sponses are intensity-dependent even after a photostationary P_{fr} level has been established. The question of whether these high-intensity reactions (HIR) are also mediated by phytochrome, alone or in conjunction with another pigment, has evoked considerable interest. Some investigators believe that photosynthesis is involved in HIR, but Mohr unequivocally rejects this view. He proposes that phytochrome is the sole photoreceptor for HIR, and he reasons as follows: Although red light converts 80 percent of phytochrome to P_{fr}, the level drops after the irradiation since P_{fr} is destroyed by a dark reaction. Destruction of phytochrome following P_r-to-P_{fr} conversion has been reported by several investigators. Far-red light converts only 2.5 percent of phytochrome to P_{fr}, but this level can be maintained during several hours of irradiation. Mohr contends that 2.5 percent of P_{fr} for several hours is more effective than a higher P_{fr} level for a shorter period. He explains the intensity dependence by proposing that high-intensity light produces an excited species of P_{fr} which is required for some reactions, although other reactions such as lipoxygenase synthesis are promoted by P_{fr} in the ground state. This hypothesis, developed by Mohr's former colleague Hartmann, is one of many detailed explanations presented by Mohr to account for the complex effects of light on morphogenesis.

Unfortunately, Mohr fails to give a balanced view of photomorphogenic concepts, since he lacks objectivity when presenting the views of those who hold opposing theories. He pays scant attention to the membrane theory of phytochrome action, despite considerable evidence in support of it. However, his in-depth study of photomorphogenesis in a single organism, the mustard seedling, is instructive, his analysis creative, and his presentation clear and forthright. His book, together with the proceedings volume, summarizes the vast amount of phytochrome lore acquired during two decades of intensive research. These books also reveal the large gaps in knowledge of the molecular events that transduce light energy to biological response. They should stimulate scientists from a wide variety of disciplines to use their skills to solve this fascinating problem.

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Basic Evolutionary Processes

Animal Cytology and Evolution. M. J. D. WHITE. Third edition. Cambridge University Press, New York, 1973. viii, 962 pp., illus. $55.

Although it is customary to distinguish between the Darwinian and neo-Darwinian facets of evolutionary interpretation, few scientists would deny that evolution is the grand strategy of life, operating in time and space and through the medium of mutations, chromosomal changes, and differential reproduction. It is recognized further that evolution, when viewed in all its varied aspects, is an extraordinarily complex affair, operating at many levels and open to investigation by a wide variety of techniques and procedures.

White is well aware of these complexities, and he has continued, in this third edition of his well-known book, to focus his attention on what he maintains is the essential basis of evolution, namely the cytogenetic process and all that is implied by that term. To phrase it differently, evolution in his view depends, initially and fundamentally, on the changing structure and functional realization of the heritable blueprints of organisms—genes, chromosomes, and transmission mechanisms—and the manner by which these blueprints come into being and are preserved or altered through time. As the title of the volume implies, White confines himself in great measure to the evolutionary processes as they occur or have occurred in the animal kingdom. His evidence is drawn very largely from the insect world, and within the insect world the Orthoptera provide a substantial amount of the factual and illustrative material upon which his views are based. Cytogenetic information from the plant world is mentioned only peripherally or incidentally. This might suggest that a strong bias permeates the volume, but such is not evident to this reviewer. The author, in fact, makes it abundantly clear that the cytogenetic basis of evolution is not only complex but also extraordinarily flexible and exploitable, having, in his words, "an evolution of its own [which] somehow underlies the outwardly visible evolution of phenotypes." Among the many types of cytogenetic processes and events White describes are those which are rare or, often, unique. To some their rarity may indicate their relative unimportance in the general sweep of evolution, but for the particular group of organisms in which these events have become fixed they have provided evolutionary success, however temporary or lasting that success may be. The author, therefore, is fully justified in stating that "cytogenetics . . . cannot endorse any view of evolution in which there is no place for unique, or at any rate very rare, events."

This edition, like the two previous ones, is indispensable to anyone who has an in-depth interest in the basic nature of the evolutionary processes. It is essentially a reference book, addressed to the serious investigator and not to the casual student. The quantity of data presented and examined in detail is enormous. Not everyone will agree with all of White's specific interpretations or perhaps even with his overall contentions, but the more than 3000 references will enable the reader to check original sources when questions arise. It is good to have the volume available; it would also be good if someone could do similarly with the mass of information available from the plant kingdom. It is to be regretted that the cost of this volume will undoubtedly restrict the widespread use it deserves.

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Foraminifera

Distribution and Ecology of Living Benthic Foraminiferids. JOHN W. MURRAY. Crane, Russak, New York, 1973. xiv, 274 pp., illus., + plates. $24.75.

Foraminifera, perhaps the most widespread and surely the most popular microfossils, traditionally have been the subject for ecologic studies by geologists, with a view toward "the present as a key to the past." A book on the distribution and ecology of living Foraminifera therefore potentially has great interest for all paleoecologists concerned with how the fossil record is produced.

