Book Reviews

Introductions to a Pivotal Subject

Evolution. THEODOSIUS DOBZHANSKY, FRANCISCO J. AYALA, G. LEDYARD STEBBINS, and JAMES W. VALENTINE. Freeman, San Francisco, 1977. xvi, 572 pp., illus. $15.95.

Organismic Evolution. VERNE GRANT. Freeman, San Francisco, 1977. xvi, 418 pp., illus. $15.95.

The subject treated by these two advanced textbooks is central to the understanding of living things. This fact prompted the late Theodosius Dobzhansky to remark, "Nothing in biology makes sense except in the light of evolution."

Such a pivotal position within a major modern science places a special onus on the writer of a textbook that attempts to introduce the subject to the serious student. Most existing books on evolution deal with some specialized aspect of the subject or are too elementary for the hard intellectual structure of the science to be clearly brought out. The present books attempt to find a middle way. They must introduce, review, and select from great masses of modern technical literature from many disparate fields. The task has now become especially difficult because the very foundations of biology have recently been shaken by a series of astonishing discoveries, especially in genetics, that impinge on evolutionary studies. The time is now right for an attempt to put these discoveries together, and these books break new ground. For this reason one hesitates to judge their obvious shortcomings too harshly.

The direct study of biological evolution in this century has concerned itself primarily with two questions. Simply put, these are: What is the course and what is the cause of evolution? Dealing with the first is principally an exercise in history; attempts are made to describe the paths evolution has taken in producing present-day organisms and the arrangements of their molecules. A quite separate branch of the science has concerned itself with a causal-analytical approach; it tries to elucidate the mechanisms and processes that bring about evolutionary change.

It might seem that these two approaches would be easy to integrate. The opposite is true. Dealing with phylogeny requires the study of the fossil record as well as its interpretation through comparative studies of living forms (anatomical, embryological, and biochemical). Systematists and biogeographers also contribute to an understanding of phylogeny. New approaches have recently developed in all these fields. To write about them for a student audience requires an understanding of sophisticated techniques and the application of broad judgments. Consider a few examples. Stochastic approaches have revitalized paleontology; electron microscopy has brought anatomy and embryology far down below the cytological to the molecular level. Biochemists, too, have entered the phylogenetic sphere, dissecting and synthesizing both life's proteins and the nucleic acids that code for them. Cytologists now read phylogenetic information from chromosome bandings and nucleic acid chemistry. Systematists are now able to reduce their data with powerful computer techniques; biogeography has received a flood of light from developments in the study of the movements of the lithospheric tectonic plates.

As if this were not enough to have to deal with, the branch of the science concerned with evolutionary mechanisms has also sprouted in new directions. The modern study of evolutionary causes was born 50 years ago in a brilliant flurry of mathematical population genetics. Suddenly the manner in which genetic change could be naturally incorporated into populations became clear. Confirmation of these ideas by genetic analyses of natural and artificial selection in populations proceeded slowly but steadily until the 1960's. Then two things happened. Electrophoretic identification of proteins and enzymes in individuals now permits inferences about the enormous genic variability carried in most populations. The rapid accumulation of data on this subject staggers the mind but nevertheless may be reduced to understandable proportions by innovative statistical indices. At the same time, ecology has emerged as a modern quantitative science. Evolutionary change, of course, occurs at the interface of genetics and the environment. Fifty-five years after Turesson first conceived the idea, ecological genetics has emerged as a science in its own right.

How to handle all this? The approach of the first book, *Evolution*, is to combine the talents of two experienced and prominent genetical evolutionists, Dobzhansky (zoology) and Stebbins (botany), with those of two leading younger scientists, Ayala and Valentine, the latter a paleontologist and the former an evolutionary geneticist well versed in the newer analytical techniques. Ayala's contribution is the longest, making up about two-fifths of the book. Ecology is not represented.

In bold fashion, the book sets out to cover the vast ground. Each contributor has done four chapters, more or less along the lines of his major field of interest and prior technical contributions. The early chapters are well integrated, but then each author develops a different approach. There is, of course, some strength in this, but the later chapters read more like self-contained essays than sequenced development of the subject. Stebbins is brilliant in his introduction and in his well-documented chapter on speciation. His other two chapters drift away from the data into rather speculative topics and are less successful.

Dobzhansky's chapters (on selection, races, species, mankind) are like a sudden breath of fresh air; to him, as to Emerson, "life is rather a subject of wonder, than of didactics." He writes with verve and excitement and with the sure touch that comes only from decades of experience. His approach is broad and integrative, but unfortunately what he has put down this time is poorly documented. Sometimes names are used without a reference in the bibliography. More often there are no references at all with regard to key topics, a circumstance that will frustrate graduate students wanting a lead into the literature.

Ayala has written well-referenced, detailed, and up-to-date accounts of hereditary variation and the genetic structure of populations. He also provides a valuable general review of that new and fascinating subject that is labelled by him "phylogenies and macromolecules." At this point, I must mention an obvious imbalance in this book. Ayala's contributions on the subjects mentioned above amount to about 150 pages compared with a mere 50 from Dobzhansky for a formal consideration of natural selection, a subject that should stand as the

core of any book on evolution. In view of this, the final chapter (39 pages) on philosophical issues seems an unwarranted luxury. Indeed, I question its suitability for inclusion in such a book as this.

