BOOK REVIEWS

Hot Neologisms

The Uses of Life. A History of Biotechnology. ROBERT BUD. Cambridge University Press, New York, 1993. xviii, 299 pp., illus. $49.95 or £30.

"This word has now become a significant millstone around the neck of both the industry and government," argued David Kingsbury in 1987 as the National Science Foundation struggled with the many accumulated connotations of the word "biotechnology."

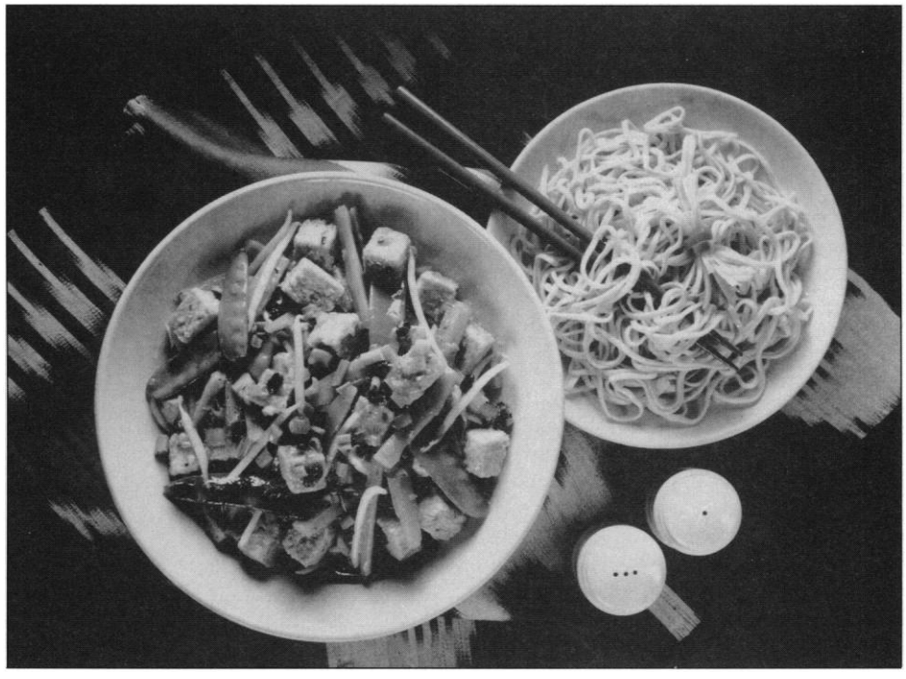
The words that scientists have fashioned to advocate some particular utility in living organisms form the core of Robert Bud's insightful survey of a century of biotechnology. The art in writing historical surveys is in the periodization, that is, in punctuating the continuous stream of time in order to make sense of how selected intellectual, social, and economic events interacted. Bud periodizes his survey by doing a linguistic archeology of the very idea of using life for industrial purposes. The result is that 1974, though a watershed year in recombinant DNA research, becomes a more modest episode "on that contested and mobile frontier which, for a century, has lain between life and engineering."

Zymotechnology, derived from the Greek root for leavening, formed the bridge between biotechnology's ancient roots in baking and brewing and its hyper modern associations with chemical engineering. Beginning in the 1870s, zymotechnical institutes spread the gospel of industrial fermentation through the Germanic communities of north central Europe and north central America. Microbiologists armed with microscopes colonized the zymotechnical institutes and tried to create a coherent applied biochemistry. Max Delbrück, head of the brewing institute in Berlin and uncle of the molecular biologist of the same name, proclaimed in 1884, "With the sword of science and the armour of practice German beer will encircle the world." Yet German industry instead used coal and Justus Liebig's synthetic chemistry to chip away at the indigo, rubber, and cellulose monopolies built upon the sunlight that fell on Britain's empire. Compared to chemistry, zymotechnology at the turn of the century "was, largely, small beer."

