Book Reviews

ORIGINS OF LIFE

Chemical Evolution

Molecular Evolution towards the Origin of Living Systems on the Earth and Elsewhere. By Melvin Calvin. Pp. ix + 278. (Clarendon Press: Oxford; Oxford University Press; London, June 1969.) 55s board; 25s paper.

A MODERN book on biochemical evolution or the origins of life must cover a good deal of familiar ground. It must include discussions of the early history of the Earth and its atmosphere, the fossil record, the prebiotic synthesis of small molecules, polymer formation, and the emergence of biological order. All of these subjects are included by Dr Calvin, but some are treated in great detail while others receive only brief mention. The result is a book which, while somewhat unbalanced from the point of view of the general reader, contains much that is of great interest to those more deeply involved in the subject.

Almost half of the book is concerned with the fossil record. The first chapter deals briefly with the fossils of the Cambrian and later periods and, in somewhat greater detail, with more recently investigated microfossils going back for at least three billion (3×10^9) years. Then follows a long discussion of the hydrocarbons present in contemporary organisms, in relatively modern sediments and in Pre-Cambrian shales. The chemical evidence, particularly the presence of pristane and phytane, strongly supports the view that Pre-Cambrian rocks indeed contain fossils of organisms related to those we know today. A "progress report" on attempts to characterize these primitive organisms further by comparing the pattern of "fossil" hydrocarbons in the rocks with that of hydrocarbons in contemporary species will certainly interest the more specialized reader.

The other main section of Calvin's book opens with a discussion of the origin and early evolution of the Earth and with the synthesis of small molecules such as amino-acids, purines and sugars from hypothetical primitive-Earth atmospheres. The exposition is skilful and conveys very well the general picture without becoming involved in the many polemical aspects of the subject. The various ways of condensing monomers to polymers are considered next in the same unprejudiced fashion.

The origin of the present genetic system (nucleic acids and proteins) remains a mystery; in this field there are at least as many theories as investigators. Thus, not everybody will accept the general picture which Calvin outlines and I suspect few would accept all of the details. Nevertheless, it is a good introduction to many current ideas, and could provide a framework to guide future experiments.

The remaining chapters of this section describe the three-dimensional structures adopted by proteins, nucleic acids, lipid membranes, and the like. No doubt, these topics will become more important as our understanding of biochemical evolution increases. Finally, Calvin gives a more personal account of the relation which he sees between the researches described in this book and human experience in general.

In many ways this presentation seems to me over-confident. The author accepts without criticism some of the more dubious claims in the "prebiotic" literature. At times he fails to distinguish sharply enough between what seems reasonable and what has been established.

Most of us would agree that life did evolve on Earth and that a little progress has been made towards understanding how it happened. The problems facing us, however, are enormously difficult and have not yielded as rapidly to experimental study as a casual reading of this book might suggest. It would be a pity if the potential researcher decided that the game is over; it is just beginning.

In a publication which appeared in 1873 T. H. Huxley wrote:

"If the problem discussed in my address to the British Association in 1870 has not yet received its solution, it is not because the champions of Abiogenesis have been idle, or wanting in confidence. But every new assertion on their side has been met by a counter assertion; and though the public may have been led to believe that so much noise must indicate rapid progress, one way or the other, an impartial critic will admit, with sorrow, that the question has been "marking time" rather than marching. In mere sound, these two processes are not so very different."

Calvin's book records a number of firm strides that have been taken since then. Only a very few of them, however, clearly lead in the right direction. LESLIE E. ORGEL

FERTILIZATION ENLARGED

Mammalian Fertilization

An Atlas of Ultrastructure. By Robert Hadek. Pp. xii + 295. (Academic Press: New York and London, June 1969.) 135s.

THE choice of mammalian fertilization as a theme for an atlas of ultrastructure is highly commendable, because descriptions of minute detail can be linked to developing sequences of biological events. Two major themes dealt with repeatedly are changes in the acrosomal and egg membranes during capacitation and sperm penetration, and the transformation of various cellular organelles during the transition from oocyte to zygote. Minor topics include the analysis of the rodent vaginal plug, and an experimental section on the transport of ferritin into egg organelles.

Unfortunately there are differences between the plausibility of the presentation of the two major themes. Descriptions of the cell organelles and their changes, such as the accumulation of cortical granules of the egg, changes in mitochondrial structure in eggs and spermatozoa, and the possible function of organelles such as the stacks of annulate lamellae prove of considerable help to the reader. The descriptions are factual and the pictorial evidence plentiful. The data and discussions should be of value to the non-specialist and also to the electron microscopist. Even so, more references to the biochemistry of these organelles would have widened the appeal of the book. There is sufficient knowledge of mitochondria, for example, to have done this with profit.

The descriptions of changes in the acrosomal region, sperm head and egg membranes during capacitation and sperm penetration leave many doubts. To begin with, the attempt to achieve capacitation by immersing spermatozoa in oviducal fluid, with no evidence that capacitation or fertilization is thereby achieved, is highly dubious. The enlargement of the apical end of the acrosome may or may not be a part of capacitation: there is no means of deciding. Recent work by other authors has shown that the plasma and outer acrosomal membranes of the spermatozoon undergo fusion as this gamete lies in the vicinity of the eggs. The resulting "blebbing" of the acrosomal and plasma membranes, before their final disintegration, would have been well worthwhile including. Other workers have indicated that the acrosomal region is probably not involved in the attachment of the fertilizing spermatozoon to the egg; this could have been debated. The importance of membrane fusion could have been