Book Reviews

Essays in Natural History

Evolution and Environment. A symposium presented on the occasion of the one hundredth anniversary of the foundation of Peabody Museum of Natural History at Yale University, New Haven, Conn., 1966. ELLEN T. DRAKE, Ed. Yale University Press, New Haven, 1968. xvi + 478 pp., illus. $15. Mrs. Hepsa Ely Silliman Memorial Lectures.

In his introduction to this impressive collection of 16 generally excellent papers covering a broad spectrum of interrelated subjects Peabody Director A. W. Crompton notes that the papers "are examples of the type of exciting and stimulating research work that we wish to see undertaken within or associated with museums of earth and life sciences in future years." Yale is to be congratulated for a job well done in drawing up the roster for its 1966 Centennial and Silliman Foundation Lectures; with minor exceptions the published articles represent natural history exposition at its best. The whole volume is not unlike what a book-length *Scientific American* issue might be: diverse, united by excellence, and destined for a long stay on the bedside table before shelving. Not all of the included essays are reviewed here.

Easily the most absorbing piece in the book is P. E. Cloud's "Pre-metazoan evolution and the origins of the Metazoa," which synthesizes geochemical as well as paleontological and other biological data (see also *Science*, vol. 160, 1968, pp. 729–36). After an early loss of NH_3 and CH_4 an anoxygenous reducing atmosphere with CO, N_2, H_2, and H_2O derived from volcanic emanations would have permitted amino acid production fairly early in the Precambrian. From 2.5 to 2.0 eons (10^9 years) ago procaryotic cells arose and then, at about 2.0 to 1.8 eons, photosynthetic autotrophs. These gave off poisonous O_2, which was promptly removed by ferrous iron in the oceans. Ultimately, the famous banded iron formations of the Precambrian were precipitated, and this was followed by an abrupt increase of continental red beds as ferric compounds began to accumulate widely on land. From 1.8 to 0.65 eons ago photosynthetic O_2 slowly accumulated until ozone protection was achieved, the ozone filtering out solar radiation between 2400 and 2900 angstroms. This permitted phytoplankton to colonize the sea surface, leading to a rapid O_2 buildup. At about 3 percent of the present O_2 value the Metazoa arose, probably polyphyletically. Cloud makes a strong case for placing the Paleozoic-Precambrian boundary at the base of the range zone of the Metazoa and gives an extensive list of reasons why various supposed Precambrian metazoan records should be rejected. Controversy will no doubt continue regarding some of them, however. Cloud's style is sprightly, and there are 12 pages of references to mull over.

H. P. Banks's "The early history of land plants" reviews recent work on the earliest vascular plants, starting with the late Silurian *Cooksonia* and going on to give us the latest on the relationships of *Zosterophyllum*, *Asteroxylon* (now regarded as a lycopod following Lyon's discovery of lateral sporangia), and an impressive array of additional Devonian genera including *Baragwanathia*, which is no longer regarded as occurring in the Silurian. A new classification of early land plants is proposed, including the new tracheophyte subdivisions Zosterophyllophytina and Trimerophytina. The importance of accurate stratigraphic records is stressed for good reason: only by that means can the geometry of phylogeny be disciplined.

A necessary and important building block in his continuing effort to supply an independent check on rotational polar wandering from purely paleontological data is offered by F. G. Stehli in "Taxonomic diversity gradients in pole location; the Recent model." Stehli abundantly proves that trend surface analysis of diversity gradients in certain Recent organisms is a powerful tool for locating the present rotational axis. Even ratios such as that of number of genera to number of families are tied to latitude and can yield useful results. Application to the fossil record is complicated by problems of preservation and regions barren of data, but clearly Stehli's methods must now be tested for every Period from Cambrian to Tertiary.

K. S. Norris' essay on acoustic mechanisms in toothed whales and J. E. Heath's paper on the origins of thermoregulation are both first-rate functional analyses. Norris holds that the main locus of odontocete sound production is in the nasal passages. From these sound energy is impedance-matched and directed forward by air sacs and the spermaceti organ. Sound reception via an oily intramandibular wave guide directly to the bulla and by other paths has supplanted the ancestral terrestrial system. Stimulating arguments such as this one ought to lead to a rash of new studies. Heath develops the idea that a shift in posture in therapsids ("mammal-like reptiles") preadapted them for heat production via the tonic mechanism. In turn, high internal heat required other adaptations such as better transport of nutrients and wastes, achieved by evolution of the four-chambered heart. Small forms leading toward later mammals developed a shivering mechanism to permit rapid warming from torpor. Then, as mammals became larger, they developed peripheral sensing and anticipatory regulation through elaboration of the neocortex.

Excellent surveys of principles are provided by Laporte's "Recent carbonate environments and their paleoecologic implications," W. G. Chanloner's "Paleoecology of fossil spores," H. C. Brookfield's "New directions in the study of agricultural systems in tropical areas," F. C. Vasek's "Outcrossing in natural populations: a comparison of outcrossing estimation methods," and R. Levins' "Toward an evolutionary theory of the niche," the latter two for the mathematically well-trained reader.