The handsomely printed volume at hand has 22 chapters, six of which are directly relevant to such general paleoecologic interests. One of these chapters consists of a useful review of the biology and autecology of living forams; the other five (about four pages each) give short sketches of such topics as

"communities," "populations," "productivity," "ecologic controls," "postmortem changes," and "application to paleoecology." The topic "communities," for example, is introduced thus (p. 194): "No organism lives by itself. Animals and plants form communities by virtue of their interdependence. The basic communities are sufficiently well known for the associated fauna to be identified by the community name." The author then explains (quoting Thorson, 1957) that there are only two foraminiferal communities known and briefly summarizes the results of a few papers bearing on the subject.

The bulk of the book is a concise summary of field (and laboratory) findings, consisting mainly of distributional information organized by geography (beach, estuaries, lagoons, deltas, various shelves of the world, coral reefs) and presented largely as an annotated bibliography. Thus, the book is admirably suited to answer questions such as "Who did what where?" and "What information is available on forams in mangrove swamps and where can I look it up?" Also, common genera are listed in the appendix and their chief occurrences noted, to provide an answer to "What is the present habitat range of this genus?"

The methods of distributional analysis presented and applied throughout the book are remarkably simple. There are two only, the first being an assessment of diversity, the second a representation of the relative proportions of *Rotaliina, Miliolina*, and *Textulariina* in the various assemblages. To determine diversity, Murray plots "number of species" against the logarithm of "number of individuals." On such semilog plots, the scatter can be described by a straight-line empirical fit and the slope of this line is a function of "α-diversity." A more easily understood number with the same information content would be "number of species expected for a count of 1000 specimens." The author refrains from introducing more complex methods. He does take care, however, to explain in some detail the inherent differences between relative abundance (expressed as percentages) and absolute abundances (expressed as numbers per gram or per volume) in the first six pages of the book.

In summary, Murray's volume is a useful addition to the reference library of the practicing paleoecologist, especially the student of shallow-water benthic Foraminifera. Geologists and graduate students will want to have access to this handy entry into the voluminous and widely scattered literature on benthic Foraminifera.

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Feeding Nations

The Nutrition Factor. Its Role in National Development. ALAN BERG. Brookings Institution, Washington, D.C., 1973. xii, 290 pp. $8.95.

This book is a practical discussion of a major world problem. Large-scale malnutrition, until recently mainly a concern of philanthropists and erudite researchers, has become an increasingly important consideration in development planning. It is evident that solutions will require cooperation between experts representing science and technology on the one hand and politics and administration on the other. Berg has provided an authoritative and balanced introduction to the complex interactions that must be taken into account.

It may seem incidental, but it is worth noting that his book is unusually well written. It reflects Berg's own background in journalism. It is, however, also authoritative in the sense that it brings together selected scientific information from a wide range of disciplines with minimal distortion. It should not be expected to contribute significantly to scientific analysis of nutrition, for that is not its orientation. It draws on the work of international nutrition experts within the broad perspective of a systems approach relating to national nutrition programs and economic issues. It should be most useful to those involved in the implementation of field programs to improve the nutritional status of the poor people of the world. To scientists concerned with nutrition its main value should be in illuminating the relationship between their work and the broader perspective of the world need.

The first three chapters present the problem first in general terms and then specifically dealing with the relationship between malnutrition and development and between improved nutrition and the population dilemma. The next seven chapters review the relevant approaches to a solution. The effects of economic growth, income, and agricultural advance are put into balance by showing that, although they do bring long-term general improvement, they are inadequate for reaching population groups in particular need such as the poor, pregnant and lactating women, and young children. The effects of cultural taboos on social acceptance of new foods are illustrated with many examples. A good analysis of traditional nutrition education places emphasis on the need for more cost-effective approaches. Chapter 7 is particularly important in that it gives a developmental and economic justification for efforts to regain the natural resource lost by the abandonment of breast feeding. Two chapters deal with the possibilities of developing new foods, especially through fortification and new formulations, and the potential role of private industry in such efforts. Chapter 10 presents a balancing of advocates' and adversaries' views of public programs for feeding children. There has been continuing unquestioned acceptance of the tremendous financial investment in such programs with little factual basis for cost-benefit analysis. The point is made that the decisions are often political. Berg's own international experience is largely identified with a major effort to assist India in developing a national nutrition program, and he includes a chapter summarizing lessons learned from that experience. Among the ten lessons he itemizes, number 5 deals with the difficulties of introducing new technology, both scientific and managerial, because of the resistance of well-intentioned critics from both bureaucratic and scientific disciplines. A retired senior civil servant from India recently told me that this was well known there as the Todhunter principle, from a famous memorandum by one of the most senior bureaucrats of the British raj directing that when notes were written in a governmental file their main objective should be to show why the particular proposal would not work.

In the final chapter, "Policy directions and program needs," Berg makes the logical observation that each situation requires its own mix of complementary actions. In general, he places his own priorities as follows: he finds fortification of present foods the most attractive possibility, followed by genetic improvement of seed with associated improvement in agricultural practices. For meeting the highest-