New narratives of creation

Life: An Unauthorized Biography
by Richard Fortey
HarperCollins: 1997. Pp. 399. £20

Andrew H. Knoll

In his brief poem "When I heard the learn'd astronomer", Walt Whitman recounts an evening spent at a scientific lecture. Facts and figures swirl about the hall, oppressively weighting the air, until he is compelled to flee into the night and restore his spirit beneath the canopy of stars. Although written more than a century ago, Whitman's verse resonates with a surprisingly large contemporary readership. Earlier attempts to understand the Universe and our place in it distilled nature's mystery into powerful narrative; science replaces awe with statistics.

This is a maddening accusation, and many readers of *Nature* would counter it by insisting that knowledge promotes wonder as effectively as ignorance. That may be, but scientists seldom do a good job of demonstrating the point. Current texts on the history of life might even be introduced as evidence in support of Whitman's view. The successive dominants of global ecosystems are generally recounted like the generations of Abraham in prose that instructs but rarely inspires. What a pleasure, then, to read Richard Fortey's elegant new book. Fortey, a distinguished palaeontologist at the Natural History Museum, London, authoritatively serves up the facts that lend substance to scientific debate about evolution, but in doing so he never loses sight of the fact that the evolutionary history assembled from fossils and comparative biology remains a story, and a darn good one at that. The result is the best account of life's history that I know, an engaging narrative that succeeds as literature as well as science.

Conventionally, Fortey begins with Darwin's warm little pond (or hot little hydrothermal vent) and ends with the rise of *Homo sapiens*. In between, there are illuminating discussions of Precambrian microorganisms, the Cambrian explosion, the great radiations and extinctions, dinosaurs, and more. Fortey acknowledges that the Earth itself plays an important role in this drama, as continents shift and climates fluctuate for better or worse. His focus, however, is squarely on character development — the trilobites, eurypterids and ammonites that populate his text emerge as organisms that lived and breathed rather than merely as the skeletal signposts of a lost world.

Not surprisingly, Fortey is best on his home turf of Palaeozoic marine animals; however, this history is ecumenical, addressing terrestrial as well as marine evolution, plants as well as animals. My only serious complaint arises from Fortey's inexplicable conclusion that competition was introduced into ecology with the Cambrian radiation of marine animals. Surely, microorganisms compete for resources (remember Gause?) and did so for billions of years before jellyfish and arthropods joined the fray? What animals added was macrophagous predation, enabling them to construct complex food webs that form a crown, intricate and unnecessary, atop ecosystems fundamentally maintained by microbial metabolism.

As good as Fortey's history is, it is nearly eclipsed by a second narrative woven contrapuntally about the first. Fortey's subsidiary theme concerns palaeontology as a way of knowing, illustrated honestly, and sometimes hilariously, by scenes from the life of Richard Fortey, palaeontologist. (His two-page sketch on the hazards of runny noses in Thailand is priceless.) Like Fortey, I came of age professionally piloting Cambridge University's little boat *Salterella* through the fjords of Spitsbergen, and I, too, harbour a secret envy of colleagues who travel to the Caribbean while I swat mosquitoes in Siberia. Thus, like many another palaeontologist, I can identify with many of Fortey's vignettes, whether they describe the sociology of field parties (deadly accurate) or the exhilaration of cracking open a piece of limestone to find a fossil never before observed by humans.

Fortunately, you don't need to know the Latin names of Palaeozoic brachiopods to enjoy Fortey's sketches. They are drawn so deftly that anyone with a modicum of imagination will gain a vicarious appreciation of the life of the palaeontologist. Only rarely do our custodians of the past save the Ark of the Covenant from Nazis, stop evil geniuses from reconstituting dinosaurs, or even stump for punctuated equilibrium. Most of us spend our days in tedium and puzzlement poring over ancient shells, bones or leaves, glad for the occasional refreshment afforded by insight. There is generosity and jealousy among colleagues, and, in the field, a little romance, a lot of drudgery and occasionally even fear. Fortey captures it well.

Famous palaeontologists past and present make brief appearances in the text. Some are brilliant (Charles Lapworth, father of the Ordovician period, is a particular favourite), others merely eccentric (Rousseau Flower smoked cigarettes in the shower and lashed barren outcrops with a bullwhip). There are even a few snakes and scallywags. These characters provide incontrovertible evidence that the reconstruction of evolutionary history is, like other branches of science, a very human endeavour. Only occasionally do Fortey's characterizations yield to pop psychology, as when

It's a colourful world

An iridescent moth wing is a thing of fleeting beauty, as most insects do not retain their iridescent colours for long after death. This is just one of the many observations about pigmentation that can be found in *Color in Nature* by Penelope A. Farrant (Sterling, $35, £25). With 300 photographs, it is a beautiful guide to the forms and the function of colour in the natural world.

palaeontological resentment about the impact theory of end-Cretaceous extinction is ascribed to an irrational fear of apocalypse, or when parents applauding their baby's first steps subconsciously celebrate the rise of bipedal primates. Given the generosity of the text in general, Fortey's portrayal of research conferences strikes a sour and dissonant note.

