

PREFACE FOR STUDENTS: A GUIDE TO STUDYING HUMAN EVOLUTION

The science of human evolution is a unique one for many reasons. One is that it is a genuine science, which requires a systematic approach, hard facts, and general theories, and yet it also deals with humans, who are notoriously difficult to study objectively. The history of the discipline is littered with examples where the balance between these two aspects has been hard to keep. This means that this book must tread a fine line between the recognition that some of what we study is little more than good conjecture, and the need to seek out solid facts and good logic to determine what really did happen. In studying human evolution it is possible to either wallow in the uncertainty of it all – all theories are equal and everyone's opinion is equally valid – or to rigidly limit yourself to the sturdy facts of the fossil record – what I see or can measure is what I know. In what follows in this book we try to show that there are real facts out there, that there is an actual history to be unraveled, but that it requires thinking and a knowledge of the wider fields of evolution.

Another unique feature of the study of human evolution is that it is a historical science. Those of you from a "hard science" background will miss the reassurance of the experiment. As evolution happened in the past, it is not possible to run it again, under different conditions, to test hypotheses (although computer simulations are bringing that closer). We are dependent upon observations and statistical analyses. This does not mean that it is not a hard science – in the phrase of the great evolutionary biologist John Maynard Smith, it is certainly a difficult science. Penetrating the past means that we need to be able to extend the information as far as possible, and that requires using models and inferences, and applying general theories. In a similar science – cosmology – this has been done with extraordinary success. Again, in this book, unlike many textbooks, we therefore encourage an approach where the particular problems are approached in terms of general evolutionary models.

Linked to this need to place human evolution in a broader evolutionary framework is a further demand. At first sight it might seem that the way to study human evolution is to find a suitable site, hope for some luck, and dig up some fossils, which can then be studied using some basic anatomical principles, adding more to the edifice of human evolution. Alas, it is more complicated than that. Choosing an area to work depends upon a detailed geological knowledge; the excavation requires expertise in stratigraphy, paleoenvironments, plant and animal fossils. Many dating techniques, all using complex physical and chemical methods, are needed. Nowadays the fossils can be subjected to scanning electron microscopy, histology, imaging and CAT (computerized axial tomography) or MRI (magnetic resonance imaging) scanning, isotope analysis. Placing the fossils in the right context requires statistical analysis, the application of computerized phylogenetic techniques. Interpreting their functional anatomy and behavior requires a broad knowledge of primates and mammals more generally, ranging from biophysics to socioecology. If tools are associated with the fossil, then a whole other battery of approaches and methods is required, drawn from archeology. To add yet another dimension, perhaps ancient DNA can be extracted from the fossils, requiring a knowledge of biochemistry, molecular biology, and genetic analysis, not to mention the whole framework of human genetic diversity.

It follows from this that a textbook on human evolution should be the sum of textbooks in archeology, anatomy, inorganic chemistry, biochemistry, genetics, molecular biology, sedimentology, geophysics, zoology, and ecology. Such a task is certainly beyond the skills of the authors, and probably beyond the endurance of the student. For this reason we have attempted here not to provide a comprehensive introduction to all aspects, but to provide an introduction to the *principles* of human evolution. These principles should provide a basis for further investigation.

In summary, this is the approach we encourage in this book:

- ◆ Be prepared to tackle problems in terms of both theory and empirical data; each is essential to “doing paleoanthropology.”
- ◆ Treat the information here as a platform on which to build; there is a vast literature out there on the subject, and this book provides a way into it, in terms of both the sketch we provide and the references.
- ◆ Take a broad-minded approach to what constitutes “human evolution” – the methods, approaches, and questions are constantly shifting, and it is an inherently multidisciplinary subject.
- ◆ Remember that even though there is much that is disputed, and much that has been wrong in the past, and no doubt will be again, nonetheless this is a science, and you should adopt a scientific approach to it.