sometimes elsewhere, Epstein takes long detours into obscure human history; for instance, his discussion of the Afrikander breed of cattle covers 27 pages, but much of this is concerned with historical problems concerning Bushmen, Hottentots, Bantu, Dutch, and Portuguese, all of whose movements, and their moving of cattle, had or could have had an influence upon the ancestry of Afrikander cattle. On such topics Epstein is often both thorough and erudite, although he cannot always give a final answer to a specific problem amid the conflicting assumptions of the past.

Epstein treats characters of skulls, horns, humps, and color patterns with loving care. Indeed, the number of pages dedicated to such descriptions, combined with a diffuse (that is, old-fashioned) organization (plus the horrendous price), will decrease the popular sale of these useful and often interesting volumes. Yet the set, in its way, is a tremendously useful one, saving untold hours of library research for anyone entering into the bibliographic maze on the origins and history of the major domestic mammals of the Old World. At the same time, Epstein largely ignores the rich patterns of the economic and other values to man of the animals discussed and pictured here with such care; there is material on this subject for another two volumes, which it is to be hoped someone will write soon.

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## Animal Resources

**Conservation of Nonhuman Primates in 1970.** BARBARA HARRISSON. Karger, Basel, 1971 (U.S. distributor, Phiebig, White Plains, N.Y.). vi, 100 pp. $6.70. Primates in Medicine, vol. 5.

This important book provides a broad view of current problems in primate conservation. It is divided into two major sections, one entitled The Exporting Countries, which considers primate population trends and supply problems in Latin America, Africa, Madagascar, and Asia, and one entitled The Importing Countries, which focuses on the volume of trade and the use of primates in Europe and the United States. The book is well balanced, considering the interests of both the naturalist, who views nonhuman primates as important faunal components of their native habitats, and the biomedical researcher, interested in primates as laboratory subjects. It discusses the species of greatest prominence in research and pharmaceutical production, such as the rhesus macaque, the squirrel monkey, the vervet, and the chimpanzee, as well as those not used in laboratory research but currently endangered because of ecological problems, such as the lion-tailed macaque, the douc langur, and the red colobus monkey.

Many species of nonhuman primates are in need of concerted conservation attention because of pressures from human populations. One of the most serious threats, according to Harrisson, is the loss of habitat due to the destruction of tropical forests. Increased logging and deforestation are a major trend throughout the tropics. Nonhuman primates are also sought in many areas for food, and in others they are exterminated as agricultural pests. Finally, primates are caught in large numbers for use in scientific research, pharmaceutical production, zoos, or the pet business. In 1968, approximately 200,000 live nonhuman primates were transported worldwide. In many cases, this trade represents a wasteful and inefficient utilization of valuable animal resources. For example, in 1968 the United States imported 75,000 primates from Latin America, of which 29,000 were destined for the pet trade. Animals shipped for this purpose often experience high mortality and present a public health hazard of infectious disease.

The author gives particular attention to chimpanzee populations and utilization. Although total African population figures are not available, it is apparent from many field studies that chimpanzee populations are declining seriously, as are those of all the great apes. The process of capture and collection is so wasteful that Harrisson estimates an annual drain on wild populations of 4500 to 6000 individuals to meet the current demand of 750 chimps a year.

Harrisson concludes with a number of recommendations to alleviate losses of nonhuman primates. These include: (i) increased emphasis on the significance and value of nonhuman primates as scientific resources of international importance, (ii) greater development of natural reserves and refuges, (iii) more intensive research programs on primate population ecology in natural habitats and in areas where conflicts exist between human and nonhuman primates, (iv) improved methods of trapping, holding, conditioning, and transportation, (v) development of breeding colonies for biomedical research, (vi) greater care in selecting species as research subjects, and the substitution of nonprimates whenever possible, and (vii) more careful regulation and licensing of the simian pet trade by public health authorities.

Certain details and charges in the books are controversial—for example, contrary to the opinions quoted, I think the Indian government and exporting firms have made very substantial improvements in the export of rhesus monkeys, and I would not characterize present conditions as "highly unhygienic." Also the book lacks numerical population data on most species, but this accurately reflects the state of the field.

In general, Harrisson has provided a vital service in this small book. She writes with clear authority and detailed knowledge from the field, and she also expresses considerable understanding and sympathy toward the valid use of primates in biomedical research. Her book deserves to be read and discussed by a wide audience of ecologists and conservationists as well as biomedical and behavioral researchers interested in the welfare of their subjects.

