

terminology seems unfortunate, for what is apparently meant is not an intellectual remembering and conscious making of allowances, but rather some kind of automatic and pre-conscious process of association (page 269): "specific visual memory traces (join) with the stimulus to form the underlying correlate" (that is, of visual perception). Although in certain cases (for example, the discussion of adaptation to a displaced image in the fourth chapter) this blows fresh air through a stuffy area of controversy, it has dangers as a general formula. Clearly, unless an optical transformation makes a difference to perception, the subject must be blind to the corresponding distinction. It may not matter which direction of the retinal image becomes labelled as "up"; but if the perception of "upside-down" is to be possible it is surely to be expected by any theory that an inversion of the image should at first make the world look upside down. Moreover, it is far from clear, as seems to be suggested on page 39, that only "memory traces", and not genetically determined connexions, prevent perception from being indifferent to the orientation of the entire image. The evidence from the behaviour of new-born kittens fitted with inverting prisms, cited on page 53, is at least ambivalent on this point. Conversely, it should perhaps not be taken for granted, as it seems to be on page 11 and elsewhere, that all adaptation must be followed by a corresponding negative after-effect, in terms of which it can be measured.

The value of Dr Rock's book does not hang on the resolution of such points as these. The comprehensive survey it offers of a relatively new and active field would alone earn it a welcome; and for the student in particular it has additional merit as an example of careful, painstaking analysis and integration of evidence in an area abounding in logical and philosophical pitfalls.

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BIOLOGICAL MACROMOLECULES

Molecular Architecture in Cell Physiology

Edited by Teru Hayashi and A. G. Szent-Györgyi. (A Symposium held under the Auspices of the Society of General Physiologists, Sept. 8-11, 1964, Woods Hole, Mass.) Pp. viii+252. (Englewood Cliffs, N.J., and London: Prentice-Hall, 1966.) 60s.

THE editors of this symposium volume describe its aim as "an attempt to present the thinking and information available at several levels in the organized state of matter of importance to biologists". The eleven contributions vary very widely in meeting this aim. Interesting and stimulating as these papers may have appeared when presented at the symposium itself, in print they make a rather uneven collection without the coherence that might have been imposed by more ruthless editing. The defects of published symposium proceedings have recently been spelt out in *Nature* (214, 46; 1967) and this volume has its share. Above all it is late; more than two years have elapsed between conference and publication. The result is that some of the papers are quite out of date (notably that by Cantoni on rRNA) while in other fields (such as the structure of antibodies on which Edelman writes) there has been such progress that the paper, while still interesting, would now serve mainly as a report on the way.

The article by Caspar on the design of organized biological structures is a valuable statement of principles and is general enough to stand the passage of years. The price paid in this case for avoiding detailed discussion is an abstractness of presentation which might make rather difficult reading for those not already familiar with the subject, but concrete examples are to be found in the articles by Cohen on fibrous proteins and Van Holde on haemocyanin. Katchalsky gives a most illuminating dis-

ussion of the analysis of the thermodynamics of structural transitions in two systems studied by his school—collagen fibres and polynucleotide helices in solution. These examples could very well serve as useful models in discussing the dynamics of more complicated macromolecular systems.

The articles singled out above deal with molecular architecture at the level which would be of most use to a cell physiologist seeking background knowledge. The short paper by Bright Wilson, while strictly in the field of molecular architecture, deals mostly with the topic of hindered rotation about single chemical bonds and would seem very far removed from the concerns of cell physiologists. It does, however, end on a salutary note of warning that the rules gained from the study of small molecules, though useful and indispensable in the field of complex biochemical molecules, should always be applied with caution. This paper provides a nice contrast with the succeeding article by Scheraga on the principles of protein structure in which he seeks to formulate simple models for polypeptide chains and then more complicated ones for polypeptide chains with different side groups that interact with each other, as in a globular protein. The paper provides a useful guide to the large body of developing literature on the attempts to make quantitative estimates of the forces holding a protein molecule together. It also proves to be an illustration of the difficulty of the theoretical problem and perhaps also shows how far there is to go before the most probable conformation of a protein molecule in solution can be predicted.

Three further articles show a very wide variation in the level and range of this symposium. The paper by Shapiro on the elucidation of the base sequence in DNA seems out of place except in so far as it does show how unfeasible the task is at present. There is an interesting article by McElroy and Seliger on the colours of bioluminescence which describes the role of the enzyme and substrate structure, and while this article perhaps goes the furthest in the symposium towards describing the relation between function and the underlying chemical processes, little is known about the structure of biological macromolecules involved. Finally, there is a paper by Inoué and Sato, which is a more or less complete report of an optical analysis of the distribution and orientation of DNA in cricket sperm, and again, while most interesting, would seem more suitable as an ordinary scientific paper than as a part of the printed proceedings of a symposium.

A. KLUG

PHOTOSYNTHETIC MECHANISMS

Biochemistry of Chloroplasts

Edited by T. H. Goodwin. (Proceedings of a NATO Study Institute held at Aberystwyth, August 1965.) Vol. 1: Pp. xv+476. 115s. Vol. 2: Pp. xviii+776. 160s. (London: Academic Press, Inc. (London), Ltd.; New York: Academic Press Inc., 1967.)

THESE two volumes contain by far the most complete description so far of the biochemical aspects of the chloroplasts. Some eighty-seven papers are included in this record of the formal proceedings of a NATO Study Institute held at Aberystwyth in 1965. Although the first volume is primarily concerned with structure and chemical composition and the second volume with biosynthesis, there is much overlap. Anyone who needs one volume is likely to require both.

In his introduction, the editor hopes that these volumes "will serve as a basic text for some years for recruits into the field of chloroplast biochemistry". Certainly these proceedings will be most useful to both recruits and veterans, but there are some limitations inherent in this type of collection of individual papers from a meeting. Early obsolescence is one problem, particularly when the