Perhaps the greatest pleasure of reading Fortey's book is provided by the prose itself. His style is conversational, literate, and relaxed — Darwin as told to Calvin Trillin. A page that begins with the biology of sponges might proceed to a rumination on the use of animal names as insults (see "snakes" above) and end with an attempt to rehabilitate the epithet "slime". Patience is rewarded — as often as not Fortey's digressions fold back on the main narrative to reveal it from a new perspective.

In making the case for the history of life as science's creation narrative, and palaeontology as a way of understanding how we got here, Fortey effectively counters Whitman's accusation that scientists rob nature of joy and wonder. But then, even Whitman was capable of proclaiming: "Of physiology from top to toe I sing.… Of life immense in passion, pulse, and power". Richard Fortey could hardly disagree. □

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Fabric of the Universe

Shadow of a Star: The Neutrino Story of Supernova 1987A
by Alfred K. Mann
W. H. Freeman: 1997. Pp. 210. $22.95, £16.95

Cosmic Clouds: Birth, Death, and Recycling in the Galaxy
by James B. Kaler
W. H. Freeman/Scientific American Library: 1997. Pp. 252. $32.95, £22.95

F. D. Kahn

Supernova 1987A is the most famous supernova of them all. There are two main reasons: it was the first supernova visible to the naked eye for some four centuries and it was the first ever to be detected by its neutrino flux. In fact the neutrinos were registered around three hours ahead of the first optical detection — not surprising really, because the neutrinos are produced deep down within the star that became a supernova and travel straight out from there. The light from the event, however, is not emitted until the shock wave reaches the surface of the precursor star; the passage from the deep interior took three hours in the case of 1987A. In all, 20 neutrinos were collected at the Kamioka and the Lake Erie installations, carrying between them about 10^{-10} joules, or roughly one part in 10^{56} of the energy released in the collapse of the precursor to a neutron star.

What a fantastic success; and the experiment had not even been planned that way. As Alfred K. Mann explains in his delightful book, the apparatus was designed to detect neutrinos emitted during the putative decay of protons. One tends to think of the proton as a stable constituent of the Universe, but theory has it that even protons do not last forever, with a lifetime possibly as short as 10^{30} years. In the event, this turned out to be an underestimate, and so the apparatus was left with nothing to look at. Mann tells the story of how he and his colleagues modified their experiment, what incredible care had to be taken with their procedures and how they made their great coup just months after the final adjustments. Those 20 neutrinos are probably the most important particles in the history of astrophysics, and will continue to be so until someone actually catches a magnetic monopole. But the biggest surprise of all is that nobody on the Kamiokande team has yet been awarded a Nobel prize. If ever recognition was overdue, here is a prime example.

Mann's book is compact, and focused on one essential aspect of astrophysics. By contrast, James B. Kaler's book is large and wide-ranging, although a little small for a coffee table. It is concerned with great theories, and all astrophysical life is there. The illustrations vie with each other in magnificence. Inevitably, the most striking of them are pictures of diffuse objects such as the Eagle Nebula, a region of active star formation in interstellar space, and of the Helix Nebula, a planetary nebula. Both photographs were taken with the Hubble Space Telescope — where would we be without it?

Kaler has organized his text around the pictures to trace the sequence of events whereby material in space takes its various known forms: how we can observe it and what we need to do to understand its physical and dynamical evolution. It is a bold scheme, but perhaps the author asks too much of his audience. It is hard to expect readers to spend great lengths of time ploughing through, say, the ins and outs of molecular spectroscopy when they could be feasting their eyes on all the gorgeous colour pictures. And quite right, too: as the Bard says, in *Love's Labour's Lost*: "Small have continual plodders ever won save base authority from others' books."

Both Kaler's and Mann's books illustrate one great eternal truth. If an author knows what he wants to say then his text is easy to read. When Kaler deals with the subject of planetary nebulae or when Mann describes his experiences with Kamiokande, then the reader is carried along willy-nilly, like a yacht with a following wind. But the going gets much rougher when they write about sub-

Watching the neutrinos

Supernova 1987A appears in the photograph on the right, taken a few days after the explosion, as a bright spot in the upper right where before there was none. The pictures are reproduced in *A Short History of the Universe* by Joseph Silk, which is now out in paperback. When first published in 1994, it was described by Michael Rowan-Robinson in these pages as "the best introduction to cosmology for the general reader currently available". The new edition comments on improved images from the Hubble Space Telescope and recent searches for dark matter. W. H. Freeman/Scientific American Library, $19.95, £14.95.