Evolution's Two Components: Biological and Cultural

It cannot be understood as a purely biological process, nor adequately described as a history of cultures.

G. G. Simpson

The proper study of mankind is man, and homework on that study has seldom been neglected. "What is man?" was probably asked by *Homo* (or, if you prefer, *Pithecanthropus*) *erectus* and perhaps by *Australopithecus africanus*. Later, poets, seers, philosophers, theologians, artists, novelists—all have asked and answered the question in their various ways. That another answer, quite different in kind, a strictly scientific answer, is possible was hardly glimpsed until Darwin. Then the main point of that kind of answer was soon established: man is a product of evolution, a peculiarly specialized species of mammal. But that basic fact is not sufficient to establish the biological status of man or to permit scientific consideration of the human condition and prospects. It raises a host of more detailed questions. To what extent is human nature determined by our biological history? Are we still evolving? If so, how? Can or should anything be done about it?

Students in the pertinent disciplines are far from agreement in their answers to those and many related questions. The geneticist C. D. Darlington, for example, says at length that the different personalities and abilities of individuals are rigidly determined by the assortment of genes that each happens to have received from his parents. Many ethnologists follow Leslie White to the opposite extreme, maintaining that genetic differences and changes in mankind can be completely ignored, that all normal individuals of our species are biologically identical as far as present status and future possibilities are concerned.

Theodosius Dobzhansky is uniquely qualified to mediate that conflict, to review the actual evidence now available, and to indicate where the true answers are likely to emerge. He is one of the principal founders of the currently most widely accepted body of evolutionary principles, the synthetic or, as he prefers to put it, the "biological" theory. He has no superiors as a population geneticist, and while working mostly with the classic *Drosophila*, he has always sought, and has often found, principles that are fully applicable to other organisms, including *Homo*. Through the years he has become increasingly concerned with their application, in fact, to mankind, and he has referred more briefly to that subject in several previous works. Now he has made the Silliman Lectures at Yale University the occasion for specific and full-scale treatment. The result, published here under the title **Mankind Evolving: The Evolution of the Human Species** (Yale University Press, New Haven, Conn., 1962. 394 pp. $7.50), is the most important and, except for one distressing lapse at the very end, the most judicious scientific treatise that has ever been written on the nature of man. The book is clearly and interestingly written; it is carefully documented; and it displays tremendous erudition over an even broader range of knowledge than is found in its author's previous works.

Although many other aspects are also treated, the theme considered central by Dobzhansky is thus stated in the first chapter:

"Human evolution has two components, the biological or organic, and the cultural or superorganic. These components are neither mutually exclusive nor independent, but interrelated and interdependent. Human evolution cannot be understood as a purely biological process, nor can it be adequately described as a history of culture. It is the interaction of biology and culture. There exists a feedback between biological and cultural processes."

Interdependent Relationships

The characteristics of the two components and the relationships between them are thoroughly explored through the ensuing 11 chapters. The second chapter summarizes as much of technical genetics as is necessary to follow the theme, making the book self-contained for the general reader, although prior knowledge of elementary genetics will make the way easier. That is followed by two chapters exploring in greater detail the inseparability of nature and nurture and the ways in which they interact. The bearing of psychoanalysis is treated with insight but without partiality. It is demonstrated, largely on the evidence of twin studies, that there are both genetic and cultural components in many psychological as well as somatic variables. The next chapter discusses the heredity of health and disease, including a "very incomplete" list of 133 abnormalities that have genetic components. Five of them are given extended consideration, as examples. Explanation of false concepts of normality and of the true concept of the adaptive norm puts this horrendous subject in its proper perspective.

The Key: Natural Selection

As a prelude to more explicit treatment of human evolution, a chapter is devoted to natural selection, now generally agreed to be the directive and adaptive component in the complex of evolutionary processes. Here Dobzhansky properly stresses the discovery, largely, although of course not wholly, due to him, that fitness in populations usually involves a high degree of heterozygosity and that it often entails inferior fitness for some individuals. He is very clear in contrasting genetic fitness, which is simply reproductive effectiveness, and fitness in the vernacular

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sense. Nevertheless, the terminology is confusing to the layman, and calling genetic fitness "Darwinian" does not entirely eliminate confusion. It is, moreover, historically inaccurate, because Darwin himself did not make the distinction.

