Vignette: The Nobel

The reason for the prestige of the Nobel Prize for physics is that, all told, it has been given well. This does not mean that there have not been some lucky mediocrities who have received it and some eminent deserving scientists who have been passed over. For the former, it was a stroke of luck; for the latter, apart from worldly disappointment, it is unimportant . . . . Considering all the laureates, one can divide them into three groups: one group has given prestige to the prize, one has been exalted by it, and one has more or less broken even.

—*Emilio Segrè*, in *A Mind Always in Motion: The Autobiography of Emilio Segrè* (University of California Press, forthcoming)

new terminology to distinguish this new era.

The clarity of Bud's periodization suffers as he moves into the most recent two decades and draws more upon anonymous policy documents and committee reports. Still, Bud's digging around in the bacteriological roots of biotechnology is an important corrective to histories that emphasize its roots in genetics. In addition, his book is the best introduction to the comparative and cultural history of biotechnology (even though he virtually ignores work in Latinate and Slavic languages). Words mutate as they move between languages, between disciplines, and between historical periods. Historically, Bud explains, those mutations were directed by scientists intending to convey specific hopes for the industrial uses of life.

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Post-Gradualism

The New Catastrophism. The Importance of the Rare Event in Geological History. DEREK AGER. Cambridge University Press, New York, 1993. xx, 231 pp., illus. $34.95 or £22.95.

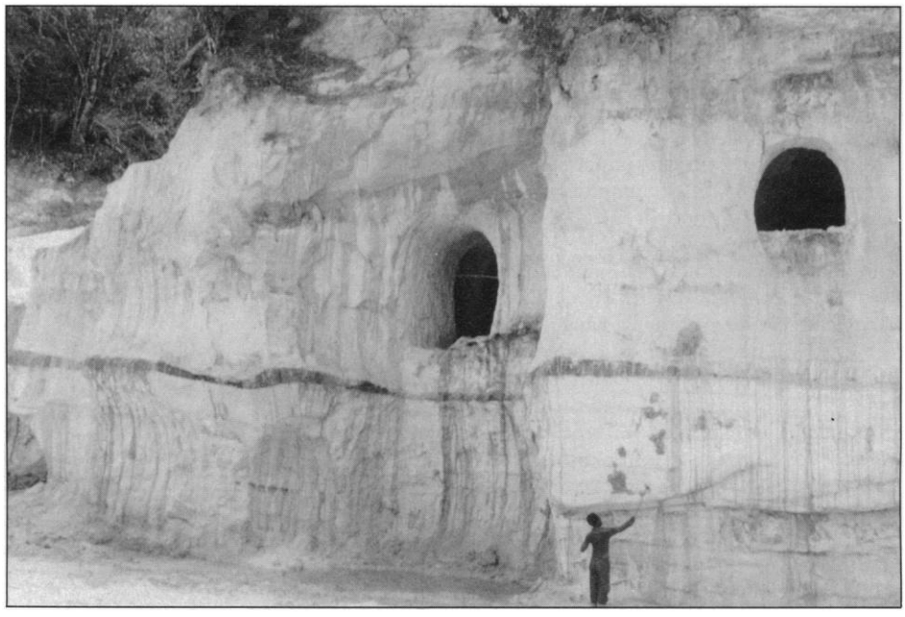
Charles Lyell is a hero in the history of geology because he argued persuasively that processes of the sort now acting on Earth can be used to explain not only the presence of observed geological patterns but also the absence of expected patterns. In other words, he required, and made legitimate, extrapolation beyond directly observable evidence. This is a general, yet underemphasized, aspect of scientific method of which geology is only an obvious example. When pressed (and many must be pressed very hard), almost all scientists would admit an important role for inference in their work.

As is now increasingly acknowledged, however, Lyell also sold geology some snake oil. He convinced geologists that because physical laws are constant in time and space and current processes should be consulted first before resorting to unseen processes, it necessarily follows that all past processes acted at essentially their current rates (that is, those observed in historical time). This extreme gradualism has led to numerous unfortunate consequences, including the rejection of sudden or catastrophic events in the face of positive evidence for them, for no reason other than that they were not gradual.

