Preface

Currently, the science of evolution emerges as a new synthesis waiting for the synthesizers.

Antonio Fontdevila

Science is a glorious enterprise.

Niles Eldredge

An obvious question to begin with is: do we really need yet another book on the basics of evolution? In the past two to three decades numerous evolution books have flooded the market—all attempting in one way or another to either explain evolution, or to defend evolution in the ongoing "conflict" between science and religion as it concerns evolutionary theory. This latter area has become something of a cottage industry that seemingly feeds on itself and generates an almost endless stream of books, each attempting some new or different take on this so-called conflict. A few of these books are quite good and well worth reading, but this book will touch only minimally on "the conflict."

Other evolution books make Darwin and the history of evolutionary theory the major focus of discussion. This book only mentions Darwin as needed to explain the modern basics of evolution—of which "Darwinism" is still a key component. Some of the major textbooks in evolution take a track that is heavy on genetics, mathematics, and modeling, and again, this book only touches lightly on these approaches. Yet another group of recent books addresses and explains the abundant evidence which supports evolutionary theory, and since some of these are excellent works this book does not dwell long on their vast riches of supporting evidence. Finally, several excellent and recent books have specifically addressed the new

findings and understandings deriving from the flood of evidence coming from recent genomic studies: this book does include some examples and findings from this rich and newly-elucidated store of information—but not, however, in great detail.

This book mainly emphasizes the fact that our understanding of biological evolution is an ongoing synthesis of ideas, discoveries, and understandings that grows daily, thanks to the thousands of scientists who make relevant discoveries and contributions on a regular basis. Only in the last decade or two has genomics made significant contributions to our understanding of evolution. Recent significant fossil finds have also added greatly to our understanding of several major clades and transitions. Relatively new discoveries concerning the area of symbiosis have added support to the claims of Lynn Margulis that this has played a significant role in the evolutionary process. The increased recognition of the huge role that contingency has played in the evolution of life on Earth represents another recent theoretical aspect of the modern consensus. These and other contributing areas of knowledge have made the topic of evolution more complex—one which now requiringes a good bit of background knowledge to feel comfortable with. In short, evolution is not a static discipline—far from it. Organic evolution is a rich and evolving scientific discipline of amazing depth and detail—one that every educated person should at least attempt to appreciate, since it is the ultimate reason why we and some 10,000,000 other living species now inhabit the Earth.

Though it has been said that evolution by natural selection is a simple idea, today the subject uses a tremendous amount of data from a number of specialty areas, and it carries with it many interesting implications. Stephen J. Gould's 2002 *The Structure of Evolutionary Theory* at the 1,343rd page of text illustrates this point well, as do some of Ernst Mayr's larger works. Books of this type were written for those who are already well steeped in the basics of evolutionary thought, while this far smaller book is aimed

at a broader audience, including those with only an introductory understanding of biology and evolution.

I hope that this book might serve as a sourcebook for review, as an introduction to evolution for the curious learner, or perhaps as a text in an introductory course in evolution. My somewhat unique framework will involve taking evolution apart and explaining separately, chapter by chapter, most of the essential components and mechanisms which together make up our current understanding of the evolutionary process.

We cannot avoid the fact that every large and encompassing area of biology (or any other science) accumulates over time a body of scientific jargon, which hopefully enhances understanding—and at the same time reduces the verbiage needed to communicate within the discipline. While this is unavoidable and even necessary, it creates a real need for everyone involved to understand and agree on the meaning of these numerous scientific terms.

Though I doubt that any two evolutionists would agree precisely on the most essential terms and components of modern evolutionary theory, I believe that most would accept that the majority of my chapter titles represent many of the important concepts and topics needed for a fundamental understanding of evolution. Additional necessary jargon will appear in the book. I have tried to incorporate an explanation of any additional terms in the most logical places. In short, I have taken something of a "reductionist" approach—attempting to cover and address the many important concepts separately, while realizing that some topics will need to be cross-referenced to others elsewhere in the book. This differs from many of the current evolution books I have encountered, which weave several threads of thought into long chapters. This sometimes work well, but too often the narrative becomes convoluted and strays from any single train of thought—which is especially difficult for the reader lacking a firm background in the subject of evolution.

My hope was to write a book that would be a clear and accessible aid to understanding either parts of, or

much of the whole of, evolutionary theory as needed by the reader. I will not claim that this approach is superior to that of other, more experienced writers in this area. I admire and have profited much from many other excellent books on evolution; please do note the suggested reading list at the end of the book (Appendix II) in which I have listed and commented on other relevant books by truly talented scientists and/or writers.

Since Darwin's day, our understanding of evolution has itself evolved significantly and continues to do so rapidly. Though there were some earlier periods of relative stasis, these last two or three decades have certainly seen rapid and numerous advances in our understanding of evolution, and some of these have affected the topics covered in this book. Punctuated equilibrium, clade, and genome are only three of the terms which have recently been introduced, and certainly no one can understand evolution well without being aware of these new ideas.

Our increasing understanding of the record of evolution which can be found in the DNA of living organisms continues to revolutionize our understanding of phylogeny, the timing of change, the significance of some symbiotic events, and the origin of some DNA segments (duplications, lateral transfers, viruses, plasmids, "captured" symbionts, transposable elements, etc.). The genomic DNA of the Earth's species represents the most character-rich area of study for determining the actual relationships between the millions of living species, and the future undoubtedly holds many more significant discoveries and surprises in this area.

The fact that several processes other than natural selection are responsible for the process of evolution is still not fully appreciated by everyone—including even some in the scientific community. Though undoubtedly natural selection is largely responsible for most of the adaptations seen in living organisms, these organisms are not just collections of adaptations—this fact being perhaps most evident at the level of the genome, where waste, excess, and genomic conflict seems to be present. Some of these other contributing

processes are discussed in the book, since these concepts are now essential to our understanding of organic evolution.

Almost certainly the most repeated quote concerning evolution is the one penned by Theodosius Dobzhansky: "Nothing in Biology makes sense except in the light of Evolution." Even some who fully accept evolution have said that this is a bit of an overstatement, but at the level of ultimate explanation, all biological phenomena arose through the evolutionary process, and evolution does have some relevance to almost every issue in biology. As some have said concerning natural selection: never has so simple an idea explained so much of the world. To quote another legendary evolutionary writer: "I do not think that evolution is supremely important because it is my specialty. On the contrary, it is my specialty because I think it is supremely important." (George Gaylord Simpson).

Anyone who approaches a full understanding of evolution will realize just how all-encompassing evolutionary theory is, and how it does in fact connect to all things biological. On a personal note I must say that I feel both fortunate and privileged to have spent so many years learning and engaging in my own small way with such a grand and important body of work as the one that now explains and supports evolutionary theory. Engagement with a topic of this caliber and magnitude is truly what "the life of the mind" is all about.

Of the many great scientific breakthroughs of the last two centuries, many feel that evolutionary theory, from the ideas of Darwin, to the evolutionary understanding of genomes and selfish genes, is the greatest set of scientific insights ever to be perceived by humans. It has certainly revolutionized our view of life on Earth, including of course, that of *Homo sapiens*—our own species. It is my hope that this small contribution will aid in making more of us literate in this immensely important and interesting domain of knowledge.

David Zeigler
Department of Biology, University of North Carolina at Pembroke