

Preface

Charles Darwin described *The Origin of Species* as “one long argument” for evolution by natural selection. Subsequently Ernst Mayr applied the expression to the continuing debate over Darwin’s ideas. My explanation of why the debate lingers is that although Darwin was right about the reality of evolution, his causal theory was fundamentally wrong, and its errors have been compounded by neo-Darwinism. In 1985 my book *Evolutionary Theory: The Unfinished Synthesis* was published. In it I discussed Darwinian problems that have never been solved, and the difficulties suffered historically by holistic approaches to evolutionary theory. The most important of these holistic treatments was “emergent evolution,” which enjoyed a brief moment of popularity about 80 years ago before being eclipsed when natural selection was mathematically formalized by theoretical population geneticists. I saw that the concept of biological emergence could provide a matrix for a reconstructed evolutionary theory that might displace selectionism. At that time, I naively thought that there was a momentum in favor of such a revision, and that there were enough open-minded, structuralistic evolutionists to displace the selectionist paradigm within a decade or so. Faint hope!

Instead, the conventional “Modern Synthesis” produced extremer forms of selectionism. Although some theoreticians were dealing effectively with parts of the problem, I decided I should try again, from a more general biological perspective. This book is the result.

The main thrust of the book is an exploration of evolutionary innovation, after a critique of selectionism as a mechanistic explanation of evolution. Yet it is impossible to ignore the fact that the major periods of biological history were dominated by dynamic equilibria where selection theory *does* apply. But emergentism and selectionism cannot be synthesized within an *evolutionary* theory. A “*biological synthesis*” is necessary to contain the history of life. I hope that selectionists who feel that I have defiled their discipline might find some comfort in knowing that their calculations and predictions are relevant for most of the 3.5 billion years that living organisms have inhabited the Earth, and that they forgive me for arguing that those calculations and predictions have little to do with evolution.

Evolution is about change, especially complexifying change, not stasis. There are ways in which novel organisms can emerge with properties that are not only self-sufficient but more than enough to ensure their status as the founders of kingdoms, phyla, or orders. And they have enough generative potential to allow them to diversify into a multiplicity of new families, genera, and species. Some of these innovations are all-or-none saltations. Some of them emerge at thresholds in lines of gradual and continuous evolutionary change. Some of them are largely autonomous, coming from within the organism; some are largely imposed by the environment. Their adaptiveness comes with their generation, and their *adaptability* may guarantee success regardless of circumstances. Thus, the filtering, sorting, or eliminating functions of natural selection are theoretically redundant.

Therefore, evolutionary theory should focus on the natural, experimental generation of evolutionary changes, and should ask how they lead to greater complexity of living organisms. Such progressive innovations are often sudden, and have new properties arising from new internal and external relationships. They are *emergent*. In this book I place such evolutionary changes in causal arenas that I liken to a three-ring circus. For the sake of bringing order to many causes, I deal with the rings one at a time, while noting that the performances in each ring interact with each other in crucial ways. One ring contains symbioses and other kinds of biological association. In another, physiology and behavior perform. The third ring contains of developmental or epigenetic evolution.

After exploring the generative causes of evolution, I devote several chapters to sub-theories that might arise from them, and consider how they might be integrated into a thesis of emergent evolution. In the last chapter I propose a biological synthesis.

In the bibliographical introduction to the reference section of this book I acknowledge authors who inspired me to return to the fray. Here I acknowledge family, friends, and colleagues who helped and encouraged me. First and foremost is my daughter Clio, who was my front-line editor during the development of this work. Once I had produced the first draft, my personal readers were, in order of recruitment, Clio (now studying parrot behavior as a graduate student at Victoria University of Wellington, New Zealand); the zoologist Louise Russert-Kraemer of the University of Arkansas; the social psychologist Bill Livant, formerly of the University of Regina; and the biochemist Rodney Roche of the University of Calgary. Particular thanks go to Rodney, who read two subsequent versions of the manuscript and provided much help with references. I am also grateful to the molecular biologist Kevin Little, now at the University of Auckland, who was very helpful with the epigenetics chapter. The microbiologist Lee Haines was an enthusiastic informant on insect endosymbionts. The historian of medical biology Judith Friedmann introduced me to the subject of anticipation diseases, as well as making helpful general comments along the way. Kathy Wynne-Edwards gave me the full story of the Siberian hamster, an iconic illustration

of how physiological evolution can work. Elisabeth Vrba had a catalytic influence on the progress of this work's publication, as well as providing me with many of her important publications.

Some of my students were directly involved in my study of evolutionary theory. At the risk of alienating the many, I would mention a few of the more recent ones: Camilla Berry, Carol Hartwig, Ben Geselbracht, Kevin Peterson, John Simaika, and Will Duguid. My regular evolutionary sparring partners are Richard Ring, Bill Livant, and Tom Reimchen, and my cheering section includes Dawna Brand, Eugene Balon, Roy Pearson, Renée Hetherington, and Gizelle Rhyon-Berry. Members of the Department of Biology at the University of Victoria, including Louise Page, Tom Reimchen, Richard Ring, George Mackie, John Taylor, Gerry Allen, and Nancy Sherwood, willingly provided reference material along with librarian Kathleen Matthews. Once the manuscript was ready to submit for publication, Gerd Müller and Werner Callebaut, editors of the Vienna Series in Theoretical Biology, responded very enthusiastically. They continued to give me solid encouragement and support through the editing and revision stages. I am also grateful for the hospitality of the Konrad Lorenz Institute on two occasions during the development of this work.