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## Man's Morphological History

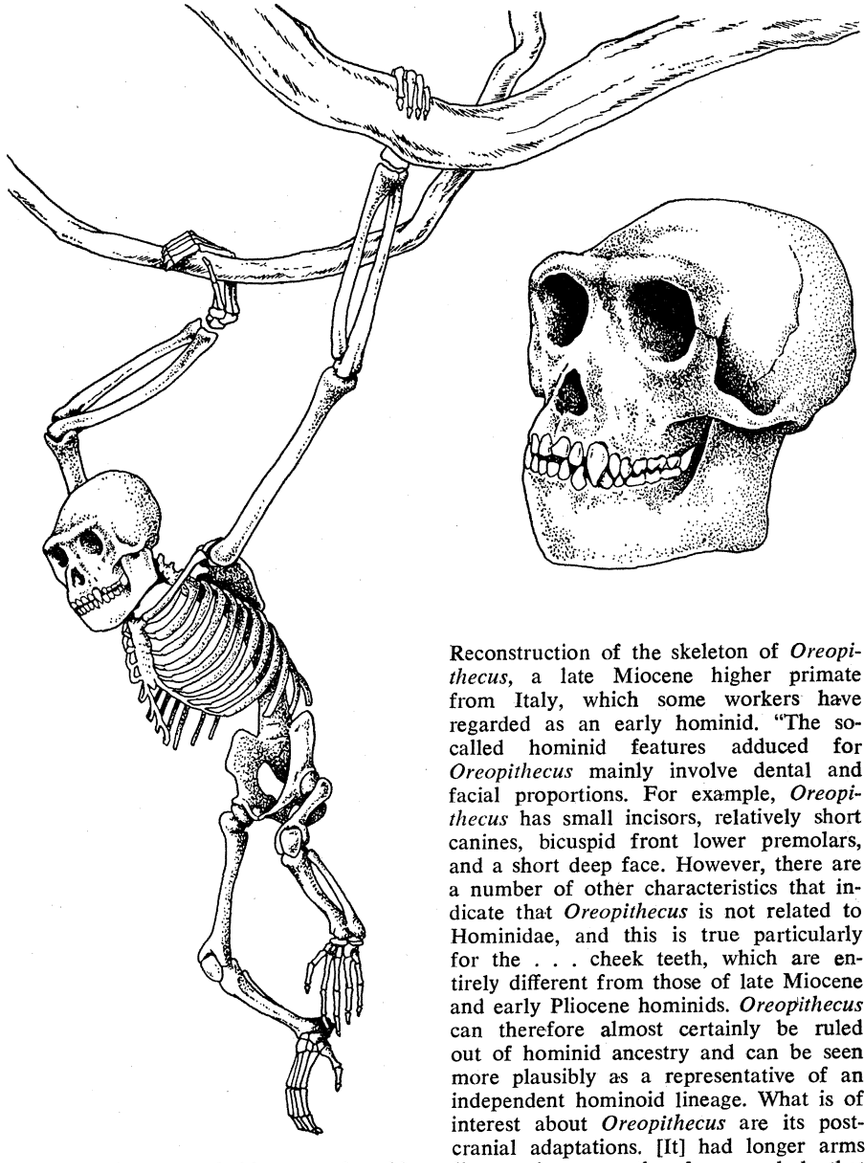
**The Ascent of Man.** An Introduction to Human Evolution. DAVID PILBEAM. Macmillan, New York, 1972. x, 208 pp., illus. Paper, $3.25. Macmillan Series in Physical Anthropology.

As little as two years ago David Pilbeam produced for the World of Science Library an introduction to the evolution of man. That volume, although containing a personal interpretation, was aimed primarily at the layman, the student reading outside his major field, and possibly the beginning student of human evolution. This new book is subtitled "an introduction to human evolution," and Pilbeam does attempt to make the language and con-

cepts of the subject readily understandable to the novice, but the book differs markedly from its predecessor in that it passes rapidly into the heart of the matter.

Bypassing most previous overviews (and thus avoiding adding to the borrowing sequences that frequently pervade such works), Pilbeam goes directly to the original investigators and their work.

