genome sequence will be deposited in GenBank both while in progress and at completion. An international workshop is being organized for September 1998 to develop a plan for completing the *Drosophila* genome that encourages participation of all groups currently working on this project.

It is our hope that this program is complementary to the broader scientific efforts to define and understand the information contained in our genome. It owes much to the efforts of the pioneers both in academia and government who conceived and initiated the HGP with the goal of providing this information as rapidly as possible to the international scientific community. The knowledge gained will be key to deciphering the genetic contribution to important human conditions and justifies expanded government investment in further understanding of the genome. We look forward to a mutually rewarding partnership between public and private institutions, which each have an important role in using the marvels of molecular biology for the benefit of all.

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BOOKS: PALEOBIOLOGY

Palaeobiography

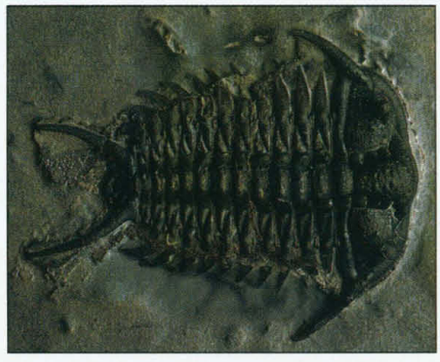
Paul Copper

Life. A Natural History of the First Four Billion Years of Life on Earth. RICHARD FORTEY. Knopf, New York, 1998. xiv, 347 pp., + plates. $30 or C$42. ISBN 0-375-40119-9.

A portentous book title as bold as this—*Life*—is bound to raise a few eyebrows. It is also almost certain to catch the eye of the book browser. In a drama bolder and more sweeping than *Gone with the Wind*, Richard Fortey sketches the full story of life on Earth, the stage and the actors, over more than four billion years. Originally published in Britain as *Life: An Unauthorized Biography* (Harper Collins, 1997), this bright brown volume, plastered with the imprint of *Archaeopteryx* (the oldest known bird), is as encompassing as its title suggests. Fortey, senior palaeontologist at the Natural History Museum, London, takes us on a roller coaster from the spawning of the simplest unicellular organisms during violent infancy of the Earth; through monumental crustal upheavals, voyages of continents, and mass extinctions; to an ending at the dawn of human-recorded history.

The key to this book, a layperson's guide to the secrets of fossils and environments most ancient, is the way the author has magically transposed and integrated his academic biography and intellectual growth into the natural history of life. I know of no other "autobiography"—if the book can be called one—quite like this, where the author's life is stitched into such an immense stretch of time. Neatly and adroitly, Fortey weaves his personal observations, his encounters with scientists (famous and less well known), and his introductions to controversies (century-old and contemporary) into a chronological tapestry of life on Earth.

The text literally begins with *Salterella*, the vessel that in 1967 carried Fortey, then a young Cambridge undergraduate, to his first field season in Spitsbergen. *Salterella* is also one of the oldest shelly fossils, a curious Early Cambrian genus named after the pioneering trilobite specialist John W. Salter. First described in 1861 from the shores of Labrador (where I have collected thousands of the little conical shells around some of the earliest metazoan reefs), its affinities can only be guessed: is it a worm, a coral, a mollusk?



CHIP CLARK / NMNH / SMITHSONIAN INSTITUTION

Ordovician "sea beetle." Guaranteed an excellent fossil record by their calcite carapaces, trilobites are the characteristic creatures of the Early Paleozoic. (*Ceraurus pleurexanthemus*, from Ontario.)

Coincidence, circumstance, and chance, and their effects on the global gene pool through time, are pervasive themes articulated throughout the book. At the personal level, Fortey explores how one chooses a career path, who happens to win the prizes and scholarships, and who loses out to disappear from sight. In the fossil record we learn about the luck of the gene draw, evolution through the trials of mass extinctions, the consequences of changing climates, continental drift, and cosmic impacts.

The book has many strengths. Fortey lyrically raises fossils from the dead, re-creating vibrant, vivid organisms that absorb light, breathe, eat, function, and interact with their ecosystems. Read his descriptions of the Middle Cambrian Burgess Shale from Canada ("on the dark shales there was a fishmonger's slabful of arthropods"), a Carboniferous rainforest ("the air is so humid that the moisture congeals upon your shoulders"), and the Eocene Messel Grube from Germany ("imagine a delicate bat, *Palaeochiropteryx*, as fragile as a paper kite, with every bone laid out upon a dark slab, as if it had been waiting its turn as an extra in a Dracula movie"). The author presents bites of life's story sequentially, from oldest to newest, as if to suggest (probably rightly so) that the past is the key to understanding the present and the future. He moves continents about like cardboard cut-outs to explain migration paths of continental tetrapods and plants. He lucidly spells out the "rules of the evolutionary game" (which organisms needed to follow to succeed, compete, and survive over millenia), and how these are displayed in the fossil record. Fortey provides a bird's eye view of the science of paleontology, and an insider's perspective of the "psycho-cultural" shenanigans that often come with the paleopriesthood: the cladist cult, the mass extinction dichotomy of catastrophists and uniformitarians, the taxonomic schism of splitters and lumpers, the heretic leaders, and the hermits who wait in isolation to reach

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fame long after their demise. With a deft eye and keen, neutral perception he exposes foibles and strong points alike, as if working with paleontological hammer, needle, and brush to prepare the bare skeletons beneath. Fortey is not opinionated and leaves ample room for thought and reflection. He sometimes sidesteps the contentious issues (what did kill the dinosaurs?), but this is possibly a gentler way of seeing the debate from the sidelines.

