Letters to the Editor.

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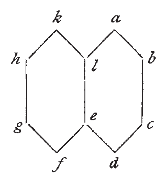
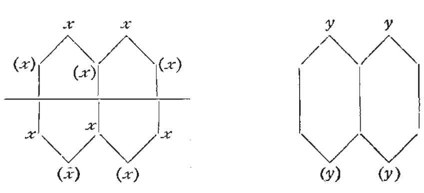
The Atomic Vibrations in the Molecules of Benzenoid Substances.

SIR WILLIAM BRAGG has recently suggested (Presidential Address to the Physical Society, Proc. Phys. Soc., 1921, 34, 33) that in the molecule of crystallised naphthalene the carbon atoms are arranged so that in the accompanying figure the centres of atoms at h, l, b, g, e, c lie in a plane, whilst those at k and a lie above the plane and those at f and d an equal distance below it.



If this were the normal stable arrangement in naphthalene and its simple derivatives, enantiomorphism would result in the case of all monosubstituted, and in the majority of the higher substituted compounds, the special examples of symmetry being obvious on inspection. Since, however, all the available evidence tends to show that the molecules of naphthalene derivatives are identical with their mirror images, it follows that the structure suggested by Sir William Bragg represents a phase of an oscillation of the relatively unrestricted molecules of the fused or dissolved substance in which the pairs of carbon atoms k, a and f, d appear alternately above and below the plane containing the six remaining atoms. At the first glance such a process appears peculiar and unsymmetrical, but this objection disappears when it is noticed that an identical result is obtained if all the atoms are supposed to be in motion in such a way that adjacent atoms move in opposite directions and to an equal distance from the plane of the original ring. If the component perpendicular to the plane of the ring is x, then the condition arrived at is shown below, x and (x) signifying, respectively, above and below the plane of the ring.



By rotating about the axis figured, the second position is obtained with six atoms in the plane of the original ring and four arranged as indicated ($y>x$ and $<2x$). A similar vibration of the phenanthrene molecule would demand in the case of an isolated phase that the atoms lie in two planes parallel with that of the original ring, and also in four parallel planes containing carbon atoms to the number of two, six, five, and one, respectively. The above argument is circular to the extent that the naphthalene configuration was partly derived by analogy with the hexagonal rings of the graphite layers, but the point is that if independent evidence is forthcoming that an individual naphthalene molecule in a crystal has the arrangement of atoms put forward by Sir William Bragg, then at the same time at least one mode of vibration of the benzenoid molecules will be clearly indicated.

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Transport of Organic Substances in Plants.

IN a letter in NATURE of February 23, p. 236, under the above title, Prof. H. H. Dixon and Mr. N. G. Ball put forward the view that the wood of the vascular bundles provides the main path for the removal of the organic materials formed in foliage leaves to places of storage or conversion, the structure, form, and arrangement of the bast (phloem) being regarded as precluding any important longitudinal transmission within it.

I venture to doubt if the view that the phloem may serve as an important carbohydrate-conducting tissue merits such summary dismissal as the writers of the letter would appear to suggest.

In the first place, it is somewhat misleading to state that this belief . . . "seems to be based entirely on ringing experiments," unless this statement is intended to apply only to the "older writers." In an article on the Translocation of Carbohydrates (*Science Progress*, October 1910, January 1911) I attempted to bring together the available evidence from anatomical and experimental studies, and a perusal of that paper should show the wider basis for the view put forward by Czapek in 1897 that the phloem is to be regarded as the chief tissue concerned in the conduction of organic material in the plant. In later papers (*Annals of Botany*, 1915, 1917) I dealt with many of the points which call for consideration in any investigation of this problem, and indicated the nature of results obtained by the application of Senft's method of locating sugars by the formation of their osazones. Unfortunately, the war and the heavy pressure of departmental duties have held up the work, and it has not yet been possible to publish results in detail.

The following comments may be made, however, in connection with the view put forward by Prof. Dixon and his collaborator. The sugars are described as having to traverse the cross-partitions (of phloem cells) as a stream if they use this tissue as a conduit. It may be doubted whether the movement can be compared to the mass movement of water in a tube, and other considerations have been urged in the later paper referred to above.

Experiments made by Czapek (referred to in my last paper, pp. 293, 294, 303) showed that removal of starch from an attached leaf continued if a short length of the petiole was plasmolysed (but not killed), that a killed (boiled) portion of petiole prevented translocation permanently, but that a narcotised portion only temporarily interrupted the process, which was renewed on recovery of the tissues. Though perhaps not altogether excluding the possibility of conduction in the wood, such experiments appear to point to the activity of living cells in the transportation, and I have suggested a possible explanation of the continuance of the process in plasmolysed (living) cells, assuming the sieve-tubes to be the channels concerned (*loc. cit.*, p. 303).

Various histological features of sieve-tubes and their associated cells appear to harmonise well with the view that they serve to conduct carbohydrates, *e.g.* their continuity, distribution, and degree of development in different types of plants, the structure of the sieve-plate, the distribution of connecting-

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