There is no facile consensus here. Himself a major contributor to the study of human evolution, Pilbeam has his own strong opinions about certain of the arguments that riddle the field and lets us know (rightly) what these are. At the same time, he does not hesitate to put into print those instances in which he himself has come to change his mind because of new finds or analyses, and he has not been tardy to describe fairly and to juxtapose opposing opinions.



Reconstruction of the skeleton of *Oreopithecus*, a late Miocene higher primate from Italy, which some workers have regarded as an early hominid. "The so-called hominid features adduced for *Oreopithecus* mainly involve dental and facial proportions. For example, *Oreopithecus* has small incisors, relatively short canines, bicuspid front lower premolars, and a short deep face. However, there are a number of other characteristics that indicate that *Oreopithecus* is not related to Hominidae, and this is true particularly for the . . . cheek teeth, which are entirely different from those of late Miocene and early Pliocene hominids. *Oreopithecus* can therefore almost certainly be ruled out of hominid ancestry and can be seen more plausibly as a representative of an independent hominoid lineage. What is of interest about *Oreopithecus* are its postcranial adaptations. [It] had longer arms than legs; it was probably not a knuckle walker, and we can therefore conclude that it was an arm swinger. . . . Many other adaptations—broad shallow thorax, reduced lumbar region, certain features of the elbow joint—also point to this same locomotor-feeding behavior. In all probability, this complex of features evolved independently of the similar adaptations found in apes and man. Some characteristics of the hindlimb, it has been said, indicate that *Oreopithecus* was a biped. For example, the pelvis was broad . . . and shallow . . . , as in hominids, and the femur apparently had a 'carrying angle.' However, a number of other features, such as the hip and ankle joints, indicate considerable mobility of the lower limb. . . . Possibly *Oreopithecus* was a form that spent its time in the trees mainly as a hanger but was bipedal on its occasional visits to the ground. However, it is perhaps more probable that the so-called bipedal features . . . have been misinterpreted. The extinct Malagasy lemur, *Palaeopropithecus*, was an arboreal hanger with extremely long arms and hindlimbs very poorly adapted to bipedal weight bearing, yet had a . . . pelvis more like that of hominids than any other known primate." [From *The Ascent of Man*]

Inevitably Pilbeam has had to supply simplified summaries. Because he presents original results from many sources, however, the reader can readily appreciate exactly how strong, or how weak, the speculative generalization may be. The book reflects strongly the considerable changes in methodology that are currently reinvigorating the field. Pilbeam gives concrete demonstrations of ways in which measurement and analysis may yield unsuspected information about anatomies and in which biomechanics may suggest better associations between structure and function. Whereas other texts on the subject might state, for example, that a particular morphology is capable of a special behavior or related to a certain ecological setting, this book shows the reader how frequently such ideas (sometimes major parts of the conventional wisdom of human evolution) rest upon data that are meager and fragmentary in the extreme and how often alleged facts are ideas in the mind of the investigator. The discussion, moreover, indicates clearly to the student those matters on which further study might supply better insights or stronger evidence.

Although Pilbeam has attempted at almost every point to indicate the inextricable links between morphology on the one hand and behavioral, molecular, and ecological aspects of evolution on the other, he has not tried to summarize these other areas. This introduction is very much to the fossil record and its contribution to the understanding of human evolution.

Inevitably one can find errors and points for criticism. This reviewer has been misinterpreted at one point, where Pilbeam suggests that the shoulder of man could have arisen from that of an orangutan; clearly this is not a viable possibility; in later sections Pilbeam corrects this misimpression. Again, in other parts of the book the results of multivariate statistical studies on foot bones of a number of fossils are cited as justification for certain evolutionary speculations; more critical evaluation can demonstrate that these results in fact indicate almost directly the contrary. But criticisms of this type can be made for any book by any reviewer.

The lasting impression that I obtained from this reading must not be obscured by a list of such points. This is unequivocally a book that will give many readers an insight into what is going on in the study of human morphological evolution; further, this book, introduction though it may be, is necessary reading for the original investigators themselves.

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## A Heterogeneous Subject

**The Genetics of Human Populations.** L. L. CAVALLI-SFORZA and W. F. BODMER. Freeman, San Francisco, 1971. xviii, 966 pp., illus. $27.50. A Series of Books in Biology.

Human population genetics is a heterogeneous subject combining data and techniques from medicine, biochemistry, anthropology, demography, and statistics with those of genetics. Cavalli-Sforza and Bodmer have attempted to cover this wide area. It is a testimony to the breadth and depth of their combined knowledge that they have been able to carry it off.