Are there drawbacks to this book? Few. Sometimes the descriptive train falters slightly while moving up the stratigraphic column (as if losing steam chugging up a long hill), but this is barely noticeable. The book lacks a "calendar" of the major revolutions of life, with which the uninitiated could keep track of time. Similarly, some pertinent paleogeographic maps might have better explained the formation and fragmentation of supercontinents, which account for much of the main trends of life. The role of global climate change in shaping the distribution and diversity of organisms seems underestimated. Although I could list many quibbles, Fortey clearly dislikes pedantry (several times he cites it as a major shortcoming in science), and such criticism might be carping. The book is painted with very broad brush strokes and should be perused accordingly.

This book was a pleasure to read and can be enjoyed by all. If you wish to get a sense of the excitement in paleontology (the thrill of finding an exquisitely preserved new fossil species, or a new skeleton leading to a cascade of fresh concepts) without the sterility and precise language of a scientific paper or symposium, or if you wish to learn of life's history while avoiding the fact-stuffed summaries of encyclopedias, this is a book for you.

ECOLOGY

Not Noticed by Darwin?

Deane Bowers

Induced Responses to Herbivory. RICHARD KARBAN and IAN T. BALDWIN. University of Chicago Press, Chicago, 1997. x, 319 pp., illus. $44 or £35.25. ISBN 0-226-42495-2. Paper, $17.95 or £14.25. ISBN 0-226-42496-0.

Plants are more reactive than their reputation might suggest. After being damaged or stressed (often in the process of serving as food for animals), they exhibit changes collectively called "induced responses." These responses—whether chemical, biochemical, or physical in form—can in turn affect herbivores feeding on the plants positively or negatively. Although induced responses are typically assumed to benefit the plant by reducing subsequent herbivory, Karban and Baldwin show that actually the effects of induced responses are variable and complex in both plants and their herbivores: A plant may show an induced response, but there may or may not be an effect on a particular herbivore and the plant may or may not benefit. Coupling their considerable experience in the study of induced responses with an exhaustive survey of the burgeoning literature in the field, Karban and Baldwin have crafted a thoughtful and provocative book.

A great deal has happened since the first book on induced responses, a volume edited by D. W. Tallamy and M. J. Raupp (*1*), was published seven years ago. Karban and Baldwin successfully integrate the wide diversity of recent studies, from the molecular biology of the genes involved in signaling induced responses, to the population dynamics of herbivore communities. Though Tallamy and Raupp's volume contained 17 chapters by 31 contributors (including Baldwin and Karban) and the new one has only six chapters, both books have a similar organization of topics. Each considers plant responses to herbivore attack, effects of induced responses on herbivores at levels ranging from individuals to communities, and the potential importance of induced responses for agriculture.

RICHARD KARBAN / UC DAVIS

Wild cotton reacts. Damage by the cotton leaf perforator, *Bucculatrix thuberiella*, induces greater numbers of glands of gossypol (small dark spots), which discourages herbivores.

Although edited volumes are often valuable additions to our understanding of particular research fields, they seldom have space to integrate their various chapters. In contrast, as is clear from reading *Induced Responses to Herbivory*, there are many advantages to a single, unified approach. It provides more room for discussion, speculation, and elaboration, and for detailing evidence for or against particular hypotheses. Nevertheless, because this book represents the views of its two authors, it does not have the breadth or represent the diversity of interpretations possible in an edited volume.

Besides reviewing the literature on induced responses, the authors insightfully and critically examine aspects of conventional wisdom in the field. They evaluate evidence that induced responses are costly to plants, that herbivore population outbreaks may be caused by induced responses in host plants, that plants can receive signals from other plants, and that certain types of plants are more likely to show induced responses (evergreen versus deciduous, or herbaceous versus woody). In these evaluations Karban and Baldwin pull together a vast literature on plants, herbivores, and pathogens. Their exhaustive survey will aid everyone from students just learning about the field to researchers already well-versed in the subject.

Although not all readers will agree with the authors' perspectives, the book is comprehensive and well-written. Still, I was disappointed to find the authors continuing the use of military terminology in describing types of responses, a tradition popular since the description of plant-herbivore interactions as an "evolutionary arms race." Using terms like "mercenary" or "civilian" does not advance our understanding of the mechanisms or functions of induced responses. Despite this minor quibble, the authors have done a great job of gathering information from a wide variety of fields, synthesizing (rather than merely reviewing) it, and suggesting productive avenues for future research.

The phenomenon of induced responses is a relatively new one in the field of plant-herbivore interactions. As the authors point out, "unlike most other natural phenomena, Darwin did not describe it." Much has been accomplished in the quarter-century since researchers first noted the importance of induced responses for plants and their herbivores. This book highlights how far we have advanced in our knowledge, and how much more remains to be done.

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