Coherence of the Reflected X-Rays from Crystals.

ON Jauncey's theory (*Phys. Rev.*, **25**, 314; 1925) of the unmodified line in the Compton effect, an unmodified X-ray is scattered when the energy of the impulse imparted to an electron is insufficient to eject the electron from the parent atom. In this case the impulse is presumably imparted to the atom itself. The change of wave-length of the unmodified ray should thus be of the order of [(mass of the electron)/(mass of the atom)] × (change of wave-length of the modified line). It is generally assumed that no coherence occurs for modified scattering on account of the change of wave-length. In the case of unmodified scattering, however, it is assumed that coherence does occur, as, for example, in regular crystal reflection (see papers by Williams, *Phil. Mag.*, **2**, 657; 1926; and Jauncey, *Phys. Rev.*, **29**, 757; 1927). But how can coherence occur in unmodified scattering if there is a change of wave-length, however small? Perhaps there is no change of wave-length at all in unmodified scattering.

Following the idea underlying Jauncey's interpretation of the unmodified line, the atom should not by itself receive the impulse of the scattered quantum unless the energy acquired from this impulse is sufficient to give at least one quantum of vibrational heat energy to the atom. According to Einstein's theory of specific heats, this energy is $h\nu$, where ν is a frequency of the order of that of the *reststrahlen* from the substance in question. The wave-lengths of two bands of these *reststrahlen* from rock-salt are 47μ and 54μ (Wood, "Physical Optics," p. 412), or, let us say, of the order of 50μ. A quantum of this wave-length has an energy of 0·024 electron. If we consider the K_a line of molybdenum reflected from the (100) planes of rock-salt in the n^{th} order, the energy of recoil given to a sodium atom by the impulse imparted by the reflected quantum is $0{\cdot}0252 \sin^2\theta$ volt-electrons (see Compton, "X-Rays and Electrons," p. 267). Replacing $\sin\theta$ by $n\lambda/2d$, the energy of recoil is $4{\cdot}02 \times 10^{-4} \times n^2$ volt-electrons. Hence the ratio of the energy of recoil for each order to the energy of a quantum of *reststrahlen* is as follows:

n	1	2	3	4	5	6	7
ratio	0·017	0·067	0·15	0·27	0·42	0·60	0·82

The highest possible order of reflection according to Bragg's law is the seventh. The fact that the ratio is always less than unity indicates that the energy of recoil is always less than that of a quantum of thermal agitation, and this implies that the thermal agitation will not be excited. Presumably, therefore, the impulse is imparted to the crystal as a whole. There is thus no reason to anticipate an absence of coherence in the reflected rays.

This point of view leads naturally to the quantum interpretation of crystal diffraction as suggested by Duane.

G. E. M. JAUNCEY.
Washington University, St. Louis.
A. H. COMPTON.
University of Chicago, Sept. 1.

Spectrum of Ionised Krypton.

THE lines of the spectrum of krypton which appear under the influence of condensed discharge, were first carefully measured by Baly (*Phil. Trans.*, vol. 202, p. 183; 1903). Messrs. L. and E. Bloch and Dejardin (*Ann. de Phys.*, vol. 2, 1924) have recently studied the spectra of krypton developed with electrodeless discharges, and re-arranged most of the lines given by Baly, and also many new lines measured by themselves, into groups of spectra appearing with varying excitations. Following the analogy with ionised neon, the spectrum of which was analysed by me some time ago, I have observed that the spark lines of krypton which appear at the lowest excitation show a considerable number of regularities. I give below three groups of terms, *A*, *B*, and *C*; such that *A* combine with *B*, and *B* with *C*, and account for a large percentage of lines. The values given are purely arbitrary, the deepest level so far discovered corresponding to 0.

A.

0	4774·4
2263·6	5645·7

B.

21094·9	25550·4	28891·5
21457·7	26272·7	29164·5
22952·1	27288·0	29532·4
23240·1	27306·1	

C.

44247·5	48970·1	50526·3
45053·8	49045·7	51607·5
48577·4	49227·2	52245·5
48620·0	49734·2	52310·1

I have not yet succeeded in identifying the natures of these terms unambiguously: Zeeman splitting of some of the lines holds out the best promise of success in this direction.

P. K. KICHLU.
Physics Dept., Science College,
Patna, India, Sept. 14.

The Diminution in Number of the Nodes in the Bivalents of Lilium.

THE species of Lilium examined have twelve pairs of long chromosomes. The numbers of nodes in the bivalents of *Lilium longiflorum* (and *Lilium regale*) were counted at different stages, from the earliest prophase, immediately after the diplotene stage, to the diaphase; and also at the metaphase itself. These counts were usually made after pressing cytoplasm and chromosomes from the cell. Such counts showed that the average number of nodes for the group of twelve chromosome pairs was 22·1 for the diaphase and metaphase, while in the earliest prophase it was found to be 39. Thus nearly half the nodes (43 per cent.) disappeared between the diplotene stage and the diaphase. In *L. longiflorum*, pollen mother-cells observed at stages between the earliest prophase and the diaphase showed different degrees of diminution in the number of nodes. In the four largest chromosomes of *Hosta cœrulea*, a similar reduction was observed, from 9 to 5 nodes. From the drawings of Newton (*Linn. Soc. Jour.* (*Bot.*); 1927) it can be estimated that there was a loss of nodes between the earliest prophase and the diaphase of somewhat less than one-half the number in Tulipa.

The nodes at the diaphase and first metaphase can be proved, in all or nearly all cases, to be chiasmas. This can be shown in *L. candidum* by pressing the metaphase bivalents flat, when the X-chiasmas are clearly visible. The question is, then, what is the nature of the nearly fifty per cent. of the nodes which disappear before diaphase? The writer considers that the majority of these are not half twists; as has, perhaps somewhat hastily, been concluded by the early cytologists.

JOHN BELLING.
Department of Genetics,
Carnegie Institution of Washington,
Cold Spring Harbor,
Long Island, N.Y., Aug. 23.