by the Correspondence Principle in modern quantum theory, and the paradox to which I have directed attention is a definite proof that, in this form, the Correspondence Principle is false. It is false for the obvious reasons that physical characteristics cannot be simultaneously describable by classical variables and by quantum operators, and hence that there cannot be any rigorous one – one correspondence between these two systems. Trivial though this conclusion appears, it is sufficient to require the complete revision of the greater part of the quantum theory, which at present still leans heavily on the crutches of the Correspondence Principle.

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Isotopic Constitution of Uranium

THE analysis of uranium rays from the volatile hexafluoride by Dr. Aston[1] has shown a single line at atomic weight 238. The element appeared to be simple to at least two or three per cent, but its properties were not favourable for study in the gas discharge. As uranium is of great importance for the subject of radioactivity, the spark source described in NATURE of April 6 (**135**, 542) was tried with uranium metal and gold as electrodes, and also with an electrode made by packing a nickel tube with pitchblende. It was found that an exposure of a few seconds was sufficient for the main component at 238 reported by Dr. Aston; but in addition on long exposures a faint companion of atomic weight 235 was also present. With two different uranium electrodes it was observed on eight photographs, and two photographs with the pitchblende electrode also showed the new component. The relative intensity could be only roughly estimated on account of the irregularity of the spark, but it appeared to be less than one per cent of the intensity of the main component.

This faint isotope of uranium is of special interest as it is in all probability the parent of the actinium series of radioactive elements. In discussing Dr. Aston's analysis[2] of the isotopes in lead from radioactive minerals, Lord Rutherford[3] pointed out that the lead isotope of atomic weight 207 is probably the end product of the actinium series, so that the atomic weight of protoactinium would be 231, $(207+6\times4)$. This value has been verified by the recent chemical determination of the atomic weight by v. Grosse[4]. Protoactinium itself may be formed by α- and β-ray transformations from a hypothetical isotope of uranium, actino-uranium, with an atomic weight of 235 or 239[3]. The relative amount of actino-uranium at present on the earth would be 0·4 per cent of the uranium according to a recalculation by Dr. v. Grosse[5,6]. The present observations thus support this theory, with the atomic weight of 235 for the isotope actino-uranium. A third isotope, uranium II, of atomic weight 234 amounts theoretically to only 0·008 per cent of the uranium, and would be too faint for observation by the mass-spectrograph.

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July 12.

[1] Aston, NATURE, **128**, 725; 1931.
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[3] Rutherford, NATURE, **123**, 313; 1929.
[4] A. v. Grosse, *Proc. Roy. Soc.*, **150**, 363; 1935.
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[6] A. v. Grosse, *J. Phys. Chem.*, **38**, 487; 1933.

Intensity of Polarised X-Rays

To obtain a pencil of plane-polarised X-rays as free as possible from unpolarised radiation, Barkla's original method is still the standard. The resulting beam produced by scattering an ordinary X-ray beam through 90° from its original direction is always very weak. Partial polarisation of the direct beam from an X-ray tube was found by Barkla, and Kulenkampff[1] found strong polarisation near the short wave-length limit in the general radiation. Mark and Szilard[2] found no polarisation in the fluorescent radiation even at 90°. In the scattering method some increase of intensity is found when the scatterer will give a 'powder' line for which the Bragg angle, for the strongest component of the incident radiation, is 45°.

The polarised beam got by any of these methods proved too weak for use in some experiments on the interaction of polarised X-rays and crystals. A serviceable polariser for CuK_α radiation was made by using a single crystal as the scatterer. The most intense beam was got from a single crystal of copper cut parallel to the 311 planes ($2\theta = 90°\ 10'$). Serious reduction in reflecting efficiency due to distortion can be avoided by the use of a special technique for preparing the section. The results of a comparison of intensity of the beam of polarised X-rays given by such a polariser and by the standard methods are shown in the table. As an ionisation spectrometer was not available, a photographic method had to be used. An attempt was made to produce the same blackening of photographic film by each of the methods in turn under similar conditions of working of the X-ray tube and of photographic development. Each film was then measured on a Moll microphotometer and the blackening expressed as $\log_{10}(I_0/I)$, where I_0 is the galvanometer deflection when the unblackened film is before the thermopile and I is the corresponding deflection for the blackened film. The value 0·301 is for a film transmitting one half of the light incident upon it normally.

Scatterer	Density of blackening of film	Time of exposure (sec.)
Section of single crystal of copper	0·441	5
Copper powder (foil)	0·301	900
Carbon block	0·344	3,600
Wax block	0·414	4,800

Since photographic blackening by X-rays is a function of the product of the incident X-ray intensity and the time of exposure[3], the results show that the increased efficiency got by using the single crystal polariser is of the order 100 to 1000 fold. Since the polarised beam from the crystal is a directed beam, greater accuracy of setting of the apparatus is needed than for the standard methods, but the routine accuracy of X-ray crystallography suffices. With this more powerful beam, advantage can be taken, in the study of the interaction of X-rays and matter, of the vectorial properties of polarised X-rays. In one such experiment now in progress it was found that an exposure of 24 hours was necessary with polarised X-rays when an exposure of 5 min. with ordinary X-rays sufficed. Without the thousand-fold increase of efficiency the experiment was impracticable, needing apparently an exposure of nearly three years.

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[3] Bouwers, *Z. Phys.*, **14**, 374; 1923.