dimorphism in two dimensions which is comparable with that of rhombic and monoclinic sulphur in three dimensions.

The increase of chain length affects the transition temperature in a similar manner to its effect on many other physical properties.

The existence of solid films with areas of 26·2 sq. A. per molecule does, therefore, support the hypothesis of interlocking chains.

A further criticism has been brought that some films which have areas corresponding with the interlocking position may not be solid. There is, however, no sensitive process for distinguishing between a viscous liquid and a weak solid film. The ordinary method of blowing dust particles on the surface may give very doubtful results in border-line cases; since the pressures generated by blowing, although apparently small, may have a profound influence on a thin unimolecular film. The monoglyceride films of area 26·2 sq. A. per molecule for which " dust on the surface obviously does not move very easily " (Adam, *Proc. Roy. Soc.*, **117**, A, 532; 1928) are examples of such border-line cases. Here a more delicate technique is needed to establish their physical state without ambiguity.

Nevertheless, it is clear that films with an area per molecule slightly larger than that calculated for interlocking may be liquid. These films are very likely to be obtained when the angle of free tilt is close to the interlocking angle. The liquid alcohols fulfil these requirements, and the available evidence suggests that the area per molecule is slightly greater than that found for fatty acids (Adam and Dyer, *Proc. Roy. Soc.*, **106**, A, 694; 1924).

Further misconception has arisen from the bearing of this hypothesis on the results of X-ray analyses of crystals of long chain compounds. Interlocking should give rise to one of a series of calculable tilts. The principle seems to apply there, at least to a first approximation. It must, however, be remembered that the crystal is of a much more complicated structure, and disturbing influences are much more likely there than in a thin film (cf. Müller, *Proc. Roy. Soc.*, **124**, A, 317; 1929, on the mutual influence of the polar groups of the molecules forming the bimolecular layers of the crystal).

In conclusion, it may be stated that all the aliphatic compounds yet examined by X-ray methods consist of plane zigzag chains. The areas of films calculated for the interlocking positions do not depend on one analysis alone, but are based on the collected results for these different substances, and in particular on the accurate and detailed analysis of stearic acid and the hydrocarbons (Müller, *Proc. Roy. Soc.*, **114**, A, 542; 1927; **120**, A, 437; 1928) which are in such excellent agreement.

C. G. Lyons.
Eric K. Rideal.

The Laboratory of Physical Chemistry,
   Cambridge, Mar. 7.

Structure of Naphthalene and Anthracene.

In a paper published in the *Proceedings of the Royal Society* (vol. A, 125, p. 542; 1929) on the structure of naphthalene and anthracene, J. M. Robertson comes to the conclusion that " the scattering centres lie nearer the *ac* planes than the *bc* planes, but no simple structure with a plane of symmetry parallel to the *ac* plane is possible ", and that the scattering centres lie along a chain structure similar to hydrocarbons. On the other hand, the structure of hexamethylbenzene as determined by K. Lonsdale (*Proc. Roy. Soc.*, vol. 123, p. 537; 1929) suggests that the

benzene rings in aromatic compounds should in all probability be plane structure. This has further support from the plane hexagonal structure of graphite (Ott, *Ann. d. Phys.*, vol. 85, p. 81; 1928). As regards whether the scattering centres are nearer the *ac* plane or the *bc* plane, the optical and magnetic anisotropies which have been measured by S. Bhagavantam (*Proc. Roy. Soc.*, vol. A, 124, p. 545; 1929) require that the carbon atoms should lie nearer the *bc* plane than the *ac* plane. The structure proposed by Robertson, however, does not explain the intensities of reflection from many of the crystal planes, which he supposes are due to small glancing angles for those particular reflections. But on evaluating the angle factors for the intensities it is seen that such large discrepancies cannot be explained in that manner.

I made an X-ray investigation into the structure of naphthalene and anthracene, the results of which will be published shortly. It has been found that the best agreement for the intensities of reflections from these crystals is obtained when all the carbon atoms in one molecule are supposed to be in one plane and the planes of the molecules are inclined to the cell faces. The correct positions of the molecules are obtained by first placing them along the *bc* planes, then rotating them through 25° about the *c* axis (the two molecules in the unit cell being rotated in opposite directions), and then rotating them about *b* axes through 12° and 9° for naphthalene and anthracene respectively. The agreement will be best seen by referring to the table appended herewith, where the results for some simple planes are given. Similar agreements were obtained for all the forty planes from which reflections were observed. It can be easily seen that agreements are much better than those obtained by Robertson.

TABLE I.

Indices.	Naphthalene.		Anthracene.	
	Theoretical Structure Factor.	Experimental Structure Factor.	Theoretical Structure Factor.	Experimental Structure Factor.
001	15·3	15·3	13·2	13·2
002	6·0	6·2	8·8	8·4
110	18·2	17·5	27·0	30·3
11$\bar{1}$	5·1	5·9	10·2	8·9
020	6·6	7·0	8·3	7·5
200	15·0	14·8	19·8	18·3
20$\bar{1}$	24·8	23·0	21·0	14·9
20$\bar{2}$	5·2	4·8	9·2	9·9
210	10·0	10·6	14·7	16·2
21$\bar{1}$	9·2	10·0	12·6	14·9

The intensities of 007, 20$\bar{7}$, 40$\bar{7}$, 60$\bar{7}$ reflections from naphthalene and 009, 20$\bar{9}$, 40$\bar{9}$, 609 reflections from anthracene, on which Robertson bases his arguments for supposing that the scattering centres lie nearer the *ac* planes, agree qualitatively with experiment as the structure factors for the 40$\bar{7}$ and 40$\bar{9}$ planes respectively come out the highest among the series according to this arrangement of placing the carbon atoms.

Kedaveswar Banerjee.
  210 Bowbazar Street,
   Calcutta, Nov. 26, 1929.

I believe Dr. Banerjee's structure to be essentially correct. It has been clear to me for some time that the last two sections of my paper to which Dr. Banerjee refers must be amended as regards the distribution of the scattering centres in the *a* and *b* directions. During last summer, Sir William Bragg made ' abso-