

LETTERS TO THE EDITORS

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A New Structure of Carbon

ATTENTION has been directed by Taylor and Laidler¹ to the appearance of 'extra' lines on X-ray photographs of graphite. These lines are given by several quite unrelated specimens and they do not seem to be connected with impurities. Finch and Wilman² and Taylor and Laidler¹ tried to interpret them as secondary diffraction phenomena of the graphite structure, but without producing any convincing evidence for their theories³. We find, however, that the lines may be explained by the presence of about 10 per cent of another structure that is closely related to graphite, and this therefore implies that carbon can exist in three different crystalline forms.

The new structure may be described in the following way. Ordinary graphite is composed of layers of carbon atoms arranged in hexagonal rings, these layers are so disposed that alternate atoms lie directly over other atoms and centres of hexagons respectively in the layer below. There are three different layers that can be built together to satisfy this condition; graphite uses two of them alternately; the new structure uses the three in sequence. Thus its unit cell has a *c*-axis $\frac{3}{2}$ times as long as that of ordinary graphite, in agreement with Finch and Wilman's observation that many of the lines may be indexed on the basis of the ordinary unit cell if the fractional *l* indexes $\frac{1}{2}$ and $\frac{2}{3}$ are allowed.

Although the structure may be referred to hexagonal axes, it is really rhombohedral, the basal symmetry plane of the graphite structure being replaced by centres of inversion, so that the alternating six-fold symmetry is lost. The simplest description of the structure is that it belongs to the space-group $R\bar{3}m$, ($a = 3.635$ A., $\alpha = 39.49^\circ$) and has atoms at $\pm(\frac{1}{6}, \frac{1}{6}, \frac{1}{6})$.



a. Diamond \rightarrow α -pseudo-graphite structure.
b. α -pseudo-graphite structure.
c. β -pseudo-graphite structure.

The structure, although closely resembling graphite, is similar to diamond in the arrangement of its planes; but in diamond the planes are puckered and closer together. Nath⁴, in a theoretical study of the transition from diamond to graphite, has suggested that there is an intermediate structure formed, and it is interesting that this structure is exactly that described here. The accompanying figure is reproduced from his paper. It shows the diamond structure (a), an intermediate structure which has not been observed (b), and the new structure (c). There is, however, no explanation of the apparent existence in equilibrium of the two structures.

The experimental evidence on which we base these results will be described elsewhere.

We wish to thank Dr. Taylor for the loan of one of his photographs, and Mr. H. P. Rooksby of the General Electric Company for specimens of Ceylon and Bavarian graphites.

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Feb. 20.

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¹ Taylor and Laidler, *NATURE*, **146**, 130 (1940).

² Finch and Wilman, *Proc. Roy. Soc., A*, **155**, 345 (1936).

³ Lonsdale, K., Knaggs, I. E., and Smith, H., *NATURE*, **146**, 332 (1940).

⁴ Nath, N., *Proc. Ind. Acad. Sci.*, **2**, 143 (1935).

Purification of Penicillin

PENICILLIN has been obtained in the form of a highly purified barium salt by repeated fractional extraction from amyl acetate into water, chromatographic separation on an alumina column, treatment of the active fraction with aluminium amalgam and further repeated chromatographic separation until the alumina column appeared homogeneous. The preparation thus obtained, though not crystalline, has an activity of 450–500 Oxford penicillin units per mgm., corresponding to a complete inhibition of the growth of *Staphylococcus aureus* in broth in a dilution of 1 : 25,000,000. Penicillin must therefore be regarded as one of the most powerful antibacterial substances with predominantly bacteriostatic action known.

Details of the method of purification and an account of some chemical, physical and biological properties of penicillin will be published shortly.

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Jan. 31.

Further Observations on the Increased Yield of Nucleic Acid from Irradiated Yeast*

DURING the course of investigations intended to extend previously reported observations¹ of increased yields of nucleic-acid-like substances from yeast irradiated with full ultra-violet radiation under conditions resulting in prolonged injury to the yeast cells, certain irregularities in the yields were noted. It now appears that these may be attributed to lack of quantitative yields in the final step of the chemical procedure wherein nucleic acid is precipitated.

As in the previous experiments¹, starch-free yeast (*S. cerevisiae*, Fleishmann bakers' strain) was employed at a concentration of 300 gm. wet weight to each litre of suspension medium. Each suspension was divided into two equal portions. One was irradiated with full ultra-violet light from a quartz mercury arc. The other, which served as a control, was not irradiated but was subjected to the same conditions of stirring. Because of rise in temperature of the irradiated suspension above that of the control in certain of the experiments in which an air-cooled arc was used, a Kromayer water-cooled arc was substituted in other experiments. With it, the energy was insufficient to obtain an appreciable degree of killing (methylene blue test) during the period of irradiation (10–22 hr.). Subsequent to irradiation, nucleic acid was prepared from the con-

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