BOOK REVIEWS

Bad Surprises

Why Things Bite Back. Technology and the Revenge of Unintended Consequences. EDWARD TENNER. Knopf, New York, 1996. xiv, 349 pp. $26.

"The best laid schemes o' mice an' men gang aft a-gley." So lamented Robert Burns, a poetic sentiment at odds with the modern spirit. After all, hasn't the progress of science and technology allowed us to prosper, transcending the insecurities that haunted earlier times? Don't our knowledge and power allow us to move forward with great certainty, improving the world through well-planned projects?

Edward Tenner sets out to shake this self-confidence, citing troubles deep enough to rekindle Burnsian humility in even the most enthusiastic technophile. He writes about "revenge effects," the unintended, destructive consequences of practical measures that often mock any anticipated benefit. Antibiotics marshaled against disease have spawned new varieties of highly virulent drug-resistant bacteria that pose new threats to human health. Methods for preventing forest fires have been so effective in preserving the dry underbrush that wildfires are now enormous conflagrations, destroying forests that survived lesser flames for centuries. Cleverly engineered structures that have altered the contours of rivers and beaches have unwittingly contributed to the lethal force of "natural disasters" that now vex civilization. Improvements in the equipment of skiing, football, and other sports have produced a rash of injuries far more serious than ones common in earlier periods. Business firms have spent countless billions on new information technology, expecting rich returns on their investment, only to find that productivity lags while signs of physical and psychological stress in computerized workplaces steadily mount.

Tenner offers literally dozens of capsule histories about these "revenge effects," describing their perverse logic in lively, often amusing prose. A cascade of examples from medicine, environment, office technology, and sports reinforces the impression that similar gremlins lie in wait regardless of the field of planning and application. Troubles arise, he suggests, when noble but narrowly focused goals enter the complex interactions that make up nature and society. Unable to foresee which complexities need attention, we forge ahead blindly, always expecting the best. Chlorofluorocarbons, introduced as refrigerants to replace potentially explosive chemicals, eventually wreak havoc when they float to the stratosphere and deplete the ozone layer. Safety-enhancing gear for mountain climbing paradoxically makes the sport more dangerous because it encourages climbers to take greater risks. Productivity in offices sags rather than surges as computer software is introduced, for reasons we all secretly know but never admit: the most talented and productive people in the organization waste precious time quietly "de-bugging" the software and training their perplexed colleagues in its use.

As he spins these sobering tales, it becomes clear that the effects that Tenner writes about are not limited to our dealings with new technology. These are ironies, predicaments, and disasters that arise in the course of human action of whatever kind. In search of love, people often enter into relationships that turn out to be combative, even hateful. In search of satisfaction, a great many turn to substances that offer addiction, sorrow, and death. Ancient dramatists understood this situation full well. Greek tragedies reveal that the very steps taken to avoid calamity are often ones that bring calamity about.

Not content merely to describe our situation, Tenner offers some solemn counsel. Dismissing glib claims that current troubles are merely transitional ones that the next generation of hardware and software will surely fix, he suggests that the recurrence of revenge effects demands continuing vigilance. "Technological optimism means in practice the ability to recognize bad surprises early enough to do something about them. And that demands constant monitoring of the globe, for everything from changes in mean temperatures and particulates to traffic in bacteria and viruses" (p. 277). Although he is clearly right on this score, I wonder how helpful this advice can ever be in practice. Tenner's own analysis shows that unhappy results usually come as bolts from the blue. What can individuals or organizations do in such circumstances? Expect the unexpected? What does it mean to be vigilant about events one simply cannot anticipate? The Oedipus plays of Sophocles show people being vigilant all right, but it is precisely their vigilance that destroys them.

One disappointment I had in reading the book was that it did not explore developments that might produce revenge effects in the 21st century. Although Tenner devotes three chapters to plant and animal pests that arise from the introduction of foreign organisms into new ecosystems, he does not speculate about similar prospects posed by the new hybrid organisms of biotechnology. Similarly, his treatment of the physical and social maladies that accompany computers in the workplace does not prompt him to envision what lies in store for a society bound and determined to saturate homes, schools, and personal lives with digital technology. Stressing the need for caution and humility, Tenner himself grows a little timid, reluctant to step beyond historical cases to suggest strategies for managing innovation. Just as well; his readers will be challenged to propose new strategies to deal with nemeses quietly percolating in today's best laid schemes.