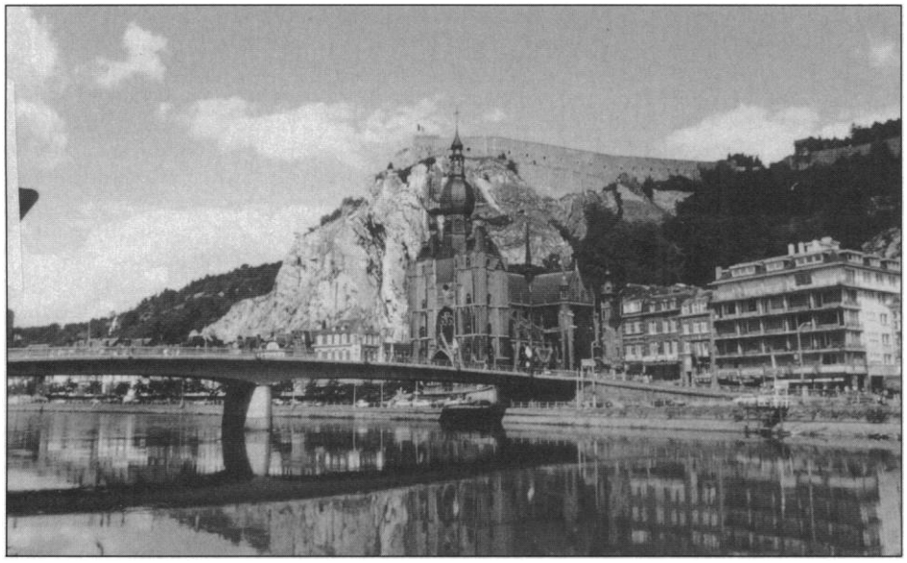
Indeed, geology appears at last to have outgrown Lyell. In an intellectual shift that may well rival that which accompanied the widespread acceptance of plate tectonics, the last 30 years have witnessed an increasing acceptance of rapid, rare, episodic, and "catastrophic" events.

Two aspects of this shift are noteworthy. First, it represents a powerful response to creationists, who often argue for wholesale rejection of all of historical geology whenever they find any indication of rapid geological phenomena. Second, dramatic though this shift is, it has been very slow in filtering into introductory college and high school classrooms, where "uniformitarianism" is often accompanied by the mantra that "the present is the key to the past" and nothing else.

It is for these reasons that the late Derek Ager's book is welcome and significant. The volume is the summation of a lifetime of global geological work by one of the most influential stratigrapher-paleontologists of his generation, a highly eclectic compilation of the author's geological observations from around the world in support of the general view that the geological record is dominated not by slow, gradual change but by episodic rare events causing local disasters. Ager is no newcomer to the idea of sudden change; he coined the term "tempestite," now in common use, for sedimentary deposits formed by storms, and he is well known for his suggestion that geological history is like the life of a soldier: "Long periods of boredom and short periods of terror." Yet



"Miocene kaolin being worked in adits with a thin red band below the left adit marking a very brief extension of a river flood-plain, Pugu Hills, Tanzania." Kaolin, or china clay, "represents the deep weathering of felspar-bearing rocks and is commonly found associated with granitic rocks, such as the Permian Dartmoor Granite in Cornwall. . . . Here it was close to the granitic rocks of the African shield." [From *The New Catastrophism*]



Limestone cliff above the River Meuse at Dinant, Belgium, the "type section" of Dinantian (Lower Carboniferous) deposits such as are found also in the Grand Canyon, the Canadian Rockies, and the uplands of England and Wales. "For many years I have pointed out how, at certain times in earth history, carbonate deposition was remarkably widespread around the world. . . . I suggest that [such episodes] were related to the availability of carbon dioxide in the atmosphere. This may have resulted from a slow build-up of this gas . . . such as we see going on today, coupled with the increase in global temperatures due to the 'green-house effect' about which we now hear so much. We may therefore expect, in the near geological future, a rise in sea-level and another spread of carbonate deposition on the continents. . . . I do not necessarily blame all this on mankind." [From *The New Catastrophism*]

by the eminence of its author and the straightforwardness of its tone this volume may mark the arrival of catastrophism at the status quo.

