in close agreement with the value $W = 1 \cdot 5$ eV. reported by us[3].

Ramsey found that a new specimen of polythene, prior to any irradiation, gave $W = 0 \cdot 5$ eV. It is likely that comparatively small doses of X-radiation (10^3–10^4 r.) will create new traps in the material at deep energy-levels. We have found a similar increase of activation energy in 'Perspex' from 0·5 eV. before irradiation to 1·2 eV. after less than 10^4 r. The new activation energy does not appear to decrease with time; indeed, measurements on the decay of the conductivity induced in the insulator of small cylindrical condensers by successive weekly doses of 10^4 r. suggest that such changes are not only permanent but also cumulative. Coleman and Bohm observed a similar effect in polystyrene under continuous long-term beta irradiation[9].

Measurements similar to those described above for polythene have been carried out on 'Perspex', using a thin disk placed in a vacuum vessel with provision for controlling the temperature. Sheets of polythene have been used in this apparatus for confirming the results obtained with a flat coil of polythene cable, which are given above.

The induced current for 'Perspex' is of the same order as for polythene at 20° C., but the decay is more rapid by a factor of about ten. The dependence of induced current on dose-rate in 'Perspex' is given by:

$$i \propto R$$

over the range 0·5–30 r./min., and between 20° and 90° C. The induced current, moreover, is independent of temperature over these ranges. The time constant decreases with increasing dose-rate. These results suggest that in 'Perspex' the traps are distributed uniformly in depth[7,8], with a gap between the deep and the shallow traps (Fig. 2).

More detailed analysis of the growth and decay curves will, it is hoped, yield quantitative information on the distribution of energy-levels in these materials.

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[1] Farmer, F. T., *Nature*, **150**, 521 (1942).
[2] Kallmann, H., and Kramer, B., *Phys. Rev.*, **87**, 91 (1952).
[3] Fowler, J. F., and Farmer, F. T., *Nature*, **171**, 1020 (1953).
[4] Ramsey, N. W., *Nature*, **172**, 214 (1953).
[5] Mayburg, S., and Lawrence, W. L., *J. App. Phys.*, **23**, 1006 (1952).
[6] Coleman, J. H. (private communication).
[7] Randall, J. T., and Wilkins, M. H. F., *Proc. Roy. Soc.*, A, **184**, 390 (1945).
[8] Rose, A., *R.C.A. Review*, **12**, 362 (1951).
[9] Coleman, J. H., and Bohm, D., *J. App. Phys.*, **24**, 497 (1953).

Possible Relation between Deoxyribonucleic Acid and Protein Structures

IN a communication in *Nature* of May 30, p. 964, J. D. Watson and F. H. C. Crick showed that the molecule of deoxyribonucleic acid, which can be considered as a chromosome fibre, consists of two parallel chains formed by only four different kinds of nucleotides. These are either (1) adenine, or (2) thymine, or (3) guanine, or (4) cytosine with sugar and phosphate molecules attached to them. Thus the hereditary properties of any given organism could be characterized by a long number written in a four-digital system. On the other hand, the enzymes (proteins), the composition of which must be completely determined by the deoxyribonucleic acid molecule, are long peptide chains formed by about twenty different kinds of amino-acids, and can be considered as long 'words' based on a 20-letter alphabet. Thus the question arises about the way in which four-digital numbers can be translated into such 'words'.

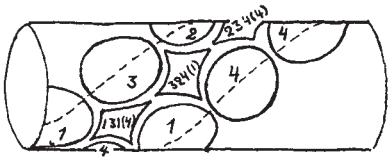

Fig. 1

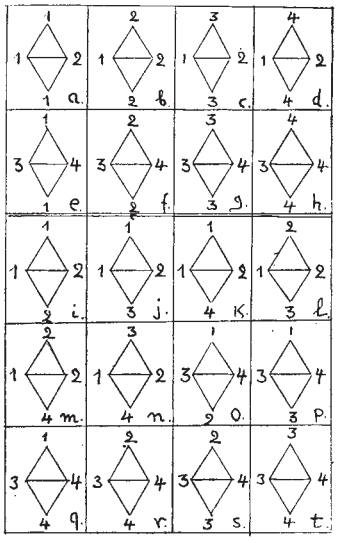

Fig. 2

It seems to me that such translation procedure can be easily established by considering the 'key-and-lock' relation between various amino-acids, and the rhomb-shaped 'holes' formed by various nucleotides in the deoxyribonucleic acid chain. Fig. 1 shows schematically the structure of the deoxyribonucleic acid molecule as derived by Watson and Crick. We see that each 'hole' is defined by only three of the four nucleotides forming it since, indeed, two nucleotides located across the axis of the cylinder are related by $1 \longleftrightarrow 2$ and $3 \longleftrightarrow 4$ binding conditions. It can easily be seen that there are twenty different types of such 'holes', as shown in Fig. 2. The first eight of them are simple, while each of the remaining twelve can exist either in right-handed or left-handed modification. It is inviting to associate these 'holes' with twenty different amino-acids essential for living organisms.

One can speculate that free amino-acids from the surrounding medium get caught into the 'holes' of deoxyribonucleic acid molecules, and thus unite into the corresponding peptide chains. If this is true, there must exist a partial correlation between the neighbouring amino-acids in protein molecules, since the neighbouring holes have two common nucleotides. There must also exist a correlation between adenine-to-guanine ratios in different organisms, and the relative amount of various amino-acids in the corresponding proteins. The detailed account of the proposed theory will appear in *Kong. Dan. Vid. Selsk.*

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Washington, D.C. Oct. 22.

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