At a time in which it has become fashionable for popular writings on technology to revel in fantasies of power and transcendence, it is refreshing to find a book that asks why our artifice so often disappoints and vexes. But will we ever learn anything from the kinds of episodes Tenner so richly documents? Our society's sense of technological possibilities still resembles that of the cartoon character Wile E. Coyote, whose repeated attempts to use complicated contraptions to catch the Road Runner always come crashing down. It often seems that . . . Uh, oh. I've got to stop now. There's the delivery truck pulling up. Oh good, it's another box from the Acme Corporation!

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Approaches to Prions

Prion Diseases. HARRY F. BAKER and ROSALIND M. RIDLEY, Eds. Humana, Totowa, NJ, 1996. xvi, 317 pp., illus. $89. Methods in Molecular Medicine.

It is by now a truism to characterize prion diseases as unique. Unique they are indeed, and in many ways. Not only may they introduce revolutionary concepts regarding pathogenesis, they have a uniquely rich and

fascinating history, part of which took place in exotic lands and includes the rather unusual practice of cannibalism. Prion diseases also have a peculiar and disturbing way of affecting humans and animals, which occasionally results in threats, real or imaginary, of leaping the species barrier and spreading uncontrollably among us. Finally, being such, prion diseases could not fail to involve politicians, the media, and the general public, as they have recently done, and with considerable controversy, in the United Kingdom and continental Europe.

In spite of this extensive history, the causative mechanism of prion diseases remains controversial. Recently, the upper hand has been gained by the "protein-only" or prion hypothesis, according to which the agent responsible for the pathogenesis and transmission of these diseases is exclusively a protein and the "instructions" for the causation of the disease are contained in the secondary or tertiary protein structure. Like many other revolutionary ideas, this one was considered heresy by the scientific establishment when it was first proposed. An opposite theory is championed by a small but vocal group of scientists who maintain that the information is specifically encoded in nucleic acid. According to this second view, the causative agent of prion diseases has the basic structure of a virus, that is, a protein with a nucleic acid core or "a piece of bad news enwrapped in a protein," according to one definition.

Prion Diseases deals with several of these issues in an informative, concise, and entertaining way. Several of the chapters are authored by investigators who have been at the center of events in the history of prion diseases, such as the 1986 epidemic of bovine spongiform encephalopathy (BSE) in the United Kingdom. This makes for a lively and direct narration.

The introductory chapter deals with issues rarely covered in other reviews, such as the reaction of the general public to the "bizarreness" of prion diseases. The paradoxes that the diseases present and the evidence in favor of the viral and of the protein-only hypotheses are reviewed sensibly and objectively. This chapter succeeds in putting prion diseases into the proper perspective.

The two chapters on surveillance and environmental causes of human prion diseases as well as the two dealing directly with BSE are especially timely and useful. They provide information and food for thought that are badly needed by countries, including the United States, that must strengthen their surveillance systems for human and animal prion diseases. The account of the early response to the BSE epidemic in the United Kingdom is inspirational, providing an engaging narrative of how the mystery of the first outbreak of the disease in the United Kingdom was solved in record time by a small group of scientists with the support of responsive politicians and bureaucrats. This was another of Britain's finest hours in which much was owed by many to few.

Clinical, neuropathological, immunohistochemical, and ultrastructural techniques relevant to human and animal prion diseases are presented in five chapters. The remaining eight chapters deal with techniques of prion inactivation, scrapie susceptibility, prion "strains," transmissibility in knock-out and transgenic mice, and methods for studying normal as well as protease-resistant prion protein, including prion protein amyloid. The general quality of these chapters is good. Some provide critical discussion that will be of unquestionable use to those who wish to pursue similar experiments. In a few, the methods are unfortunately presented in cookbook style.

Sadly, the presentation of diagnostic methods does not do justice to the usefulness of the immunoblot in the detection and characterization of prion diseases, and the protocol given is outdated. The simpler and more sensitive methods of prion-protein detection used in human tissues should be also applied to diagnosis in animals.

Glaring errors, if present, were missed by this reviewer, except, of course, for the incorrect genotype ascribed to fatal familial insomnia and familial Creutzfeldt-Jakob disease with mutation on codon 178 of the prion protein gene.

This is a commendable book for those, scientists and non, who wish to learn about methods in the study of prion diseases, the current status of the prion and viral hypotheses, and, perhaps most important, how a responsible country should deal with the threat posed by these diseases.

