The changing face of the Earth

Robert P. Beckinsale

A Short History of Geomorphology.
By Keith J. Tinkler.
Croom Helm/Littlefield, Adams: 1985. Pp.317. £19.95, $25.

THE compilation of a short, comprehensive and readable history of the study of landforms calls for selective wisdom of the highest class. Keith Tinkler's book has all those virtues, even though nearly one-quarter of it is given over to an excellent bibliography and a rather simple index. The dominant method used is to illustrate particular themes by studying influential publications in some depth to convey an overall view of the subject without sacrificing attention to detail. Necessarily, where possible, the focus falls upon form and process as viewed over time.

The reader is assumed to have at least a nodding acquaintance with geomorphology and its terminology, but these prerequisite demands are small and undergraduates are encouraged also by a brief historical *caveat*. The account moves quickly through classical authors to the Italian Renaissance and so to the long period when the earth sciences, with rare exceptions, were constrained by biblical notions. This period merged into the age of James Hutton and John Playfair who believed that "in nature we have no deficiency of time" and whose thoughts were as complementary as their styles were disparate.

There followed the effect of the Industrial Revolution on scientific thinking, which fostered Charles Lyell, the great uniformitarian, who used existing phenomena as a complete basis for his conclusions on processes (and not surprisingly sometimes showed an unfortunate bias). Before his death in 1875, fluvialism had become more positive and the reality of a recent Ice Age generally accepted, thanks to "a blend of factual investigation and imaginative insight... unparalleled in the history of geomorphology up to that point"(p.119).

Most of the remainder of the text covers geomorphology since the 1880s rightly emphasizing the influence of Eduard Suess who postulated a periodic movement of sea-level, diastrophically controlled and globally synchronous, and of William Morris Davis who popularized stages in river courses and cycles in the development of a variety of landforms. During and after the Second World War allegiance to marine planation and cyclic aspects faded in face of improved technologies and heightened interest in climato-genetic geomorphology and in details of fluvial, coastal and tropical landforms. Since 1960 the shift towards quantification and process studies has quickened and progress has been made in, for example, the understanding of slope development, river flow, ice-sheet dynamics and the significance of physical thresholds. Conceptual and theoretical advances have included the systems theory with its concern with a stable, though not static, equilibrium state.

In the final chapter Tinkler tries to assess future trends, a task which some readers may consider regrettable as this space could have been more profitably devoted to ocean-floor spreading, plate subduction, vulcanism and orogenesis, topics which are almost ignored. But anyone interested in the study of landforms will find this a competent summary which manages to sustain a stimulating commentary throughout its commendably short course. □

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A chip off the old block

E.N.K. Clarkson

Living Fossils.
Edited by Niles Eldredge and Steven M. Stanley.
Springer-Verlag: 1984. Pp.291. DM138, $54.10.

IN SOME groups of animals and plants the rate of evolutionary change is exceedingly slow, and their modern representatives hardly differ structurally from the earliest members to appear in the fossil record. G.G. Simpson referred to such slow evolution and abnormally long survivorship as bradytely, distinguishing it qualitatively from horotelic (normal) or tachytelic (very rapid) evolutionary change. The survivors of such bradytelic lines are "living fossils", conceived as either specifically adapted to particular niches within a more or less permanent environment or as more than usually tolerant of fluctuating conditions. Lineages which become bradytelic might be "advanced" on their first appearance but lack of environmental stimulus for change would enable them to survive indefinitely.

How valid are Simpson's concepts in the light of the current developments in patterns and processes of macroevolution? Is there anything special about such arrested evolution or is bradytely simply the "slow end" of a normal distribution of evolutionary events?

Eldredge and Stanley, in trying to come to terms with these and related questions, solicited specialist contributions to obtain data on groups which might be, or have been, regarded as living fossils. They requested, for example, information on anatomical similarity of modern forms to their ancient relatives, the time scale involved, ecological specializations, diversity and so on. In other words, how good are the examples of living fossils and in evolutionary terms what does it all mean?

There are 30 separate papers in this collection and two concluding summaries, one by each editor. Over half of the papers are devoted to vertebrates — various mammals, coelacanths, *Amia* and *Polypterus* (though not *Sphenodon*). The interesting question is asked (and answered) as to whether there are any anthropoid living fossils. A great variety of invertebrates are discussed, among them *Neotrigonia, Peripatus* and limulines (though not *Lingula*), but also bryozoans, and cephalocarids as living fossils lacking a fossil record. There are, however, no plants, not even *Ginkgo*.

Some authors have given a largely anatomical account of their group, but have usually tried to assess whether the surviving representatives are or are not "good" living fossils. Others have also advanced concepts and theory, often thought provoking. It is, of course, easier to categorize as a living fossil an animal whose similar forebears appeared 500 million years ago, than a type which originated more recently. Even then it may not be easy, for, as Ward, for example, acknowledges in his excellent paper on *Nautilus*, the apparent stasis may only be a factor of low morphological complexity. And again Fisher points out that the sparse fossil record of limulines virtually precludes their evaluation as "good" living fossils. In spite of the very different ways in which the various authors have approached their groups, this volume is a really valuable source of well researched information.

Having collected the evidence, to what conclusions do the editors come as to the reality of bradytely as categorically distinct from other rate-phenomena? Eldredge concludes that there is no strong evidence for bradytely as a separate kind of evolutionary mode. Likewise Stanley suggests that Simpson's three classes, including bradytely (originally developed within a gradualistic framework) tend to lose their value as separate categories when seen from a punctuationist standpoint. Does this imply that, after all, one's own point of view may still be the ultimate determinant, and the question should be left open? Possibly, but few could take exception to the concept that living fossils are simply survivors of long-lived groups which have continued, for a variety of reasons, including those Simpson proposed. □

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● *Ghosts in the Mind's Machine: Creating and Using Images in the Brain* by Stephen Michael Kosslyn. Publisher is W.W. Norton, price is £9.95. For review see *Nature* **310**, 344 (1984).

● *The Youngest Science* by Lewis Thomas. Publisher is Oxford University Press, price is £3.95. For review see *Nature* **302**, 778 (1983).