corresponded to integral multiples of 27^m, and all except the greatest, to the concurrence of integral multiples of both periods. This exception may seem to vitiate the whole conception of the double periodicity suggested, but the objection disappears when it is remembered that an impulse may be periodic without its amplitude factor being a constant, and it only requires a suitable adjustment of the values of these factors for the maximum of the 27 minute period to more than neutralise at this one point the minimum of the 18 minute period. There are also many other oscillations of short period present which must necessarily modify the absolute values of maxima.

This double periodicity may be accounted for, if we suppose the magnetic disturbances to be due to ionic emissions from the sun, propagated in rays with approximately equal spacing, whilst the density of the ions varies in a periodic manner, in shells along the rays, owing to a pulsating or rhythmic emission from the disturbed region on the sun. In this way the orbital motion of the earth, entering the successive rays, would account for one period, whilst the arrival of successive shells at the earth's position would account for the other, and variations in the degree of concentration in both rays and shells would account for any variations in amplitude, as well as for the presence of minor oscillations concurrently with those presenting the more conspicuous features of the record.

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Use of Interference Methods in the Determination of Stellar Diameters.

REFERRING to the article on the work of Prof. Michelson in NATURE of January 2, it is interesting to note that the first suggestion as to the application of interferential methods to the determination of the angular diameter of stars appears to have been made in 1868, being due to Fizeau, and that the method was actually put to the test in France—although with negative results—seventeen years before Prof. Michelson's paper of 1910 referred to by Sir Oliver Lodge. Pointing out a relation between the width of the interference bands and the dimensions of the source of light, Fizeau added this pregnant remark: "It is perhaps permitted to hope that by taking this principle as a basis, and in forming, for example, by means of slits wide apart, interference fringes at the faces of large instruments intended for stellar observations, it will become possible to obtain some new data on the angular diameter of the stars" (*Comptes rendus*, 5, 66, 1869, p. 934).

In the absence of any telescope of sufficient size, this suggestion was bound to remain barren for more than fifty years, but the method was nevertheless actually used in Marseilles in 1873, by Stephan, with a telescope of 0·80 metre aperture, for the purpose of measuring stellar diameter. The aperture was, however, too small, and Stephan had to be satisfied with ascertaining that the apparent diameter of stars of the first magnitude, including Sirius, is less than 0·158″ (*Comptes rendus*, 5, 76, 1873, and 5, 78, 1874, p. 1008).

The first successful application (to the measurement of the diameter of the satellites of Jupiter, of the order of about 1″) was made by Prof. Michelson in 1891, but, by an improvement of the method, Hamy in Paris measured in 1898 the apparent diameter of Vesta (0·54″).

As we all know, the prize fell finally to the hands of the American astronomers, thanks to the amazing self-confidence and tenacity of purpose, combined with almost superhuman skill, which rendered pos sible the adjustment of mirrors, some twenty feet apart, to an order of displacement comparable to the wave-length of light.

The fame of Prof. Michelson is so well established, and the results themselves are so striking and far-reaching, that the above acknowledgment of the efforts made elsewhere, sterile, it seems, only because of the modest equipment available, in no wise diminishes the glamour of the final achievement.

M. GHEURY DE BRAY.

The Free Path of Slow Protons in Helium.

IN the issue of NATURE for December 19, p. 900, Dr. A. J. Dempster states that he has found that slowly moving protons pass almost freely through helium atoms without being neutralised. In this connexion it may be of interest to state that I have found in the course of experiments on the scattering of protons (hydrogen positive rays) by helium and other gases, that the scattering in helium is a maximum for rays of the energy of about 10,000 volts. For slower rays the scattering is less, and for rays of 3500 volts, the slowest examined, is about 75 per cent. of the maximum. While these rays are considerably faster than those used by Dempster (300 to 900 volts), both results are probably part of the same effect. This may be analogous to the abnormal penetration of very slow electrons through certain gases found by Ramsauer. The *velocities* of these electrons were about the same as those of the protons used by Dr. Dempster. The effect was most marked in argon, but also occurred in helium and neon.

Results on the scattering of protons in hydrogen, now awaiting publication, do not show this abnormality, the scattering increasing with decreasing energy of the rays, though less rapidly than would be expected if the scattering were due to forces of the inverse square type. Experiments on argon are in progress.

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Residual Ionisation in Closed Vessels.

EXPERIMENTS have frequently been carried out to determine the residual ionisation in closed vessels, and to reveal the conditions under which this is a minimum. One of the lowest values hitherto measured is that of McLennan and Murray, who made their measurements over Lake Ontario, using an ionisation chamber of ice. They obtained the value $q = 2{\cdot}6$ pairs of ions per c.c. per second.

It seems to have escaped notice that K. Bergwitz ("Elster-Geitel Festschrift," p. 585 (1915)) has made measurements in rock-salt workings in Germany, when he found the exceedingly small value of $q = 0{\cdot}8$.

The value of the residual ionisation has a significance in connexion with estimates of the contribution of the penetrating nebular γ-radiation to atmospheric ionisation, and I have not seen a reference to Bergwitz' result in recent publications on this subject. This is undoubtedly due to the fact that the above-mentioned publication is not so well known as it deserves to be. It commemorates the sixtieth anniversary of those two distinguished and inseparable German scientists, Elster and Geitel, and contains many valuable contributions to radioactive literature.

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