This is an important book because it is the first comprehensive textbook of human population genetics. As of now it defines the field.

The book starts with a review of basic concepts of genetics—probably not necessary for most readers who are otherwise prepared for the book. It ends with two very useful appendices, one on statistical methods and the other dealing with some of the practicalities of segregation, linkage, and gene frequency analysis. Between these is material on randomly mating populations, inbreeding, assortative mating, mutation, sexual dimorphism, polymorphism, polygenic inheritance, population structure, human evolution, and eugenics. To include so many subjects in detail requires a big book (nearly 1000 pages, 4 pounds).

There is an appropriate balance of mathematical theory and empirical information. There are numerous tables and graphs, showing either actual data or numerical examples illustrating mathematical principles. The authors have clearly taken considerable pains to make the material understandable. One device is to include meticulously worked problems at the ends of most of the chapters. At the end of the book are 81 questions taken from final examinations in the medical genetics class at Stanford. If Stanford medical students master the full contents of this book along with the conventional medical wisdom of a crowded curriculum they are indeed the geniuses they are reputed to be.

The book requires no specialized knowledge not ordinarily possessed by upper level science majors or medical students. Considerable mathematics is used and this is not always easy, but it is not advanced. The more sophisticated parts of population genetics theory—for example, that dealing with stochastic processes—are largely omitted or are summarized verbally. The book is interesting to read, partly because it contains so much information from diverse sources. I found myself reading it avidly, almost like a novel. One can skim the book and is greatly aided in doing this by occasional summarizing sentences that are set off as italicized paragraphs. A proper reading, of course, involves following the algebra, and this requires pencil and paper.

The subjects are highly diverse, as is expected in a field that is still being defined. Some topics represent special interests of the authors: migration matrices, measures of genetic distance, histocompatibility and leukocyte typing, and the demography of African Pygmies. But I hasten to say that this is not overdone. In general there is a proper balance of experimental, demographic, and mathematical content.

The final chapter is entitled "Eugenics, euphenics, and human welfare." Here the authors begin to express their own views on social issues. They are anything but crusading eugenicists. They place great emphasis on the futility of phenotypic selection against rare traits and the slowness of genetic change under moderate selection for quantitative traits even when heritability is high. They also note the naiveté and racism of some of the early eugenicists. There is an extensive discussion of the heritability of intelligence and of racial differences. They argue that it is difficult, if not impossible, at present to determine whether any substantial part of the average IQ difference between Blacks and Whites is genetic. I agree. They go on to discourage further research in this area. Here I tend to disagree, and wonder if they are not overreacting to their Stanford colleague Shockley.

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## The Construction of Classificatory Systems

**Mathematical Taxonomy.** NICHOLAS JARDINE and ROBIN SIBSON. Wiley, New York, 1971. xviii, 286 pp., illus. $15.95.

This volume constitutes the first publication in a secondary source of a considerable body of theoretical work in numerical taxonomy by Jardine and several co-workers. It will be particularly valuable as a reference text, since much of the original material was published in journals not widely read in North America.

The major theme of *Mathematical Taxonomy* is that biological numerical taxonomic methods should be chosen on the basis of their formal properties, rather than empirically. Jardine and Sibson suggest selecting methods by first specifying a set of conditions that any acceptable method must meet, then deducing which possible methods meet all the conditions. Rather than attempting a comprehensive analysis of taxonomic problems within this framework, the authors restrict their attention to two areas of taxonomic methodology: measurement of dissimilarity between pairs of OTU's (operational taxonomic units), and clustering by phenetic similarity.

Two types of measurement of dissimilarity between OTU's (considered as classes of individuals) are considered. "I-distinguishability" comprises measures of the degree of non-overlap between the (usually multivariate) probability distributions describing OTU's. "D-dissimilarity" is characterized as the gain in information realized when a class X of individuals is identified as one of A or B, given initially that X is either A or B. A generalized measure of I-distinguishability is derived, rather elegantly, from purely statistical and information-theoretic considerations. Jardine and Sibson suggest as the most desirable measure of D-dissimilarity a quantity, "K-dissimilarity," whose value between a pair of OTU's is established by summing over characters the univariate I-distinguishability terms obtained from the marginal distributions of the two OTU's. As the authors in-