Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Diffraction of Cathode Rays by Thin Films of Platinum.

IN a letter to NATURE of June 18, Mr. Reid and I described the rings formed when a beam of cathode rays was sent at normal incidence through a thin film of celluloid and struck a photograph plate placed some distance behind the film. These were attributed to a diffraction of the cathode rays by the film, the cathode rays behaving as waves of wave-length h/mv according to de Broglie's theory of wave mechanics, and regularities in the structure of the film, or in the size of the molecules, making it behave as a kind of diffraction grating. In a paper now awaiting publication by the Royal Society, this work has been confirmed and extended to films of gold, aluminium, and of an unknown (probably organic) substance. In particular, the relation that the size of the rings is in all cases inversely as the momentum of the cathode rays is fully confirmed, and the number and size of the rings correspond remarkably with what is to be expected from the known crystalline structure of gold and aluminium, using de Broglie's expression for the wave-length of the cathode rays.

The present letter describes an extension of these results to the case of platinum. The difficulty was to get a film of platinum sufficiently thin to permit of the passage of the cathode rays without so much scattering as to mask the rings. One method was to obtain a thin film of platinum by cathodic spluttering on glass and removing the deposit by hydrochloric acid. This gives films thin enough to be transparent and several millimetres each way, but when they were mounted on frames, they always broke during the course of drying. To avoid this, I tried mounting them on the thin celluloid films used in the earlier experiments. This, of course, has the disadvantage that one would expect to get the rings due to both celluloid and platinum superposed. However, the most marked celluloid ring is about half the size to be expected for the smallest platinum ring, the other celluloid rings being very faint, under the conditions of experiment. It was found that when a photograph taken with platinum on celluloid was compared with one for celluloid alone, several new rings appeared. The photograph (Fig. 1) shows the innermost and strongest of these, the celluloid ring inside being visible only as a disc owing to over-exposure. In addition there were two new outer rings too faint to reproduce. Photographs were taken of these rings with various speeds of rays, and the size varied inversely as the momentum within the errors of experiment.

Since platinum is a face-centred cube of side $3 \cdot 91 \times 10^{-8}$, the distances d between successive crystal planes are given by $\frac{3 \cdot 91 \times 10^{-8}}{\sqrt{h^2+k^2+l^2}}$, where h, k, l are the indices of the plane, to be so chosen that they are all even or all odd. The smallest values of the denominator are $\sqrt{3}$, $\sqrt{4}$, $\sqrt{8}$, $\sqrt{11}$, $\sqrt{12}$. Each of these spacings gives a ring in the Debye-Scherrer method of X-ray analysis, and if the view that all particles behave like waves is correct, should do so with cathode rays also, assuming that small crystals orientated at all possible angles to the beam are present in the film. It is believed that the ring illustrated is a compound of the $\sqrt{3}$ and $\sqrt{4}$ ring unresolved (in the case of gold, which gives better films, the corresponding rings have actually been resolved), the two outer rings being $\sqrt{8}$ and an unresolved compound of $\sqrt{12}$ and $\sqrt{11}$. Taking the diameter of the inner ring as the mean of $\sqrt{3}$ and $\sqrt{4}$, the diameters of the outer rings are $\sqrt{8 \cdot 2}$ and $\sqrt{11 \cdot 1}$ as a mean from four plates. The absolute size of the rings is given by the Bragg law $n\lambda = 2d \sin \theta$. Taking the inner ring and using the above formula for λ, I find for the side of unit cube $3 \cdot 75 \times 10^{-8}$ (mean of 6 plates) against $3 \cdot 91 \times 10^{-8}$ as found by X-rays. This is 4 per cent. low, and would be about 6 per cent. low if the relativity correction were put in. The values found for gold and aluminium were also low by about the same amount. This may be due to a systematic experimental error, or may have a theoretical reason (for example, be analogous to the Compton effect).

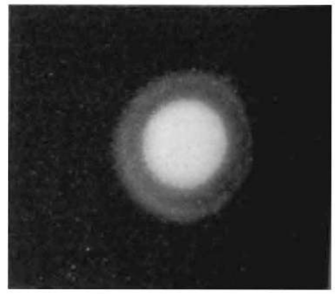

FIG. 1.

These results have been confirmed by some experiments with a thin piece of platinum further reduced in aqua regia. Though this was still too thick as a whole, it must have had thin patches, as photographs showed, besides spots due to holes and the direct beam, other 'diffracted' spots arranged in circles round the centre. These are explained by supposing that in this film, which had probably been originally made by rolling, the crystals were not situated in all possible directions, and so did not give complete Debye-Scherrer rings, but only spots on them, more like a Laue pattern. It was possible to distinguish between the spots corresponding to the two inner rings, and the ratios of their distances from the centre were $\sqrt{3} : \sqrt{4 \cdot 2}$ (mean of two plates).

The energy of the rays used in these experiments varied from 30,000 to 60,000 volts, and the distance from film to plate was 32·5 cm.

G. P. THOMSON.

University of Aberdeen, Nov. 17.

Note added in proof.—Using a very thin piece of platinum leaf, I have now been able to obtain rings similar to those described above, without the use of celluloid backing. The inner ring is resolved into two as in the case of gold.

Method of Fossilisation of an Insect Wing.

IT has long been known that when the wing of an insect becomes fossilised the original chitin is either completely destroyed or else replaced by some other substance, such as carbon, silica, or oxide of iron. This, however, does not explain the extraordinary perfection with which some insect wings have been preserved, even in Palæozoic strata. A recent study of two thousand fossil insects from the Lower Permian of Kansas, approximately two hundred millions of years old, has brought to light many specimens in which the wings are as perfect as if they had just been dissected from the insect; yet it is evident that the original chitin is not present, neither is it replaced by any other substance. The explanation of this is to be found as follows:

The wing of an insect is really a bag the sides of which have been brought into contact and fused together