LETTERS TO THE EDITOR.

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Reflection of X-Rays and Related Phenomena.

IN a letter to NATURE of April 17, M. de Broglie described bands or fringes observed in the photographs produced by reflection of X-rays on certain crystals. Further experiments seem to show that there are two or even three different types of bands present, which must be attributed to different causes.

First, there is the ordinary dispersion, with the difference that in the case of a three-dimensional grating the spectrum of the primary beam, presumably continuous within certain limits, will appear as a series of bands as certain wave-lengths are destroyed by interference. This would lead to an apparently abnormal lengthening of the spots at a distance from the centre, which has, in fact, been observed. It would not, however, account for bands in the principal regularly reflected spot.

Secondly, the bands of interference described by Hupka and Steinhaus must be present whenever the primary beam is divergent. As was to be expected, these appear to be present in all the spots if the focus of the kathode rays on the anti-kathode is sufficiently small. They seem to indicate the existence of X-rays of considerably shorter wave-length than the average wave-length in the primary beam, and may possibly be due to fluorescent radiation.

Thirdly, very strongly marked bands are often observed, which must probably be attributed to invisible cracks along the planes of cleavage in the crystal. In certain circumstances the movement of the focus of the kathode rays in consequence of changes of hardness in the tube may enhance this effect. The fact that the bands are nearly equidistant in a large number of different crystals of the same substance might possibly be attributed to the varying velocity of growth of the crystal on account of the seasonal changes during its formation.

As M. de Broglie pointed out, analogous figures to those obtained by photographing the reflection of X-rays on cubic crystals may be produced by reflection of visible light on a square crossed grating. Laue's theory, which seems to be equivalent to Bragg's, if one assumes cubical packing, shows that only a limited number of lines of definite wave-lengths appear on the plate if one has a three-dimensional grating or space-lattice. Reflection on some crystals, *e.g.* the base of a prism of phosgenite, $(PbCl)_2CO_3$, appears to show all the spots a two-dimensional grating would lead one to expect, *i.e.* only the surface layer appears to come into play. Whether this is due to its opacity to X-rays or to the fact that the mean distance apart of the atoms in the direction vertical to the reflecting plane may be an irrational fraction of the distance in the reflecting plane, has yet to be investigated. If, however, one accepts the hypothesis that we have here reflection on the surface layer only—an hypothesis which the number and position of the spots would seem to justify—then we have in this case true spectra of the X-rays emitted by the tube and not, as in Laue's experiments, X-rays of definite wave-lengths sorted out by the grating. The spectra appear to comprise about one octave with a mean wave-length of $\lambda = 0{\cdot}037c$, where c is the distance of two neighbouring reflecting atoms. It appears difficult to obtain good photographs with this crystal, as with most others containing elements of high atomic weight. This may be due to the increased amount of secondary fluorescent radiation and to the greater sensitiveness of the photographic plate to these rays.

The examination of a series of crystals of the regular system confirmed the consequence of all theories and the experiments of various physicists, that the figures obtained must depend only on the position of the plate and the crystal with respect to the primary beam. It is difficult to give definite data as to the reflecting power of different crystals, though it seems that it may be taken as a general rule that those composed of elements of lower atomic weight reflect better than those containing heavier atoms. The relative intensity of different spots varies in different crystals, probably according to the distribution of energy amongst the different wave-lengths in the primary beam. But even in one and the same crystal the intensity of different spots varies according to its position. Thus with an ordinary square crossed grating the spectra are at the points of intersection of a series of concentric circles and hyperbolæ. By turning the grating in its own plane by 45° the circles open out into hyperbolæ and *vice-versâ*. When the plane of incidence is parallel to the lines in the grating spots of equal brilliance are on the circles; at 45° the same spots, still of equal brightness, are on the hyperbolæ. The same experiment carried out with X-rays reflected on rock-salt shows that the spots of approximately equal brightness are on the circles.

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Stratigraphical Problems in New Zealand.

THOUGH I do not in any way object to the review of my book on the geology of New Zealand published in NATURE (January 30, p. 591), I should like to explain further one or two points, for, from the manner in which they are quoted in the review, they are obviously open to misapprehension.

It is stated that "it is hard to comprehend why unconformity should be demanded as a proof of the distinction between two successive geological systems." The fact is that those who have wished to split the system of our younger rocks into distinct parts have insisted upon the existence of unconformities. Careful work has, I think, now shown conclusively that such breaks do not occur in these rocks. It is therefore the wish of some of us to represent these rocks as in fact they are: a simple conformable sequence. The lithological nature of all the lower members shows that they were deposited during a uniform and continuous movement of depression.

It is true that the lowest members of this sequence contain Cretaceous fossils. These Cretaceous sediments are followed by a considerable thickness (500 to 2000 ft. in different sections) of unfossiliferous rocks. Cainozoic fossils then begin to appear—in small numbers at first—but soon a luxuriant Miocene molluscan fauna is developed. It is, however, well to bear in mind, as is frequently mentioned by Hutton, that several of the genera appear in the Eocene sediments of Australia. Associated with the "Miocene" mollusca is an echinoid fauna consisting of thirty-two members, which, in a critical article by Tate, is said to be Eocene with a Cretaceous complexion; at any rate, all the members of it are extinct.

The point on which I wish to insist is this. All the lower members of this conformable sequence were deposited during the continuance of uniform physical conditions and in direct continuous succession. Some time after the Cainozoic fauna had appeared elevation commenced. A series of rocks deposited under such conditions should surely constitute a geological system