Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 428.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Light thought to have been seen in the Neighbourhood of Alternate Current Magnets

THE late Prof. S. P. Thompson showed that visual effects (excitation of the optic nerve) were produced when the head was placed in an alternating magnetic field.[1] He said, further :

"Nearly four years ago Prof. Birkeland of Christiania told me that his workmen at the nitrate factory at Notodden declared that they could see lights over the choking coils used to limit the currents supplied to the electric furnaces. This may have been in reality a subjective phenomenon similar to that now recorded."

No doubt the view expressed by Prof. Thompson is the most probable. It seemed worth while, however, as a 'fool experiment', to see whether objective lights could be detected by prolonged photographic exposure.

Dr. W. H. Hatfield, to whom I casually mentioned the idea, was so kind as to interest himself in it, and he had a suitable alternate current magnet constructed at the Atlas and Norfolk Works, Sheffield. The iron was, of course, laminated, the gap between the poles being about 0·7 mm. wide and about 8 mm. deep. The mean flux density through the cycle was 4800 lines per sq. cm.

The top of the magnet was flat, so that a photographic plate could be brought right up to the gap, the lines of force being parallel to it. An Ilford hypersensitive panchromatic plate was used, with a thin sheet of 'Cellophane' between it and the magnet.

If the effect existed, there should have been a dark line on the plate, corresponding to the gap. Exposures up to thirty days were given, but no positive result was obtained. Some test experiments indicated that a luminosity fairly distributed through the visual spectrum and just bright enough to be seen by a well rested eye should have impressed the plate easily in twelve hours. The actual exposure was some sixty times greater. It appears most improbable, therefore, that any objective lights can exist. Perhaps most readers of NATURE would have been content to assume that in the first instance.

RAYLEIGH.

Terling Place, Chelmsford.
August 17.

[1] *Proc. Roy. Soc.*, B., **82**, 396 (1910).

Cosmic Rays and Magnetic Storms

S. E. FORBUSH[1] has noted a systematic decrease of cosmic ray ionization at Cheltenham, U.S.A., and Huancayo, Peru, simultaneous with a decrease of the earth's horizontal magnetic force (H.F.), during magnetic storms of April 1937. V. F. Hess and A. Demmelmair[2] have confirmed the existence and world-wide character of the cosmic ray decrease by observations on the Hafelekar near Innsbruck. They agree with Forbush in concluding that the study of these cosmic ray changes during magnetic storms will give valuable information on the spectrum of the cosmic radiation.

It promises also to settle an important unsolved question which bears closely on the mode of origin of magnetic storms themselves. The most intense disturbance of the earth's surface field during a magnetic storm usually occurs in polar regions; but this is not the part of the disturbance with which the greatest change in the energy of the magnetic field round the earth is associated. The energy change depends mainly on the general decrease of H.F. that occurs in all latitudes during and after the main phase of a magnetic storm[3]. The polar magnetic disturbance appears to be due to electric currents in the earth's atmosphere, but it is not known where the general decrease of H.F. is produced, except that the main cause is above the earth[4]. It may be in the highest layers of the ionosphere or right outside the atmosphere.

Ferraro and I have tentatively suggested[5] that it may be due to a ring current encircling the earth at a radial distance of a few earth-radii, a, and composed of positive and negative charges in oppositely directed orbital motions. Størmer[6] had earlier suggested a ring current of much larger radius, composed of charges of one sign only. I have criticized this hypothesis on various grounds[3,4], one being that it would imply an appreciable modification of the earth's field, during a storm, throughout an immense volume of surrounding space, in a manner likely to alter considerably the normal paths of cosmic rays. The present observations give a quantitative relation between the change in cosmic ray intensities and the magnitude δH of the decrease in H.F. at the equator during a storm; they should, with the aid of such calculations of cosmic ray paths as have been made by Størmer and by Lemaître and Vallarta, lead to an estimate of the distance of the currents which reduce the H.F.

Below these currents the H.F. is reduced, above them it is increased, and there the main component of the earth's field corresponds to a doublet of magnetic moment $M + \delta M$ exceeding the earth's normal moment M. It is presumably this increase δM, in this outer space, which accounts for the decrease of cosmic ray intensities.

Theoretical discussion of the cosmic ray change might conveniently be based on the following simple model of the earth's field during a magnetic storm. It is not intended to represent all the important actual features of the field, even if the currents concerned are located in the high ionosphere, and still less if they are ring-currents outside; but it should give the order of magnitude of the radius a' at which the currents are located.