Vertebrate History: Problems in Evolution. (McGraw-Hill Series in Population Biology.) By Barbara J. Stahl. Pp. ix+594. (McGraw-Hill: New York and Maidenhead, 1974.) £8.75.

THIS is the most interesting book on this subject that I have read, because it deals with the problems involved in understanding the course of vertebrate evolution. Most textbooks on vertebrate history are primarily accumulations of information on the structure and diversity of each group of fossil vertebrates, and are really textbooks of palaeo-osteology. Yet, for any reader, the interest of a subject lies in the problems it contains, in the lines of evidence available for solving those problems, and in the methods that can be used for obtaining and analysing that evidence. For example, the problem of the origin of the amphibians is not merely one of osteological modification; the papers that have discussed this subject also include opinions based on studies of the embryology, life history and behaviour of present-day amphibians, the anatomy and physiology of respiration, the ecology, climatology and geography of the Devonian, and the nature and distribution of Devonian sediments. Consideration of such wider topics in turn forces the reader to ponder to what extent they may or may not be relevant to the central question. It provides, therefore, a far better methodological training than the normal textbook description of the trees to the exclusion of the wood they make up.

The book is divided into nine main chapters: fossils (their nature, discovery and investigation); the origin of the vertebrates; bone and cartilage in early vertebrates; the first fishes with jaws; the rise of the modern fishes; the amphibians and their origin; the rise and fall of the reptiles; birds; and finally, mammals. The mammals are thus cut down to their proper status—in most books on vertebrate palaeontology, which give a description of all the diverse orders of mammal, they occupy one third to one half of the text.

The chapters themselves are written in a style that is concise and enjoyable to read, and the concepts and questions that arise are clearly defined. The format is attractive, with topic headings to the side of the text. In considering the main problems raised in these chapters, Dr Stahl has had to read and evaluate a large number of papers. The most important of these are listed in a well-selected bibliography of about 280 titles (some as late as 1972), and there are 216 excellent figures.

Dr Stahl's book cannot replace such textbooks as those of Romer or Colbert as a source of information on vertebrate palaeontology. It does, however, provide an opportunity for the interested student to find out more without becoming surfeited by facts, and thus to come to appreciate the proper significance of the information those other textbooks provide.

Barry Cox

Evolution

Aepyornis, *the Pleistocene elephant bird. From Stahl's new book.*

The Genetic Basis of Evolutionary Change. By R. C. Lewontin. Pp. xiii+348. (Columbia University Press: London and New York, 1974.) £2.15.

FOR Darwin, evolution was the conversion of variation among individuals within an interbreeding population into variation between species and genera. The central ideas of molecular biology did not have an immediate impact on evolutionary thought. They did change our concept of mutation from a process of shuttling back and forth between wild-type and mutant states to that of an infinite series of changes which almost never back-tracks. But the full impact waited on the development of two experimental techniques: the determination of amino acid sequences in peptides, and gel electrophoresis. These techniques provided for the first time quantitative answers in genetic terms to two important questions—how fast has evolution proceeded, and how much genetic variation is there in natural populations? The classical evolutionist may object that the level of description has been changed from the important to the trivial—from morphological to biochemical differences.

Dr Lewontin has not only played a large part in the development of theory but was among the first to answer the second question experimentally, in 1966, by showing that in wild populations of *Drosophila* there is probably genetic variation at the majority of loci specifying peptide chains; a finding subsequently confirmed in many species by other workers. This book derives from a series of lectures he gave in Columbia in 1969 and, consequently, perhaps suffers in structure. It is not as wide in scope as the title would suggest and concentrates too much on the evidence from gel-electrophoresis. The approach is historical and the first 100 pages are almost a grand build-up to the presentation of the answer to my second question. The theoretical frame work is presented as an antithesis between two views. In the first of these —the 'classical' view—most of the genetic variation in populations is thought to be selectively neutral or harmful. Much evolutionary change may not have been adaptive but has resulted from the chance fixation of neutral alternatives. In the other view—the 'balance' view—it is held that variation is actively maintained in population by selective forces, although there would be disagreement about their exact nature, and that evolution proceeds by the active fixation of available alternatives at loci, with a gradual change of selection pressures over time. The necessary synthesis has not been achieved (though the author clearly leans scientifically and politically on the 'balance' side); Lewontin suggests that the profusion of facts which are now available for the 'theory machine' have merely led to "a great clashing of gears".

There are perhaps two main reasons for the present confusion. The first is that all wild populations have to cope with the wide diversity of environments, both in space and time, and we have neither an adequate description of these, from the point of view of the organism, nor an adequate theoretical treatment of their implications. The second is that differences in fitness between genetic alternatives may be so small (say of the order of 1% or less) that there is great difficulty in measuring them adequately. This is particularly true for the measurement of fertility. With *Drosophila* far too much work has been concentrated on the measurement of viability differences, which is relatively easy to do, even though recent evidence shows that fertility differences are much more important. In my view, the great merit of the book lies in its critical discussion of the present confusion and of the validity, both biological and statistical, of some of the evidence that other workers have put before us.

But we must remember that the loci that we observe with these techniques only refer to a small part of the DNA, the 'single-copy' set coding for proteins. The evolutionists have hardly faced up to the evidence now accumulating from the multiple-copy sequences, such as the satellite DNA or those sequences which code for ribosomal RNA. I suspect that the mechanisms that we shall have to invoke for the evolution of this part of the DNA will lie quite outside our present philosophy and outside the scope of this book. **Alan Robertson**