatory: this instrument is a semi-absolute instrument the instrumental constant being controlled by land observations as frequently as possible. The marine collimating compass, for the determination of the magnetic declination, will be placed on the bridge deck, above the chart room. The after magnetic observatory will contain the marine earth-inductor, which will be driven at a constant speed by a rotary converter, controlled by tuning-fork; the inductor will be provided with commutator and slip rings, so that observations may be made using either a direct current or a string galvanometer. A C.I.W. magnetometer-earth inductor and a Smith portable magnetometer will be carried for land observations and for comparison with the instruments at fixed observatories.

The atmospheric electricity laboratory will be situated immediately forward of the aft magnetic observatory. A potential gradient recorder and a point discharge apparatus will be carried. The potential gradient observations will be standardized by a Wulf electrometer. In addition, ionization measurements will be made with a modified Ebert apparatus and conductivity measurements will be made with a modified Wilson apparatus.

The meteorological equipment will include thermometer screen with thermometers; mercury barometer, aneroid and barograph; mercury in steel thermographs for dry and wet bulb temperatures and for sea temperatures; an Assmann psychrometer and an Aitken nucleus counter.

An oceanographical laboratory will be provided, aft of the aft magnetic observatory. Echo-sounding apparatus will be carried.

It is expected that the *Research* will be launched in February 1939 and will be ready for her first cruise in the following October. She will carry six officers, four scientific workers and twenty-two petty officers and men. On her first cruise she will first visit Washington, in recognition of the assistance given by the Carnegie Institution; after calling at the South American ports, she will cross the Atlantic and make observations in an area in the South Atlantic between, and south of, Tristan da Cunha and Cape Town. In this area there has been a large decrease in recent years in the secular change of the magnetic declination. The *Research* will then make a double traverse of the Indian Ocean, first on approximately a great circle track to Perth and then returning on a more northerly track, calling at Cocos Island, Colombo, Seychelles, Mauritius and Durban, where she is due to arrive about November 1940. The subsequent course has not been decided upon in detail, but may include a third crossing of the Indian Ocean and a return via the Pacific and the Panama Canal. The Indian Ocean will be the area to be the most completely observed on the first cruise, since it is in this area that there is the greatest uncertainty in the magnetic data.

H. S. J.

Eye and Brain as Factors in Visual Perception*

By Dr. R. H. Thouless

THAT we see with our eyes is known to everyone and has been known for a long time. That we see also with our brains is less generally realized, and the implications of this fact are relatively recent importations into the theory of vision. The full statement of the physiological mechanism of vision would include not only the sensitive retinal surface and the visual areas of the cortex but also the whole system, which includes retina, optic nerve, visual area of the cerebral cortex, and other sensory areas of the brain as well.

Transmission Theory of Vision

It is possible, of course, to study vision in such a way that everything except the activity of the retina is neglected altogether or relegated to a secondary position, and it was in this way that the scientific study of vision began. This is the point of view which we find in the work of Helmholtz and in much of the experimental research into vision which has followed his deservedly great authority. The basic assumption is that the essential process of vision is the formation of an optical image on the retina and its transmission to the visual centres of the brain by means of the optic nerve. Differences between the sensations transmitted to the brain and the finished perception which appears in experience were attributed to the action of the higher processes of judgment and the influence of past experience.

This theory of vision, which we may call the 'transmission theory', has behind it not only the weight of the authority of the great originators of the experimental study of vision; it has also the advantage of being the view of the man in the street. Its truth seems to many to be so axiomatic that its denial may have the appearance of wilful paradox.

It is, nevertheless, now clear that the transmission theory is wrong, and that a wholly different way of approaching the problems of visual perception is necessary if we are not to be led astray. To say this is not to deny the greatness of the achievements of those investigators in the past whose work on vision was guided by this theory. Within a certain limited field, it proved itself a fruitful guide to research. This field was that of the sensory physiology of the retina. If we wish to discover what is happening on the retina, we must arrange conditions of experiment so as to cut out, so far as possible, the complicating effects of the cerebral components of the visual part of the nervous system. This was what was done when the early experimenters made observations through tubes or on black backgrounds. So such workers as Helmholtz, König, Abney and a host of others made a firm foundation for a science of vision in the sensory physiology of the retina. The error, however, has sometimes been made of mistaking the foundations for the completed building. When we get rid of tubes and black backgrounds

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