gous not with zoological or botanical but with ecological or community classifications in biology, are even less satisfactory. An analytical technique (cumulative graphs of artifact types) attacked in one chapter but even more strongly defended in others is downright absurd. The conference finally recommended a "cultural stratigraphic nomenclature" which, as is elsewhere pointed out in this volume, is misnamed and which is unlikely to stand up. It suffers not only from mixed and inadequately defined criteria but also from confusions of concept (for example, between a hierarchy of nested sets and one of levels of abstraction) and of terminology (for example, between "horizon" as a point in time, as a physical plane, and as a unit of association).

It is not an adverse criticism but a recommendation in the present state of knowledge that this book raises more questions than it settles. It brings together a great body of data and of erudition. Always by implication and often explicitly it indicates deficiencies and likely points of attack. It is a tired cliché to say, "This book is a must for anyone interested in . . ." whatever it may be, but that is true of this book for anyone professionally concerned with any phase of African prehistory.

G. G. SIMPSON
Harvard University, Cambridge, Massachusetts, and *University of Arizona, Tucson*

Light Transmitters

Fiber Optics. Principles and Applications. N. S. KAPANY. Academic Press, New York, 1967. 447 pp., illus. $17.50.

Technological progress in fiber optics, especially during the past ten years, has given the engineer an important additional tool for transferring information by means of light. The medical investigator can use a bundle of flexible fibers both to illuminate internal parts of a living body and to return an image or other analytical information. Fibers assembled in the form of plates are surfaced with flat or curved faces for use in photographic or other optical systems or, when fused vacuum-tight, in photoelectronic systems such as cathode ray tubes, image converters, and image intensifiers. The initial flexibility of the fibers is advantageous for producing image dissectors and scramblers. Fibers made of luminescent or lasing materials and excited to produce their own radiation are highly efficient in collecting and relaying this light. Simplified, the mechanism underlying the propagation of an image through a fiber is the entrapment of energy by total internal reflection. Ray tracing is quite adequate to describe image formation by a fiber several wavelengths or larger in diameter. Wave theory accounts for the propagation of light through fibers of small diameter, as well as for coupling between fibers, certain radiation effects, and coherence. A sufficiently small fiber becomes a dielectric wave guide capable of sustaining predictable modes. Each fiber in a packed bundle should be clad with a material of lower refractive index to help minimize leakage of light across fiber walls. Fiber bundles result in space-variant imagery and are converted to space-invariant systems by such means as spatial filtering and dynamic scanning.

The author of the present monograph is a pioneer in the field. He has relied heavily on his own contributions and has added sufficient material to form a comprehensive treatment. The book will be especially helpful to the optical engineer with some undergraduate training and certainly of interest to those who may have an application for fiber optics. Fundamental phenomena, methods of analysis, results of calculations or experiments, and applications are discussed and illustrated. Obviously, detailed considerations of complicated shapes and assemblies could not be included. In some areas the book has a quality more often found in a first book concerning a new technology, namely, catalog-type photographs of the exteriors of instruments and allusions to further possible developments and to what might be done to improve procedures or equipment.

Three additional scientists contribute appendices. Two of these add to the analysis of image transmission and space-variant imagery of fiber bundles. The third writes about vision, comparing the retina to a bundle of fibers. The visual receptors of mammals are nonhomogeneous, nonisotropic, photosensitive cells that exhibit waveguide properties, and visual properties such as directional sensitivity, color detection and resolution are reviewed in the light of what is known about fiber optics.

H. JUPNIK
AO Instrument Company, Buffalo, New York

Irreversible Processes

Statistical Mechanical Theories of Transport Processes. ROBERT M. MAZO. Pergamon, New York, 1967. 180 pp., illus. $9.50. International Encyclopedia of Physical Chemistry and Chemical Physics, vol. 9, part 1.

Our understanding of the molecular basis of irreversible processes has undergone vigorous development in recent years. However, aside from a scattering of review articles in archival journals and some introductory material in textbooks (for example, in F. Reif's *Fundamentals of Statistical and Thermal Physics*), little of this development is easily accessible to the student. Mazo's book provides an excellent introduction to some recent developments.

Attention is focused on a rather limited area, the phenomena of fluid flow, heat flow, and diffusion in simple fluids. The systems discussed most are those composed of spherically symmetric molecules interacting by means of pairwise additive potentials, in classical mechanics. Even in this limited area of the theory of irreversible processes some fundamental work is omitted, in particular the remarkably successful approach followed by Henry Eyring and his collaborators; for various reasons this seems to be not regarded as sufficiently well founded to be generally accepted.

The main lines of development discussed here are associated with the names Boltzmann, Enskog, Bogolyubov, Choh and Uhlenbeck, Kirkwood, and Rice and Allnatt. Except for Boltzmann's kinetic theory of dilute gases, which is known to be correct and well substantiated by experiment, all the other theories leave something to be desired. They suffer either from obscure difficulties of principle or from practical difficulties in application; and agreement with experiment is often no better than within factors of 2 or 3. The difficulties are discussed carefully and candidly by Mazo.

The book ends with two chapters that supply a bridge to currently active areas of research; they deal with the use of time-correlation functions to calculate transport coefficients, and with the use of perturbative techniques (both diagrammatic and operational) in classical many-body systems.

Even a quick scanning of this book will give a student a good feeling for what has been going on during the last few decades and will bring him up

to date. It must be remembered, however, that many important areas of research are ignored completely—for example, irreversible processes in solids, quantum liquids, and chemically reactive systems.