What this book represents, however, is probably more important than what it contains. As engaging as Ager's examples are, they are much less than complete. Although he gives a very cogent general summary of the incompleteness of the record, several important topics, notably the effects of storms on sedimentation and of episodic deposition on the accumulation of fossil deposits, receive only cursory treatment. As an introduction to uniformitarianism/catastrophism the book should be read in conjunction with other works (which Ager cites); a convinced gradualist would not be convinced by this book alone.

Most surprisingly, Ager retreats from perhaps the most obvious recent catastrophist theory—the impact theory of mass extinction—in favor of Earth-based causes. This chapter, the last in the book, is unsatisfying, if only because Ager is less firmly in control here of actual observations. He oversimplifies impact arguments and recites many now-discounted objections as though they were conclusive refutations. But perhaps it is the most interesting chapter in the book, for even in his neo-catastrophism Ager demonstrates that he too is bound by the adage that he cites at least twice: "To find a thing you have to believe it to be possible" (p. 191). Geology will perhaps forever remain gripped in the tug of war between seeing and theorizing.

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The Birth of Stars

Star Formation in Stellar Systems. G. TENORIO-TAGLE, M. PRIETO, and F. SÁNCHEZ, Eds. Cambridge University Press, New York, 1992. xiv, 573 pp., illus. $69.95 or £45. From a school, Tenerife, Spain, Dec. 1991.

According to the standard hot big bang cosmological model, the baryons that made up "normal" matter in the early universe were contained in an evenly distributed ionized gas that produced the 2.7 K cosmic background radiation. Yet in the present epoch most of the visible baryonic matter is locked in stars, which in turn are strongly clustered within galaxies. The dual processes of galaxy formation and star formation thus have played a central role in shaping the nearby visible universe and in creating the heavy elements of which we and our planet are mainly composed.

Star Formation in Stellar Systems is a collection of papers by leading researchers on the astrophysically critical stellar birth process. Originating as a series of lectures given at the third Canary Islands Winter School, the volume emphasizes the large-scale features of star formation within galaxies. The papers are reasonably accessible, introducing their topics at an advanced undergraduate level and carrying them forward to the frontiers of the field. The book contains many useful illustrations drawn from the current literature.

The observationally oriented contributions to the book emphasize the products of recent star formation. Thus, for example, there is considerable discussion from a variety of perspectives of the features and implications of the concentrations of young stars associated with HII regions. The topics range from the application of HII regions to determine galactic star formation rates, discussed by Kennicutt, to the specifics of spectacular individual young stellar complexes such as the core of the Tarantula Nebula and violent star formation in galaxy nuclei, explored by Melnick.

Two papers focus on the critical connection between interstellar clouds and the birth of stars in very different settings. Hunter considers the normal star formation process within galactic disks by following the main stages of this process from molecular clouds to young stars. Mirabel jumps up four orders of magnitude in scale to deal with the largest star formation events, the "starbursts" associated with mergers of galaxies. He also discusses the role of multiple phases of the interstellar medium—from cold molecular gas to million-degree plasmas—within such events.

The book is rounded out by four theoretical papers that build a physical foundation for the subject while also serving to link together the observational discussions. Bodenheimer tours the main features of the birth of individual stars, Larson gives an overview of star formation processes on galactic scales, Elmegreen presents our current understanding of the triggering of star formation by spiral arms and other processes, and Franco deals with issues relating to the propagation of star formation. The basic physical background provided by these theorists enables the reader to appreciate as yet unsolved problems such as the formation of binary stars or the potential role of star formation propagation in igniting intense bursts of star formation on galactic scales.

Star Formation in Stellar Systems will give advanced astronomy students a broad perspective of this complex subject; readers interested in pursuing specific topics in detail will have to consult other sources, many of which appear in the book's extensive reference lists. There is some overlap