attributed to normal night-time decay following a low noon maximum on November 13. The low value of dn_t/dt after dawn on November 13 suggests that one of the effects of the disturbance may be either an increased rate of recombination or a decreased rate of production of electrons in the lower levels of the ionosphere, where most of the ionization originates. The equivalent column heights at 05.00 hr. lie in the normal range on November 13 and November 14, but this parameter appears to be abnormally high at 10.00 hr. on November 13.

Several workers have measured n_t during magnetically disturbed periods by observations of transmissions of satellites. Hame and Stuart[2] report decreases in n_t at two periods of high magnetic activity near the vernal equinox. Ross[3] finds an inverse correlation between n_t and K_p, the correlation being good in the summer but poor in the winter. Garriott[4] finds normal values of n_t and abnormally high equivalent column heights on disturbed days, the observations applying mainly to the winter half of the year.

These results are not necessarily inconsistent with the present ones, since all the previous observations were made at appreciably lower geomagnetic latitudes than apply here. Maeda and Sato[5] have shown that, at high latitudes, ionospheric disturbances are mainly 'negative' in type (f_oF2 decreases) at all times of the year, while in medium latitudes disturbances are predominantly negative in summer, but may be either positive or negative in winter. The importance of the observations described in this communication is to show that, at least on the present occasion, the reduction in N_m was accompanied by a proportional reduction in n_t. Thus there appears to have been a scaling down of the whole ionosphere rather than a vertical redistribution of ionization within it.

I wish to thank Sir Bernard Lovell for the use of the facilities of the Nuffield Radio Astronomy Laboratories and Dr. J. H. Thomson for valuable guidance. Thanks are also due to the Director of the Radio Research Station (Department of Scientific and Industrial Research), Slough, and the Superintendent of the Magnetic Department, Royal Greenwich Observatory, for permission to quote pre-publication values of f_oF2 and K indices respectively. This work was carried out under U.S. Air Force Contract No. $AF61(052)$–172.

G. N. TAYLOR

Nuffield Radio Astronomy Laboratories,
University of Manchester,
Jodrell Bank.

[1] Evans, J. V., *J. Atmos. Terr. Phys.*, 11, 259 (1957).
[2] Hame, T. G., and Stuart, W. D., *Proc. Inst. Rad. Eng.*, **48**, No. 10, 1786 (1960).
[3] Ross, W. J., *J. Geophys. Res.*, **65**, 2607 (1960).
[4] Garriott, O. K., *J. Geophys. Res.*, **65**, 1151 (1960).
[5] Maeda, K. I., and Sato, T., *Proc. Inst. Rad. Eng.*, **47**, 232 (1959).

PHYSICS

Optical Demonstration of Bragg's Law

A SIMPLE and rather striking demonstration of Bragg's Law can be given by making use of Lippmann's method for producing colour photographs[1]. In this method a photographic plate with an extremely fine-grained emulsion is placed with its sensitive layer on a mercury surface. It is then exposed from above, through the glass plate, to monochromatic light, for example from a sodium arc lamp. Due to reflexion at the mercury surface, standing light waves are produced in the sensitive layer, which, after development, give rise to parallel equidistant layers of photolytic silver, with a spacing equal to half the wave-length of sodium light.

Such a plate, of dimensions, for example, 3 cm. × 3 cm. (prepared in this Laboratory by B. Phielix, using, with some modification, a method described by H. Lehmann[2]), is fixed on a revolving holder, and inserted in an ordinary spherical glass flask as used in chemical experiments (diameter about 10 cm.). The flask is filled with benzene, to prevent reflexion at the outer surface of the emulsion layer. If now a parallel beam of white light, after passing through the solution, is reflected by the Lippmann plate, the latter acts as an 'interference mirror', and reflects a coloured beam, the colour changing with the angle of incidence. The reflected beam, when falling on a transparent screen, is of sufficient strength to be visible in a lecture room. In the experiment as I have performed it, the colour changes from yellow at a glancing angle Θ in the neighbourhood of 90° to violet at Θ about 45°.

The arrangement may serve to illustrate the influence of a slight change in spacing on the reflected wave-length. By breathing on the sensitive layer, a slight swelling of the gelatine takes place, which produces a considerable change in colour, from yellow to red for Θ close to 90°, whereas for $\Theta \sim 45°$ the colour of the reflected beam changes only from violet to blue. Thus also the different sensitivity of 'high-angle' and 'low-angle' reflexions for a slight change in spacing can be illustrated.

I do not know whether this 'application' of Lippmann's plates has already been described elsewhere. In a most interesting paper on "The Crystal Structure of *Tipula* Iridescent Virus as determined by Bragg-Reflection of Visible Light"[3], A. Klug, (the late) Rosalind E. Franklin and S. P. F. Humphreys-Owen analysed a crystal with lattice spacings so large that these could be measured by reflexion of visible light. Dr. Klug told me that cells containing these virus crystals had been used to demonstrate Bragg's law optically. This suggested to me that the above demonstration might be of some interest.

W. G. BURGERS

Laboratorium voor Fysische Scheikunde
der Technische Hogeschool, Delft.

[1] Lippmann, G., *C. R. Acad. Sci., Paris*, **112**, 274 (1891).
[2] See *Hdb. d. angew. u. wiss. Photogr.*, **4**, 247; **8**, 222 (Wien, 1930).
[3] Klug, A., Franklin, Rosalind E., and Humphreys-Owen, S. P. F., *Biochim. Biophys. Acta*, **32**, 203 (1959).

Acceleration of Deuterons in a Synchrotron

BECAUSE of the theoretical interest in the study of the collisions between nucleons, all the large heavy-particle synchrotrons at present operating have been designed to accelerate protons[1]. In many of these machines, however, the frequency of the accelerating voltage can be pre-set to follow any suitable law of variation with magnetic field. There is nothing then to prevent the acceleration to an appropriate energy of particles with an e/m different from that of the proton providing that they can be injected.

In the Birmingham proton synchrotron[2] the radio-frequency law was originally obtained by a rotating condenser which varied the capacity in an oscillator circuit[3]. This system has now been successfully