
PREFACE

Human evolution, and the evolution of human predecessors, were undoubtedly dramas that involved a complex web of characters and events. The scientists who study human evolution, paleoanthropologists, have a rich history as well, involving discovery, analysis, and debate. This book is designed to present an up-to-date picture of both our evolutionary origins as well as the field of paleoanthropology in a relatively nontechnical manner that can be appreciated by the general reader.

A major feature of this presentation is its approach to the study of the primate fossil record. Skeletal remains are viewed in light of what they can reveal about the populations they represent: their anatomy, behavior, and social organization. The primate fossil record is presented as an evolutionary theater and not merely as isolated bones uncovered by tireless investigators.

The text is written primarily for the uninitiated, and a number of features are included to aid the reader's comprehension and allow further research on the topics discussed. A glossary of many of the technical terms is appended as a reference. A number of theoretical possibilities provide the reader with alternative views.

Because our knowledge is changing rapidly, who knows what theory now in vogue or disrepute will be ignored or championed a few years hence? It would be a gross misreading of the material and a disservice to those working in the field if one were to close the book feeling that all the work has been done and that all questions have been settled. Few other fields of scientific endeavor leave so much unanswered and have so much work yet to be done. Perhaps some who read this book will rise to the challenge.

Until fairly recently, the discovery of evidence for primate evolution and earlier stages of human cultural development was largely the result of accident. Now, however, sufficient material exists for planned research to proceed. Advanced technologies have provided new insights. Within recent times the following changes in fossil studies have occurred: Paleoanthropology has become more concerned with framing questions than with simply collecting more evidence, such as tools and fossils; the successful application of newer dating techniques and the refinement of others have allowed a more accurate time scale to be established; and the understanding of human evolution has expanded as its study has become interdisciplinary. The

rapid development of the field of paleoanthropology and its remarkable success (as a result of both field and laboratory studies) in understanding primate evolution are all the more dramatic given the limited funding available.

The scientific approach attempts to understand the universe through direct observation. Science searches for knowledge and understanding through the formulation of theories of nature. Scientific theories are first forwarded as hypotheses, which scientists utilize to explain phenomena. Together with certain initial data, a hypothesis entails the facts of observation. The hypothesis considers a supposition as if it were true, without actually accepting it as true. The researcher needs to have some clue as to what facts will help solve a problem. The best guide is a tentative hypothesis, which concurs with existing knowledge and is so framed that with its help the researcher can deduce that under certain conditions certain other facts will be found if the hypothesis is valid. The initial conditions of the hypothesis should be observable or experimentally produced, and the deduced facts should be observed. When assessing the strength or predictability of a hypothesis, stress is laid on the range and variety of facts that can be brought under its explanatory umbrella. Each hypothesis is tested against new information, and it can and should be modified to reflect new data or be rejected in favor of another.

Scientific theories are explanatory principles that stand the test of time. A theory may signify any hypothesis, whether confirmed or not, or it may be restricted to hypotheses that have been so strongly confirmed as to have become part of accepted scientific doctrine. A theory generally signifies a systematic account of some field of endeavor, derived from a set of general propositions. There may be rival theories, and scientists must jettison one theory for another if circumstances dictate. The scientific attitude is scientific only to the extent that its practitioners are prepared to admit that a favored theory is no longer functioning.

Science is about the systematic search for answers to questions. For paleoanthropology, the main question is: **Who are we, and how did we get here?** Paleoanthropologists are not the only ones seeking to answer the query. This is either **the** or **a** fundamental question for anthropology, philosophy, and theology, for example. This book records scientific endeavors to explain who we are and how we got here. We try to explain human evolution and try to place humans into the context of geological and biological change on planet Earth.

Scientists often work in steps, first asking limited questions to get at a broader question. One discovery may lead to another; one question may be the basis of another question; one answer may lead to another question. Major scientific breakthroughs are usually the result of the work of many people building upon one another's work.

Knowledge advances through seeking answers to questions. The following questions were asked and answered in the process of formulating the modern theory of evolution. Geologists provided hypotheses (often competing at first) to explain geological change and the appearance of fossils. First Jean-Baptiste de Lamarck and then Charles Darwin and Alfred R. Wallace asked why there was variation in life and how such variation was produced and maintained. Having provided the answer as to why variation exists, Darwin attempted to explain how such variation was passed

generationally. His explanation was incorrect. Gregor Mendel asked the same question, and provided the correct answer. The synthesis of Mendel's theories with the Darwin-Wallace hypothesis led to new insights and a more comprehensive theory of evolution.

Observing phenomena is only one part of the scientific endeavor. The phenomena need to be explained, measured, and described. Sometimes a problem cannot be approached directly because of the nature of the available evidence. For example, the knowledge we seek about the behavior and social organization of extinct human and nonhuman primates is only partly attainable through analysis of their fossilized remains. We use models such as living monkeys and apes to overcome this obstacle (Chapter 5). Monkeys, apes, and humans share an evolutionary history (Chapter 4).

New technologies developed in the fields of geology, chemistry, and molecular genetics provide data that greatly enhance the work of anthropologists. The fruits of some of these technologies are discussed in Chapter 4, where we describe the genetic evidence that reveals the closeness of the human-ape relationship, and in Chapter 2, where we discuss how new dating techniques have provided new insights into the evolutionary relationships of our primate ancestors.

Neither the scientific method nor its practitioners are infallible. Because the scientific method requires replicability, wrong answers and misplaced emphases eventually save time because they represent an avenue of investigation that was tried and proved fruitless. Science thus becomes a self-correcting process, working toward the realization of objective truths about nature. The evolutionary origin of the diversity of life on Earth today appears to be one of those objective truths.

Many authors have a particular theoretical perspective they wish to champion. This statement is especially true of the scholarship in paleoanthropology. A conscious effort is made here to prevent our views from becoming the focal point of this presentation. Students do not need to be told that one viewpoint is gospel; they need a wide spectrum of explanations, which we have attempted to provide by describing feasible alternatives. In a true learning situation, students should be helped to form opinions based on current evidence. It is hoped that enough evidence for conflicting viewpoints is presented here so that students can begin this opinion-making process.

Discoveries undoubtedly occurred as this book was being published, a frustrating, yet fascinating, aspect of paleoanthropology. New frameworks appear as the fossils themselves emerge from their long entombment beneath eons of sedimentary deposition. Explanations based on earlier materials are constantly being revised, and in this sense, the text must always be somewhat dated. However, the revision process must not be taken to mean that all that appears is mere guesswork. To reach this conclusion precludes discovery and reveals a bias against the scientific method. The scientific method demands revision, the testing and retesting of hypotheses, and only in this manner can scientific understanding inch forward.

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