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THE CRYSTAL STRUCTURE OF WHITE PHOSPHORUS

WHITE phosphorus crystallises in the cubic system. Previous attempts to determine its crystal structure by X-rays have not given positive results, notwithstanding its high symmetry. As a matter of fact, white phosphorus at room temperature gives, by the powder method, poor photographs, showing very few weak lines.

It has been also stated (H. Joung, *Centralblatt f. Min. u. Geol.*, 107; 1926) that X-ray researches on white phosphorus are impossible because of its transformation into the red modification by the action of X-rays.

We failed to observe any appreciable transformation under the action of X-rays of long wave-length, and have inferred that the difficulty of getting good photographs could be ascribed only to the imperfection of the crystals and to the remarkable thermal agitation of the atoms at a temperature approaching the melting point, similar to the behaviour of certain alkali metals, which give sharp interference lines only at temperatures much below their melting point.

We experimented by dipping a glass capillary, internally filled with liquid ammonia, in molten phosphorus and lifting it so as to have it coated with a thin layer of crystallised white phosphorus. The capillary was then fixed in the axis of a Debye camera. The temperature may be estimated at -35° C.

The photograph obtained with the *K* radiations of an iron anticathode shows 22 lines, which can all be arranged in the cubic system for a lattice constant of the elementary cell of 7.17 Å. Supposing the cell as containing 4 molecules P_4 , the calculated density is 2.23, slightly greater than the data found in the literature at room temperature (values between 1.82 and 2.0).

The details of measurements and a discussion of the structure will be published elsewhere.

Several authors have deduced from cooling curves that at lower temperatures (less than *c.* -70° C.) another modification is formed, the form of which is

still uncertain, since one of the authors describes it as hexagonal, and others as trimetric or monoclinic (P. W. Bridgmann : *Jour. Am. Chem. Soc.*, **36**, 1344 ; 1914. D. Vorländer, W. Selke, and S. Kreiss, *Berichte*, **58 B**, 1802 ; 1925).

We repeated our observations, filling the capillary with liquid air. The photograph obtained in such a way (at *c.* -170° C.) shows a large number of lines which cannot be arranged in the cubic system.

The dimorphism of white phosphorus is thus confirmed. We cannot yet, on account of the complexity of the photographs, decide upon the symmetry of β -phosphorus, but we incline to the opinion that it belongs to a system of rather low symmetry ; at any rate we may conclude that it has a rather complex elementary cell. Investigations are still in progress.

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