Most advanced texts have not tried to put technical accounts of paleontology and genetics under one cover; students who have the background for one science often lack it for the other. Valentine plunges straight into a review of the geological record and the evolution of the metazoa. As with most other such nonspecialist treatments of paleontology, the reader is left with no feel for the basic data of the science. For example, we are led through the evolution of triploblasty and the coelom and from there directly into inferences of complex phylogenies. All these ideas, valuable as they are, are synthesized and inferred from data invisible to us.

Both Valentine and Stebbins become involved in difficult and often esoteric problems of systematics at the higher taxonomic levels. Although these matters are interesting it is clear that evolutionary mechanisms at the population level can never be integrated with the ideas, for example, that suggest the subdivision of life into five rather than two kingdoms. In fact, very little of the phylogenetic material is articulated in any way with population studies. Perhaps I hope for too much; nevertheless, some opportunities have been lost. For example, I was unhappy to find such a small amount of attention devoted to the evolution of the vertebrates. More than with most fossils, their skeletons are clues to food habits and locomotion, two characteristics we have no trouble in understanding. In turn, this permits ancient ecologies to be inferred. Where the material is abundant, as in the case of the horse, a modern population biologist can almost apply his "population thinking" to these ancient animals. When Simpson writes about this, he seems to be talking my language. Valentine's examples and discussions seem lost in a mass of statistics on such things as number of families evolving per million years. Macroevolution can and should be brought closer to microevolution.

Multiple authorship has produced some annoying repetitions. For example, parallel evolution is didactically italicized and defined both on p. 265 and on p. 326. The two chapters on speciation are not well dovetailed. The authors quote their own work rather too liberally, and this tendency is not very defensible when we find, for example, that selection is treated with no mention at all of the work of Sheppard, A. Robertson, Cain, B. Clarke, Lamotte, or Mather. Surprisingly, neither the classical work on *Cepaea* snails nor that on mimicry has found a place in the book. Although examples from *Drosophila* abound, the student will find no reference to Patterson, Stone, Hardy, Stalker, Spiess, Parsons, or Spieth, to mention only a few.

From the "committee of authors" approach, we now turn to the work of one man. Verne Grant's text for senior undergraduates is called *Organismic Evolution*. This somewhat clumsy title is contrived so as to allow the author to omit "molecular evolution, primitive organic evolution and mathematical models." Within its chosen framework, the book has both consistency and style. Grant sees the subject in a certain way and does not hesitate to voice his own opinions on controversial subjects.

Like that by Dobzhansky *et al.* this book attempts a joining of genetics and paleontology. The task here is less difficult, because it is a smaller book and is intended for a less sophisticated audience. The organization is impeccable, but the book unfortunately reads like a slightly expanded course outline. The style is terse and didactic; furthermore, the treatment of most topics is rather sketchy.

Grant is quite hostile to what he considers unnecessary synonyms. He has drawn on his experience in writing earlier books to treat difficult subjects with simplified statements rather than genuine exposition. Shades of meaning are accordingly sometimes lost. While making it easy for students, Grant has put some constraints on the capacity of hypotheses to blur and grow.

Grant has also seen the need to introduce macroevolution to his students. Thus, about half the book is devoted to brief chapters on paleontological topics. The examples are well chosen, but the chapters read like what they are, namely well-prepared lectures on paleontology by a geneticist. It would be better to send the students off to the library to read Simpson and Colbert directly.

Of the two books, the first makes the greater departure from tradition and is indeed a much more ambitious project. Thus, it has been afforded more space in this review. Both books, however, are a signal to evolutionists that they can no longer afford the luxury of retiring into their own specialty. The field badly needs books that can show the student the breadth and depth of this topic.

Perhaps the greatest effect these books will have is to stimulate others to try to do better. Both have made very good starts on a laborious undertaking. Indeed, the publication of textbooks, like the sciences they reflect, is an exercise in the evolution of ideas. The new mutations and recombinations exposed here for the first time will now be subject to natural selection. The success they are sure to enjoy will serve as an important challenge to others in this fast-developing field. Descent with change is sure to follow.

HAMPTON L. CARSON
Department of Genetics, University of Hawaii, Honolulu 96833

Childbearing and Health Risk

Family Formation Patterns and Health. An International Collaborative Study in India, Iran, Lebanon, Philippines, and Turkey. A. R. OMRAN and C. C. STANDLEY, Eds. World Health Organization, Geneva, 1976 (U.S. distributor, WHO Publications Center U.S.A., Albany, N.Y.). 564 pp., illus. Paper, $20.

This volume presents the first empirical results of a large international collaborative study of the effects of family formation patterns on maternal and child health. Its focus can be indicated by explicating key phrases in the title. "Family formation patterns" refers to a limited set of fertility-related variables: family size (defined as the number of children still alive at the time of interview); age of mother; parity; gravidity; birth order; pregnancy order; birth interval; age at marriage; interval between marriage and first birth; marriage duration; ideal family size. "Health" refers to pregnancy outcome (abortion, stillbirth, or live birth), child health and development (infant and early childhood mortality, morbidity, physical and intellectual development), and maternal health (body size, blood pressure, gynecological condition, hemoglobin level, self-reports of health). The study also considers the effects of infant and early child mortality on subsequent fertility and on family planning attitudes and behavior.

The study was planned and coordinated by the World Health Organization International Reference Centre for Epidemiological Studies of Human Reproduction and by WHO (Geneva) and was supported in part by the United Nations Fund for Population Activities and by the Swedish International Development Agency. Studies in the individual countries were carried out by interdisciplinary teams consisting largely of medical or public health professionals. In addition to the five nations mentioned in the subtitle, similar studies were un-