ANNUAL REPORT

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The work carried out during the past year may be divided into three periods:

1. 1st January to 16th March. King's College.

During this period I continued to work in King's College on the structure desoxyribonucleic acid. Two papers entitled:

"Fibre Diagrams of Sodium Thymonucleate:
I. The Influence of Water Content
II. The Cylindrically Symmetrical Patterson Function."

were written (in collaboration with R.G. Gosling) and sent to Acta Crystallographica in March 1953. These have now been published, and copies are attached to this report.

Further work on the 3-dimensional Patterson function was carried out, but no quantitative results were obtained in this way.

Measurements on the X-ray fibre-diagrams of Structure B (the less ordered form of sodium desoxyribonucleate, and that which we believe to exist more or less unmodified both in solution and in natural nucleo-protein) yielded a considerable amount of information. This is summarised in a note to Nature written in collabora-

-tion with R.G. Gosling (25th April, 1953) and entitled: "Molecular Configuration in Sodium Thymonucleate". A copy is enclosed with this report.

It is shown that the molecule of sodium thymonucleate in Structure B must consist of a two-strand helix, rather similar to that proposed by Watson and Crick (Nature, 25th April, 1953) but of smaller radius.

Since Structure B (NaDNA) has a 2-strand helical molecule, and since the change A $\rightleftarrows$ B is, in general, readily reversible, it follows that a 2-strand helical molecule must also exist in Structure A. Evidence for a 2-strand helix in structure A was obtained from a study of the cylindrically averaged Patterson function.

2. March 1953 - November 1953. Birkbeck College.

Owing to unexpected delays in obtaining the necessary apparatus for carrying out a programme of X-ray crystallographic research on viruses, a substantial part of this period was spent in continuing the interpretation of the X-ray diagrams of nucleic acid and their Patterson functions. At the same time, a literature survey was carried out of previous work on the molecular structure of viruses.

The evidence for a two-strand helical molecule of the Structure A form of DNA was presented in a note to Nature, 25th July, 1953, written in collaboration with R.G. Gosling. A copy is enclosed. The helix is of radius 9A and has 11 residues per turn. The evidence is based mainly on a study of the cylindrically symmetrical Patterson function of Structure A. It has also been

shown that the proposed structure accounts for many of the strongest features of the 3-dimensional Patterson function.

3. November - December 1953. Birkbeck College.

During this period X-ray diffraction studies of tobacco mosaic virus were started. For this purpose an Ehrenberg-Spear fine-focus X-ray tube is used, with nickel-filtered copper Kα radiation. The X-ray camera is the Phillips micro-camera modified to take a specimen-film distance of 30 mm. or 60 mm. as well as the usual distances of 10 mm. and 15 mm. It is filled with hydrogen during all exposures.

The virus solution was kindly given to this laboratory by Dr. R. Markham.

The research is a continuation of the earlier studies of Bernal and Fankuchen (1942) and of Watson (1953).

Highly detailed diffraction diagrams of orientated virus specimens (prepared by the method of Bernal and Fankuchen) containing varying amounts of water have already been obtained. While the greater part of the high-angle pattern is substantially independent of water content, the reflections corresponding to distances of about 20 A vary strikingly. This suggests that the water most closely associated with the virus may lie on either side of some structural component having at least one dimension of about 20 A.

A detailed study of the small differences in the intra-particle pattern for wet and dry viruses should make it possible to calculate the Patterson function of the difference, and hence to locate the water.

Further, intensity measurements of the equatorial reflections,

which are related to inter-particle, should make it possible to decide whether or not the ribonucleic acid forms a central core in the rod-like particle, as has been suggested by several authors. Preliminary measurements indicate the presence of a heavy core (presumably RNA) in the rod.

4. Miscellaneous.

(a) In April 1954 I was invited to the "Steinkohlentagung" at Aachen, Germany. There I read a paper on "The Mechanism of Crystallite Growth in Carbons" which is to be published (in German) in Brennstoff-Chemie in December 1954. Reprints are not yet available.

The new part this work consisted in a kinetic explanation of the sharpness of the separation of carbonaceous solids into two classes, the graphitising and non-graphitising, and an explanation of the apparent elongated shape of the crystallites in graphitising carbons.

(b) In June 1953 I read a short paper on "Le rôle de l'eau dans l'acide graphitique" to an international colloquium in Paris on "Water in Solids". In this paper a new type of structure for graphitic acid is proposed. A reprint is enclosed.

(5 reprints enclosed)