

Letters to the Editor.

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Polarisation of Downcoming Wireless Waves in the Southern Hemisphere.

IN the course of experiments carried out some years ago at the Peterborough Radio Research Station of the Department of Scientific and Industrial Research, Mr. Ratcliffe and I made some observations¹ on the state of polarisation of wireless waves after their reflection by the upper atmosphere. On all occasions on which it was possible to obtain reliable measurements it was found that the downcoming waves were very approximately circularly polarised with a left-handed sense of rotation. Since it was known that the waves originally emitted by the sending stations (emitters at both Teddington and Birmingham were used) were plane polarised, with the electric vector in a vertical plane, the experiments showed that the conversion to left-handed circular polarisation had been effected by ionisation in the upper atmosphere during the process of refraction.

In attempting to explain this result it was pointed out that the influence of the earth's magnetic field is such that, for the range of wave-lengths employed (300-400 metres), there is a considerable difference between the absorption coefficients and phase velocities of the two components propagated within a refracting medium containing electric charges of electronic mass. It seemed reasonable, moreover, to suppose that the polarisation of the waves observed at the ground was produced during their emergent passage through the lower part of the refracting region. For this portion of the wave track it was estimated that the direction of propagation would not differ very markedly from that of the lines of magnetic force of the earth. For propagation along this direction the theory showed that, of the two circularly polarised components which travel, the right-handed component would be much more absorbed than the left-handed, so that waves of predominantly left-handed polarisation would emerge from the ionised layer. The account of this attempt to explain the experimental results was, however, concluded with the following sentence: "But it will easily be seen that the most direct test of the above interpretation would be to carry out similar experiments at corresponding points in the Southern Hemisphere, where the resulting polarisation should be right-handed if the effect is due to the action of the earth's magnetic field".

The Australian Radio Research Board, on its formation by the Commonwealth Council of Scientific and Industrial Research in 1929, gave the prosecution of such polarisation experiments high priority on its programme, and Mr. A. L. Green (formerly of King's College, London, and of the Radio Research Stations, Peterborough and Slough), who had assisted in the English experiments, was entrusted with the task of carrying them out. Working in New South Wales, Mr. Green was able to carry out the tests under conditions which were exactly those required for a strict comparison of results in the northern and southern hemispheres. The emitting station was situated at Coogee, Sydney, and the receiving station at a point 142.7 km. south, at Jervis Bay. For these conditions the downcoming waves must have travelled along a direction only slightly inclined to that of the earth's magnetic field. In his lengthy series of observations

Mr. Green has found that all his reliable records show the downcoming waves to be approximately circularly polarised with a right-handed sense of rotation. At his request I have also compared some of his records with those obtained by us in England and have confirmed his result that, under comparable conditions, downcoming waves are polarised in opposite senses in England and Australia.

An account of the complete series of Australian experiments on upper atmospheric influence on wireless transmission will, I understand, be published in due course. Meanwhile, after having had an opportunity of comparing the records in question, I have been requested to announce this very interesting difference between the results in the northern and southern hemispheres.

Experiments on the polarisation of downcoming wireless waves are of more than scientific consequence. The home Radio Research Board, on its formation in 1920, instituted a fundamental inquiry into the cause (and, if possible, the elimination) of night errors in direction-finding. It was recognised at that time that such errors were caused by the arrival at the point of observation of waves which were abnormally polarised, but the origin of such abnormal polarisation was unknown. As a result of Mr. Green's experiments it can now be regarded as certain that the influence of the earth's magnetic field is such as to produce this polarisation. We can say that 'night errors' in wireless direction-finding are due to the arrival at the receiver of waves which leave the emitter as plane polarised waves in a direction inclined to the horizontal and reach the highly ionised regions in the upper atmosphere. There, under the influence of the earth's magnetic field, they are separated into their two component circularly or elliptically polarised waves, which undergo differential absorption and changes in polarisation and are bent round until they leave the ionised regions with a direction of propagation towards the earth. On reaching the receiver they cause fading and errors in the observed direction of the emitting station. It is also gratifying to note that, in connexion with the other aspect of the inquiry instituted by the home Board, Dr. R. L. Smith-Rose and Mr. R. H. Barfield, following suggestions of Mr. F. Adecock, have developed at the Radio Research Station, Slough, a practical direction-finder which is substantially free from errors even under conditions when downcoming waves of abnormal polarisation are being received.

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Potters Bar,
Nov. 23.

¹ "A Method of determining the State of Polarisation of Downcoming Wireless Waves", *Proc. Roy. Soc., A*, 117, 576; 1928.

Oxygen and Everest.

DR. RAYMOND GREENE's article¹ "Oxygen and Everest" is the substance of his contribution to the discussion following Prof. J. Barcroft's paper to Section I of the British Association at the centenary meeting, on "The Limits placed by Altitude to Physical Exercise".

In that paper it was recorded that recent experiments in the pressure-reducing chamber at Oxford have shown how work, claimed to be equivalent to ascending 1000 ft. per hour, can be done by human beings breathing oxygen, at a pressure much below that prevailing at the top of Mount Everest, 29,002 ft. The conclusion arrived at was that for the last 5000 ft. of the mountain, up and down, 700 litres or 30 cub. ft. of oxygen per man would be indispensable, involving in the containers and apparatus necessary