LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Polarization of Starlight

THE evidence for the polarization of the light from many stars has accumulated since Hiltner's first observation of the effect[1]. Owing to the correlation of the effect with interstellar absorbing medium, it now seems certain that the explanation must be found in an anisotropy of this medium. The direction of the polarization is variable from star to star, shows a regional correlation, and a general preference for the electric vector to lie in the galactic plane. The magnitude of the effect (up to 12 per cent plane polarization) would be accounted for by a 5 per cent difference in the extinction coefficient in the two planes of oscillation[2].

Previous theories have aimed at explaining this anisotropy by supposing elongated magnetic dust particles to be partially aligned by magnetic fields[2,3]; but there has been no other evidence for fields of such strength (the existence of which is questionable on theoretical grounds), or for the implausible physical properties assumed for the dust.

A direction in space is given also by a process of double streaming, such as by dust particles penetrating through the tenuous galactic gas. Such relative velocities can be damped out only very slowly, and must be regenerated frequently through the acceleration of the gas by pressure gradients, which have a very much smaller effect on the dust. Indeed, it seems unlikely that much dust exists which does not possess a velocity relative to the surrounding gas far exceeding the thermal velocities of the gas molecules; that is, the motion of the dust is generally supersonic.

The spin of elongated dust particles can be calculated when it is principally due to impacts with gas molecules at supersonic speeds. All such impacts impart angular momentum about lines lying in a plane normal to the relative velocity. It can then be shown that elongated particles will spin with their long dimension remaining mainly in planes which all contain the direction of the relative velocity. Such a motion implies an anisotropy of the probability distribution of the instantaneous directions of the particles. The maximum effect which can result is that the summation of the projected lengths of all particles in the direction of the velocity is $\pi/2$ times as great as that in a normal plane. The observed effect does not require such a high degree of alignment.

In contrast with the magnetic theories, the present process affects all those particles which are elongated enough to cause polarization, irrespective of their other physical properties.

It seems likely on dynamical grounds that the velocities of interpenetration which occur in the galaxy have their major component in the direction normal to the galactic plane; this would agree with the observed preference of the electric vector of the light for this plane.

A fuller account of this work will be given in the *Monthly Notices of the Royal Astronomical Society*.

T. GOLD

Cavendish Laboratory,
Cambridge. Dec. 16.

[1] Hiltner, W. A., *Astrophys. J.*, **109**, 471 (1949); **114**, 241 (1951).
[2] Davis, L., and Greenstein, J. L., *Astrophys. J.*, **114**, 206 (1951).
[3] Spitzer, L., and Tukey, J. W., *Astrophys. J.*, **114**, 187 (1951).

Crystal Structure of 3.4 ; 5.6 Dibenzphenanthrene

THE structure of 3.4 ; 5.6 dibenzphenanthrene (Fig. 1) is of interest because steric effects prevent the molecule from assuming a planar configuration[1]. In spite of its non-planarity, the substance has the properties of an aromatic hydrocarbon.

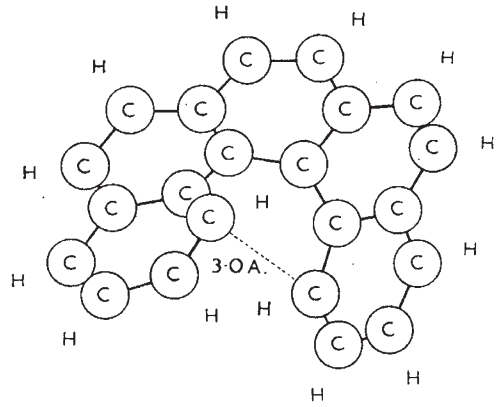

Fig. 1. Sketch of the model of 3.4 ; 5.6 dibenzphenanthrene, showing the nature of the distortion

3.4 ; 5.6 Dibenzphenanthrene crystallizes in two modifications[2]. Both are monoclinic, one of space group $P2_1/a$, the other $A2/a$. The existence of the simpler form was discovered after the investigation was well advanced.

We have determined the molecular shape of the $A2/a$ modification using X-ray crystallographic methods. Due to the complex molecular packing, only one projection could be used. Sufficient refinement has been obtained, however, to show the molecular distortion.

The $A2/a$ form of 3.4 ; 5.6 dibenzphenanthrene has the unit cell dimensions: $a = 26{\cdot}17$ A.; $b = 8{\cdot}94$ A.; $c = 19{\cdot}57$ A.; $\beta = 105{\cdot}1°$.

The systematic absences do not permit distinction between space groups Aa and $A2/a$; but Wilson's method[3,4] indicated a centric distribution of intensities. There are twelve molecules per unit cell. (Density measured 1·264, calculated 1·253.) The asymmetrical crystal unit is one and a half chemical molecules. This type of distribution requires that

Fig. 2. Two molecules of 3.4 ; 5.6 dibenzphenanthrene projected on (010). Contours at intervals of 2 *e*. A.$^{-2}$, the two-electron line being broken