Chapter 7 is a brief but adequate summary of what is known of the phylogeny and taxonomy of man, fossil and living. On evidence from the australopithecines, Dobzhansky now withdraws an earlier opinion that the Hominidae have always been monophyletic, but he continues to maintain (as does the consensus) that the later lineage has been unispecific and that *Homo sapiens* was monophyletic in origin. The next chapter, on human mental faculties and their antecedents, is in effect a combined biological and cultural definition of the species in terms ranging from brain size to esthetics. Prehuman antecedents for all those faculties are indeed found, but their level and combination in man are uniquely diagnostic. Two chapters are then devoted to the knotty and touchy subjects of polymorphism, class, caste, and race. With his customary calm good sense, the author summarizes the known facts and steers equally clear of the hysteria of the left ("There are no races!") and of the right ("There are absolutely superior and inferior races!").

The last two chapters give Dobzhansky another chance to counteract hysteria in evaluating contrasting views of present evolutionary trends in mankind. Biological evolution is continuing and will continue in our species. It will certainly be affected by increased radiation (including fallout), by the population explosion, by medical relaxation of selective mortality, and by other current trends. Some of the effects may clearly be detrimental and call for remedies. It is by no means clear, on present evidence, that the overall trend is detrimental or that proposed panaceas are either practical or needed.

Dobzhansky's careful balancing of evidence and his avoidance of premature conclusions prevent him from giving absolute answers to many of the questions he raises. Unlike some of his colleagues, whom he opposes firmly but without rancor, he makes no apocalyptic pronouncements and gives no *ex cathedra* solutions for all the world's ills. To those who find comfort in dogma and fiat, his book may seem bothersomely inconclusive. The firmest general conclusion is that not enough is known. What is actually known or reasonably surmised is here splendidly summarized and interpreted. No one who is concerned with his own nature and that of mankind—and this includes the poets, philosophers, and theologians—can afford to miss this book.

Theory and Application

Molecular Orbital Theory for Organic Chemists. Andrew Streitwieser, Jr. Wiley, New York, 1961. xvi + 489 pp. Illus. $14.50.

This book is divided into three nearly equal parts covering (i) molecular orbital theory, (ii) its application to the interpretation of the properties of molecules, and (iii) its applications to reactions and intermediates. The first part proceeds lucidly, perhaps brilliantly, through a discussion of the orbital approach to quantum mechanics, the Hückel molecular orbital theory, and the technique of applying the theory to π-electron systems. Even the chapter on matrices and group theory should be clear to students with limited mathematical training, and numerous problems are presented so that the reader can test his skill. Since the book is, among other things, a text, we were particularly interested in its handling of the approximations obviously necessary in the application of quantum theory to organic chemistry. We were slightly bemused to observe that half of the solutions were omitted for the only problem the author discusses "exactly" (that of one particle on a circle). As a result of this omission, the reader might be rather at a loss to understand the degeneracy of the second energy level in the perimeter model for benzene. More significant, however, is the disturbing omission of critical discussion of approximations. Surely, organic chemists are capable of a qualitative understanding of the errors involved in neglecting antisymmetry and electron spin, the limitations inherent in the orbital approach even with self-consistent field orbitals, the further approximation of pairwise occupied orthogonal orbitals, and the neglect of quantities such as electron repulsion and bond integrals. (These integrals are not necessarily zero, even for orthogonal orbitals, despite statements in the book to the contrary.) Some of these topics are skirted briefly, and some are adequately discussed in the final chapter of the book; but it would be most desirable to have the discussion of all of these topics where it would be read by those studying the apparatus presented in the initial chapters.

Parts 2 and 3 are almost overwhelming in their detail and completeness of coverage. They comprise a highly documented and impartially critical comparison of a manifold of theoretical predictions with experimental results. In several cases the calculations are the author's own; by this means if by no other he establishes himself as an expert in the field. Among the topics covered are bond order, dipole moments, electron spin resonance, ionization and reduction potentials, spectra, aromaticity, transition state theory, nonclassical ions, acidity, and certain reaction mechanisms.

In spite of the criticisms expressed here, *Molecular Orbital Theory for Organic Chemists* is an important work which nearly every organic chemist will want to study. Its lucidity and completeness make it good, both as a text and as a reference. Its main limitation is that the curtailment of the discussion of spin and related topics will, to some extent, prevent the book from serving as a guide to the future as successfully as it now serves as a monument to the progress made in applied molecular orbital theory during the last decade.

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Numerical Analysis

Discrete Variable Methods in Ordinary Differential Equations. Peter Henrici. Wiley, New York, 1962. xi + 407 pp. Illus. $11.50.

High-speed, automatic, stored-program digital computers were developed about 10 years ago, and as a result of their mushroom-like growth they can now be found in the research laboratories of industries, governments, and universities throughout the world. It seems unquestionable that they will become increasingly useful in the future; their impact on applied mathematics and nu-