current was alternating or rectified. An increase in voltage seems merely to intensify the rings and to result in their further subdivision. That the rings are caused by electrons is shown by the fact that they can be moved by a magnet. That they do not occur at different moments of a single discharge cycle can be shown by viewing them in a rotating mirror.

The accompanying photograph (Fig. 1) was taken at an angle of about 45° to the glass plate so as to avoid the general illumination inside the tube and clearly illustrates the multiple ring formation.

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The Diffraction of X-Rays by Vitreous Solids and its Bearing on their Constitution.

The diffraction of X-rays by glasses has been the subject of many investigations during the last fifteen years, notably by Scherrer, Wyckoff, and Seljakow. Scherrer obtained broad diffraction bands similar to those obtained with liquids, whilst Wyckoff obtained, in general, more complicated patterns consisting of lines, bands, or lines superimposed on bands. The latest contributors to this subject are Parmelee, Clark, and Badger (*Jour. Soc. Glass Technology*, **13**, 285; 1929), and Clark and Amberg (*ibid.*, p. 290), who have also obtained broad diffraction bands for silica and felspar glasses. Quite apart from the validity of any of these measurements, no previous workers appear definitely to have identified the diffraction bands with small crystallites in the glass.

With the view of obtaining more precise data on the constitution of glasses we have recently examined the diffraction effects produced by passing copper $K\alpha$ radiation through silica, wollastonite, sodium borate, potassium borate, boric oxide, selenium, potash and soda felspars, glucose and sucrose, in the glassy state. Results have also been obtained with the more usual soda–lime–silica and boro-silicate glasses.

We have been able to show that silica glass corresponds to either cristobalite or tridymite crystallites, of average size $1{\cdot}5\text{-}2{\cdot}0 \times 10^{-7}$ cm., with the evidence very much in favour of cristobalite. Also we have shown that wollastonite ($CaSiO_3$) glass corresponds to the crystalline pseudo-wollastonite and that sodium borate $Na_2B_4O_7$ corresponds to crystals of this substance.

In the case of potash felspar ($K_2O . Al_2O_3 . 6SiO_2$), it has been found that the crystallites of the glass are mainly silica (probably cristobalite). The identity of the remainder is as yet uncertain. Boro-silicate glass containing 70 per cent SiO_2, 17 per cent B_2O_3, and other substances in minor proportions gives a very similar band. It has been found, in further confirmation of the observations, that potash felspar glass devitrifies to cristobalite and that wollastonite glass, which, it is to be expected, is much more stable, devitrifies to crystalline wollastonite at 900° C.

We are not in agreement with the observations of Parmelee, Clark, and co-workers on the positions and number of bands obtained with fused silica and with felspar glass. We obtained for fused silica one band with a spacing of 4·33 A., whereas they obtained two bands, one at 7·1 A., and a faint one at 2·5 A. Our work was carried out with copper $K\alpha$ radiation, whereas they worked with the radiation from a molybdenum target. We have repeated our measurements with molybdenum $K\alpha$ radiation, and again obtain the strong band at 4·33 A., together with a faint and much more diffuse band at about 1·5 A. For equal distances of specimen from film the breadth of a band when using copper $K\alpha$ is roughly twice that with molybdenum $K\alpha$, so that failure to detect the faint band with copper $K\alpha$ may have been due to this cause. We have tested out this point and have failed to obtain the second band using copper $K\alpha$ radiation with the distance from specimen to film reduced by more than half. It seems probable, therefore, that the faint band obtained with molybdenum $K\alpha$ radiation is spurious and that the only one on which reliance can be placed is that at 4·33 A. We have checked this spacing with those of standard substances obtained on the same apparatus and are unable to understand the value of 7·1 A. given by Parmelee and Clark. We hope shortly to publish these results elsewhere in greater detail.

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Scattering of Electrons and α-Particles.

Experiments by Rutherford show anomalies in the scattering of α-particles in a certain range of velocities for light elements. Similarly, the scattering of electrons by atoms shows anomalies for small velocities, as was discovered by Ramsauer. Both effects can be treated in a similar way by wave-mechanics considerations.

Let us first consider the corresponding one-dimensional problem. A particle is reflected (scattered) from a potential valley. When the valley has the simple form of a rectangle, the effect can be treated as the well-known phenomenon of interference from thin plates in optics. For certain velocities (frequencies) no particles (light) are reflected, for other velocities the coefficient of reflection has a maximum. This is not limited to a rectangular shape but occurs for very general potential valleys.

In the three-dimensional case, particles which are treated as a plane wave are scattered by an atom or by a nucleus, which is assumed to possess spherical symmetry. This plane wave may be enveloped into a series of spherical harmonics.[1] For each component one obtains a scattering coefficient, which is an oscillating function of the velocity of the incident particles.

In the first approximation the atom can be considered as a potential valley, which can be determined by the methods of Hartree. A nucleus should also be treated in this approximation as a potential valley, as was pointed out by Gamow in his theory of radioactive disintegration.

For electrons of sufficiently small velocities, only the zero order scattering is appreciable. The minimum of the zero order scattering explains the Ramsauer effect.[2] Something similar is true when an α-particle hits a nucleus with a velocity which is high enough so that it passes over the potential wall separating the inside of the nucleus from the outer space. For certain velocities of the incident particles the scattering coefficients of low order are affected a great deal by the presence of the potential valley. The resulting modification of the Rutherford scattering law has been calculated and reproduces the general type of experimental curves. Quantitative agreement cannot be expected until the shape of the potential valley of the nucleus is known in detail.

The detailed presentation will be given in an article to appear in the *Zeitschrift für Physik.*

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[1] H. Faxén and J. Holtsmark, *Zeit. f. Physik*, vol. 45, p. 307; 1927.

[2] J. Holtsmark, *Zeit. f. Physik*, vol. 48, p. 231; 1928: vol. 52, p. 485; 1929.