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More on Prions

Prions Prions Prions. S. B. PRUSINER, Ed. Springer-Verlag, New York, 1996. viii, 163 pp., illus. $129, £78.50, DM 168, or FF633. Current Topics in Microbiology and Immunology, 207.

In this slim volume Stanley Prusiner (who also contributes a foreword to *Prion Diseases*, reviewed above) brings together nine papers on the pathogens named in the title. Prusiner's introduction and the two opening chapters, by Gambetti and by Kitamoto and Tateishi, are concerned mainly with diseases of humans, Gambetti dealing specifically with fatal familial insomnia and familial Creutzfeldt-Jakob disease, "two diseases with the same genetic mutation." Prion strains are reviewed by Carlson, Huang *et al.* and Safar consider the relation of prion protein conformation to disease, and Harris *et al.* discuss the cell biology of the protein. Two papers, by Scott *et al.* and by DeArmond and Prusiner, are devoted to the use of transgenic mice in prion research, and the volume concludes with an account by Wickner and Masison of evidence for the existence of prions in a nonmammalian organism (yeast).

Katherine Livingston

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Books Received

Advanced Electromagnetism. Foundations, Theory and Applications. Terence W. Barrett and Dale M. Grimes, Eds. World Scientific, River Edge, NJ, 1995. xiv, 791 pp., illus. $124.

Binocular Vision and Stereopsis. Ian P. Howard and Brian J. Rogers. Clarendon (Oxford University Press), New York, 1996. x, 736 pp., illus., + plates + stereopticon. $125. Oxford Psychology, no. 29.

Chemical Water Treatment. Principles and Practice. Henri Roques, Ed. VCH, New York, 1995. xiv, 620 pp., illus. $165. Translated from French edition (Paris) by Scott Altmann.

Creatures of the Dark. The Nocturnal Prosimians. L. Alterman, Gerald A. Doyle, and M. Kay Izard, Eds. Plenum, New York, 1995. xiv, 571 pp., illus. $125. From a conference, Durham, NC, June 1993.

Force-Free Magnetic Fields. Solutions, Topology and Applications. Gerald E. Marsh. World Scientific, River Edge, NJ, 1996. x, 157 pp., illus. $38.

The History of Mental Symptoms. Descriptive Psychopathology Since the Nineteenth Century. German E. Berrios. Cambridge University Press, New York, 1996. xvi, 565 pp. $135; paper, $59.95.

Liquid-Liquid Systems. N. N. Kulov, Ed. Nova, Commack, NY, 1996. vi, 270 pp., illus. $98.

Metamorphosis. Postembryonic Reprogramming of Gene Expression in Amphibian and Insect Cells. Lawrence I. Gilbert, Jamshed R. Tata, and Burr G. Atkinson, Eds. Academic Press, San Diego, 1996. xvi, 687 pp., illus. $125. Cell Biology.

Neotropical Birds. Ecology and Conservation. Douglas F. Stotz *et al.* University of Chicago Press, Chicago, 1996. xx, 482 pp., illus., + plates. $100 or £79.95; paper, $37.50 or £29.95.

Photoinduced Defects in Semiconductors. David Redfield and Richard H. Bube. Cambridge University Press, New York, 1996. x, 217 pp., illus. $54.95. Cambridge Studies in Semiconductor Physics and Microelectronic Engineering, 4.

The Quantum Dice. An Introduction to Stochastic Electrodynamics. Luis de la Peña and Ana María Cetto. Kluwer, Norwell, MA, 1995. xvi, 509 pp. $224 or £144 or Dfl. 320. Fundamental Theories of Physics, vol. 75.

Reconstructing Biology. Genetics and Ecology in the New World Order. John Vandermeer. Wiley, New York, 1996. xviii, 478 pp. Paper, $34.95.

Science of Fullerenes and Carbon Nanotubes. M. S. Dresselhaus, G. Dresselhaus, and P. C. Eklund. Academic Press, San Diego, 1996. xviii, 965 pp., illus. $130.

Time's Arrow and Archimedes' Point. New Directions for the Physics of Time. Huw Price. Oxford University Press, New York, 1996. xiv, 306 pp., illus. $25.

Waves in Astrophysics. J. H. Hunter, Jr., and R. E. Wilson, Eds. New York Academy of Sciences, New York, 1995. viii, 345 pp., illus. $80. Annals, vol. 773. From a conference, Gainesville, FL, Sept. 1994.