ROBERT ZWANZIG
Institute for Fluid Dynamics and Applied Mathematics and *Institute for Molecular Physics, University of Maryland, College Park*

The Hemoglobinopathies

Abnormal Hemoglobins in Human Populations. A Summary and Interpretation. FRANK B. LIVINGSTONE. Aldine, Chicago, 1967. 482 pp., illus. $12.50.

The sum of man's knowledge of the hemoglobin molecule is a splendid thing to contemplate. The era of molecular biology was, after all, ushered in by Pauling's demonstration that sickle-cell anemia is caused by a variant hemoglobin molecule which differs from normal hemoglobin in its electrophoretic mobility. The subsequent elucidation of the entire structure of hemoglobin, from the primary amino acid sequences of its constituent chains to the quaternary interactions of its subunits, must certainly rank as one of the pinnacles of molecular biology. Analysis of the specific mutations affecting hemoglobin has played no mean role in this progress. How the substitution of valine for glutamic acid at β_6 in Hb S alters the physicochemical properties of the molecule and thus leads to the sickling phenomenon; how the several distinct methemoglobinemias may arise from amino acid substitutions so located that they interact abnormally with the heme group; how the several Lepore hemoglobins may arise from unequal crossing over with the β–δ duplication complex; how the association of four normal β-chains in Hb H drastically alters the oxygen dissociation curve of the molecule—these discoveries and others have provided a wondrous insight into the complexity of the biological integration that evolution has wrought, even at the molecular level. For the physician, the hemoglobinopathies provide a prototype of the precision with which the pathophysiology of all diseases will ultimately be known.

Abnormal Hemoglobins in Human Populations is an attempt to review in detail a single aspect of our knowledge about hemoglobin. It is quite literally a tabulation of the reported frequencies of abnormal hemoglobins, glucose-6-phosphate dehydrogenase variants, and the thalassemias in human populations, as they relate to the hypothesis that these polymorphisms are maintained by the selective resistance of heterozygotes to malaria. Three hundred and nine of the volume's 470 pages are devoted to an appendix in which all the reported phenotype frequencies the author could find in the literature are recorded in one enormous table. Roughly 800 references take up another 49 pages, leaving only 112 pages of text. This is a blessing in disguise, however, since the author's writing is uniformly poor, ranging from a sketchy treatment of the relevant biochemistry to anthropological obscurantisms and lapses in syntax. With respect to the malaria hypothesis, the author concludes that "there were astonishingly few frequencies that did not seem to be explained directly by this hypothesis." The reader is well prepared for this conclusion by the statement in the introduction that "selection by malaria will be assumed to be the major factor in causing the high frequency of these genes."

Genetic heterogeneity poses a serious problem for the gene-frequency school of human anthropologists. The problem is perceived by Livingstone when he declines to speculate on the ancestral relationships of populations containing thalassemia genes "because of the many different point mutations that can result in the symptoms of thalassemia." However, because of the extensive degeneracy in the genetic code, it is clear that even in the case of the Hb β^S "allele" or, for that matter, the Hb β^A "allele" many different nucleotide sequences (that is, different alleles) could give rise to identical polypeptide chains. For the β-chain of Hb A (or Hb S), more than 10^{74} different nucleotide sequences could code for that particular amino acid sequence. This staggering number of *possible* alleles is vastly greater than the total number of hemoglobin molecules that have ever existed on earth. It is not yet known to what extent this enormous potential variation is actually realized. The possibility clearly exists, however, that in the absence of demonstrable inbreeding, the concept of homozygosity may be a theoretical abstraction in human genetics. And if genotypic identity cannot safely be assumed even in the presence of phenotypic identity, it is not clear what inferences about the anthropologic relationships of human populations can, in fact, be made from the study of phenotypic similarities.

There are many minor objections that might be raised to this book. The inclusion of a computer program written in a language that is not in general use is parochial, to say the least, and would seem to serve no useful purpose. There are a number of typographical errors. The author characterizes as "curious" the assumption that "the morphology and epidemiology of parasites have remained unchanged for hundreds, thousands, and even millions of years" (p. 95), yet he does not hesitate to publish the results of computer simulations which assume constant population size, constant migration, constant sex distribution, and constant fitness for 100 generations. Finally, the inappropriate designation of references by numbers and letters and, in one instance, an exclamation point would seem to be an inexcusable expediency for belated additions. No one likes to prepare a bibliography, but some standards should be met in a scholarly work. This book can be recommended only as a tabulation of hemoglobin, glucose-6-phosphate dehydrogenase, and thalassemia phenotype frequencies in human populations.

WALTER E. NANCE
School of Medicine, Vanderbilt University, Nashville, Tennessee

Systematic Zoology

Taxonomy. A Text and Reference Book. RICHARD E. BLACKWELDER. Wiley, New York, 1967. 714 pp., illus. $19.95.

Inevitably, this book invites comparison with Mayr, Linsley, and Usinger's *Methods and Principles of Systematic Zoology* (McGraw-Hill, 1953; new edition in preparation). Although they may be held to cover the same ground, the two books could scarcely be more different in their viewpoint and emphasis.

Taxonomy, as Blackwelder understands it, is "the day-to-day practice of dealing with the *kinds* of organisms [in this case, animals]. This includes the handling and identification of specimens, the publication of the data, the study of the literature, and the analysis of the variation shown by the specimens." Measured by his own definition, Blackwelder's book shows an odd im-