Bud was trained as a historian of chemistry and now heads the Life and Environmental Sciences Group of the Science Museum in London. Perhaps as a result, he is especially sensitive to how words mark boundaries between biological and chemical world views. For example, Karl Ereky, owner of Hungary's largest pig-fattening station, coined the term "Biotechnologie" in 1917 as part of a campaign to revolutionize Hungarian agriculture. Ereky and a group of social philosophers active in the 1910s and '20s, including Raoul Francé, Lancelot Hogben, Patrick Geddes, and Lewis Mumford, advocated the use of nature and life to respond "to the chemical challenge posed by Germany." They each envisioned a shift from a mechanical to an organic world view that would prepare industrial societies to then adopt their particular visions of a healthier, "biotechnic" society, in which biological production systems replaced the factory. In America, the Chemurgy movement advocated the gradual transition from a petroleum-based economy to one based on alcohol.

But the biotechnic revolution was put on hold for the Second World War. "Bioengineering" briefly became the hot neologism, describing the study of fitting the human body to military and industrial machinery, or what would later be called ergonomics or human factors research. Microorganisms, however, recaptured the spotlight after the war. The success story of penicillin transformed the industrial position of fermentation and created a massive microbiology-based pharmaceuticals industry in the United States and Europe. The Japanese vision of biotechnology remained rooted in fermentation, the source of much of that nation's diet. Microbiologist Karl Gören Hedén, frustrated at how his Swedish-speaking colleagues had adopted the ergonomic meaning of "bioteknik," maneuvered his microbe-oriented definition onto the title page of *Biotechnology and Bioengineering*. This new journal, begun in 1958, Bud claims, launched the modern usage of the term "biotechnology." Green Revolution prophets of the 1960s predicted that this type of biotechnology, especially continuous fermentation, would feed a starving world without further addicting it to chemical technology.

This distinction between bio- and chemical engineering in the popular imagination was erased in 1974 when genetic engineering was wed to biotechnology. Every possible use and manipulation of life were jammed into an increasingly muddy definition of biotechnology. Many advocates of Green society now called biotechnology dangerous. Many policy-makers appropriated the hopefulness of Green biotechnology and tried to ally it with "the victory of the metaphor of the silicon chip over the parallel with nuclear power." And most scientists, preoccupied with shaping genes, neglected to shape



"An advertisement for Mycoprotein: Stir-fried Quorn® in Blackbean Sauce." [From *The Uses of Life*; courtesy Marlow Foods]

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.

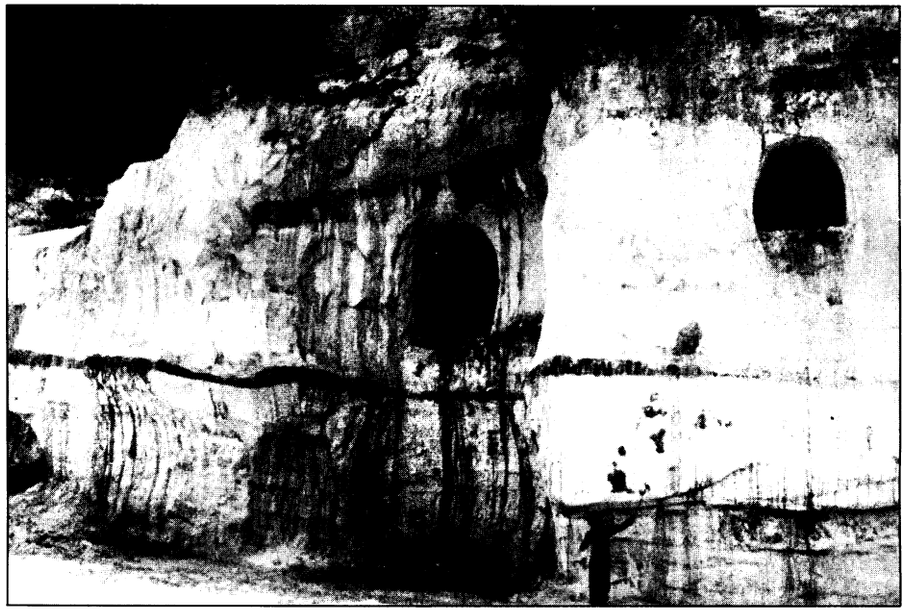
Charles Lyell is a hero in the history of geology because he argued persuasively that processes of the sort now acting on Earth can be used to explain not only the presence of observed geological patterns but also the absence of expected patterns. In other words, he required, and made legitimate, extrapolation 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*]