Two essays that seem to fall short of the mark are H. B. Fell's treatment of the biogeography and paleoecology of Ordovician seas and W. G. Kühne's paper on Kimmeridgian mammals of Portugal. Fell suggests that Ordovician faunas are compatible with an Ordovi-

cian equator inclined 70 degrees with respect to the present one, the Ordovician tropics having passed through what are now Ecuador, Panama, Newfoundland, central Russia, and East Pakistan. South America and Africa would thus have to have been widely separated, in contrast to the later Gondwana configuration accepted by many, and Fell's equator would pass through the position of the Ordovician Gondwana Pole as recently computed by Fairbridge. Why didn't Fell discuss his subject in the light of polar wandering curve superpositions, analysis of diversity gradients such as those Stehli studies, or even concepts of sea floor spreading available when his article was written? The article is virtually nonquantitative in spite of abundant and suitable data. Kühne's paper is marred by muddy philosophy of systematics, violations of the Code of Zoological Nomenclature (*nomina nuda*), and various inadequately documented assertions (trends to increase the number of cheek teeth in several supposed lineages, reference to upper cheek-tooth formulas of *Paulchoffatia*, and others). Kühne's figure 3 appears to be of a single specimen, not three. These are matters that should have been rectified by the editor if not by the author.

MALCOLM C. MCKENNA
American Museum of Natural History, and Columbia University, New York

Complexities of a Provincial Scientist

John Dalton and the Progress of Science. Papers presented to a conference, Manchester, England, 1966, to mark the bicentenary of Dalton's birth. D. S. L. CARDWELL, Ed. Manchester University Press, Manchester; Barnes and Noble, New York, 1968. xxii + 352 pp., illus. $9.50.

The bicentenary of John Dalton's birth was celebrated in Manchester in September 1966 by two conferences. One was intended primarily for specialists in the history of science; the other was more general and aimed at the public. The papers from both these conferences make up the present volume.

The essays gathered together here are most successful in destroying what I think may be called the myth of John Dalton. This is the Dalton one usually meets in science textbooks or popular histories — the simple, self-educated Quaker drawing his inspiration and most of his knowledge from Newton's *Principia* and *Optics*, developing his epoch-making theory almost in an intellectual vacuum and failing to understand the full implications of what he had created; retaining his simplicity even at Manchester as a schoolteacher, and dying as the scientific world swept by him. The Dalton one meets in this volume is a much more complicated and scientifically sophisticated person, and both his milieu and his understanding of it are shown to be much more complicated than the myth would have it. His appreciation of the implications of what he had done and his struggles to avoid having his atomic doctrine swallowed up in others' theories are also delineated with skill and sensitivity.

The general level of the articles is very high indeed, which makes it impracticable to single out individual authors and titles for praise. Let me just strongly urge all historians of science and others interested in Dalton and the origin of the atomic doctrine to purchase the book and enjoy themselves reading it.

The one serious criticism I would make is of the quality of the illustrations. This really affects only one contribution, that by Kathleen R. Farrar on "Dalton's scientific apparatus." This worthy article, which successfully destroys the myth of Dalton as a founding member of the "ink bottle, beeswax, and string" school of British science, is accompanied by some of the muddiest figures and plates I have ever seen. Details are impossible to discern in the figures, and plate IVa is simply a jumble of flasks and barometers and what have you. Plate Va, to which reference is made in the text (p. 180), simply does not exist. Plate V itself appears opposite page 171, and for 150 pages I thought that it had been mistakenly included from another volume published by the Manchester University Press. It is of "The internal structure of a segment of a receptor from the retina of the rhesus monkey as seen under the electron microscope." It was not until page 322 that the plate was linked up to Dalton's colorblindness.

L. PEARCE WILLIAMS
Department of History, Cornell University, Ithaca, New York

Biological Variability in Man

La Diversité Humaine en Afrique Subsaharienne. Recherches Biologiques, Etudes Ethnologiques. JEAN HIERNAUX. Editions de l'Institut de Sociologie, Université Libre de Bruxelles, Brussels, Belgium, 1968. 261 pp., illus.

In this interesting monograph, Jean Hiernaux assesses the distribution of a number of monogenic and polygenic features in African peoples that inhabit regions south of 22°N latitude. He uses sophisticated statistical techniques to express the patterns of human variability and the taxonomic distance between populations and to test correlations between certain phenotypic and genetic traits and selected climatic factors.

The features chosen for detailed study include 10 gene frequencies (I^A, I^B, I^0, R_0, R_1, R_2, $r + R_0{}^u$, L^M, Hb^S, and Hb^C), the frequencies of arches, loops, and whorls on the fingers, and 18 traditional anthropometric dimensions. The biometric features are considered to be multifactorially determined while the biomolecular traits are controlled by simpler genetic mechanisms.

Hiernaux computes the coefficients of correlation between the mean values of the gene frequencies and morphological dimensions and between these features and each of six climatic factors—mean annual rainfall, mean value of humidity in the wettest month, mean value of humidity in the driest month, mean daily temperature in the hottest month, mean daily temperature in the coldest month, and mean altitude. Further, he uses partial coefficients of correlation strategically to test independently the possible effects of each climatic factor.

In general, Hiernaux found that the biometric traits exhibit higher correlations with mean annual rainfall and maximum temperature in the hottest month than with other climatic factors. By contrast, the biomolecular and dermatoglyphic traits generally do not evidence such notable correlations with major climatic factors. Thus, in explaining ABO and abnormal hemoglobin distributions, Hiernaux places primary emphasis on disease vectors and other microclimatic factors instead of on gross climatic factors. He believes that human phenotypes are notably subjected to selective forces of the environment and that even in instances where rather recent admixture has occurred, the descendant populations may reflect,