

modern fossils, using his own observations on them wherever possible—tedious reading for the non-specialist perhaps, but thoroughly admirable. The conclusions drawn from the analysis of pathologies and from the specifics of muscle origins, insertions, and morphological details are also admirable and thought-provoking.

Unfortunately the attempt to squeeze large-scale interpretations from tiny samples leads to less admirable results. There are pronouncements concerning stasis and change of postcranial, dental, and craniofacial aspects over 15,000 years or possible more at Shanidar, where one end of the span is anchored by only three individuals and the other by four relatively incomplete ones. Then there is the prolonged effort to deal with the significance of the supposed fact that the Neanderthal gestation period was 11 or 12 months rather than the normal human nine—a conclusion extrapolated from a grand total of two female pubic bones and five male ones distributed between Europe and the Middle East over a time span of perhaps 30,000 years.

Also, basically, the question of what is a Neanderthal is never thoroughly treated. Early in the book Trinkaus denotes the Neanderthals as regionally and temporally restricted archaic *Homo sapiens* sharing a set of features “that have been traditionally termed *classic Neanderthal*.” What these features are and who established them as traditional designators—and on what basis—is not initially mentioned. This is partly rectified by emendations scattered throughout the text, but these are incomplete and do not make up for the lack of a competent treatment of the “Neanderthal problem.”

The thorny issue of Neanderthal phylogenetic relations with previous and subsequent populations is relegated to confusion right at the beginning with the decision to call certain fossil groups “Early Neandertals” although they are not considered Neanderthals, whereas others that are in fact early are not so labeled because they *are* considered Neanderthals.

Although there are interpretative weaknesses and the publisher has saved space by cramming illustrations together, the basic presentation of the skeletal anatomy is exemplary, and this book joins the ranks of those classic monographs that now serve as the basis for our understanding of the course of human evolution.

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Photosynthesis

C₃, C₄. Mechanisms, and Cellular and Environmental Regulation, of Photosynthesis. GERRY EDWARDS and DAVID WALKER. University of California Press, Berkeley, 1983. x, 542 pp., illus. \$65.

Photosynthesis is often portrayed as being made up of separate and distinct processes, labeled either light or dark reactions. Although photosynthesis involves the capture and conversion of radiant energy to produce useful chemical compounds, the dark reactions are not simply “turned on.” Indeed, they are regulated by signals, other than the increased availability of ATP and NADPH, from the light reactions—pH and ion changes in the chloroplast and cytoplasmic compartments as well as modulation of the activities of enzymes involved in the reductive pentose phosphate (C₃) pathway and the dicarboxylic acid (C₄) pathway. A unique and important feature of the volume under review is a discussion of recent advances demonstrating how the dark reactions involving CO₂ fixation to sucrose and starch formation are metabolically regulated.

Over the last decade the authors of the book have each contributed significantly to the study of photosynthetic carbon assimilation. Rather than review contributions from the entire field, they have written from a personal point of view emphasizing their own observations.

Walker has used isolated and intact chloroplasts to investigate the mechanisms and regulation of carbon flow during C₃ photosynthesis. He considers first the essential features of the C₃ pathway and then aspects of its regulation and the relationship of the movement of metabolites between the chloroplast and the cellular environment. The delayed induction of the photosynthetic process, seen when going from dark to light, receives considerably more emphasis than is warranted. The delay occurs because substrates must be built up before the autocatalytic process (regeneration of the acceptor for CO₂) becomes efficient. Light activates some of the enzymes during the lag.

Walker interprets his experiments using a multitude of curves each lacking an accompanying measurement of intermediate pools, enzyme activities, or both. The intermediate pools in isolated chloroplasts are considerably lower than in chloroplasts of intact leaves, making any predictions of the cause of induction in leaves questionable.

Edwards has contributed significantly to the understanding of C₄ photosynthe-

sis. A large number of the higher plants produce as the initial products of CO₂ fixation four-carbon dicarboxylic acids (oxaloacetate, malate, or aspartate). These products move from the mesophyll cells to specialized bundle sheath cells surrounding the vascular tissue. Decarboxylation occurs in the bundle sheath cells, and the CO₂ is refixed by the reductive pentose phosphate cycle. C₄ photosynthesis serves as an addendum to the C₃ cycle to concentrate CO₂ in the bundle sheath cells. The historical formulation and function of this pathway are discussed in the book, as are the compartmentation and regulation of enzymes, the transport of metabolites, and the physiological and environmental implications of the diversity of C₄ plants. Photosynthesis by succulent plants, called CAM (crassulacean acid metabolism), is discussed in light of C₃- and C₄-type metabolism.

The first part of the book attempts to provide a concise, elementary description of the photochemical apparatus and events that generate the assimilatory power (ATP and NADPH). Though the treatment of carbon assimilation is well organized and thorough, written to be understood by a graduate student, the discussion of the basic energy processes is oversimplified. It could give a reader the impression that the book is written for a popular audience, which is not the case.

C₃, C₄ presents a well-integrated description of the processes of photosynthesis and accompanying metabolism. It is the first book that clearly shows how the C₃ and C₄ pathways of carbon flow relate the processes of energy capture and conversion to the agronomic and environmental aspects of plant photosynthesis and production.

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Books Received

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Animals as Navigators. E. W. Anderson. Van Nostrand Reinhold, New York, 1983. 208 pp., illus., + plates. \$19.50.

Annual Reports on NMR Spectroscopy. Vol. 14. G. A. Webb, Ed. Academic Press, New York, 1983. viii, 406 pp., illus. \$90.

Annual Review of Biophysics and Bioengineering. Vol. 12. Lorin J. Mullins, William A. Hagins, Carol M. Newton, and Gregorio Weber, Eds. Annual Reviews, Palo Alto, Calif., 1983. xii, 520 pp., illus. \$47.

Applied Nutrition for Health Professionals: Basic Nutrition. John J. B. Anderson, Ed. Health Sciences Consortium, Carrboro, N.C., 1983. iv, 308 pp., illus. Paper, \$14.95.

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