Gordon Gould and the brothers-in-law Charles Townes and Arthur Schawlow. The dispute's skeleton is summarized by Bromberg: "Gould filed a patent application in April 1959. When the Schawlow and Townes patent . . . , filed in July 1958, was granted in March 1960, Gould . . . brought a challenge against it before the [courts] on the grounds that although [he] had filed later, he had conceived of the invention first."

Although this challenge failed when it was first filed in 1960, in a legal battle not reviewed in this book (properly, I think), it finally led to the issuance of four patents to Gould some 25 years later. The pertinent documents were Gould's notebooks and the scientific papers of Schawlow and Townes, which, with their fantastic physics, stimulated people and institutions into an almost frenzied commitment to design and produce the first working laser. The race was won by Ted Maiman at Hughes Research Laboratory with his successful operation of a ruby laser in mid-1960. The contributions of Schawlow and Townes to the genesis of the laser and indeed to the creation of quantum optics itself will always comprise one of the truly seminal works of science.

The more than one hundred pages of the Gould notebooks were all written before the actual Schawlow and Townes publications and well before the construction of the first successful lasers. In these notebooks Gould discusses open-sided Fabry–Perot resonators, Brewster-angle windows, "Q-switching," exchange pumping (the He–Ne system is specifically referenced) and optically pumped laser media (ruby and some of the rare-Earth candidates are explicitly identified). In his discussion of applications for the not-yet-extant lasers, Gould speaks of frequency and length standards, profilometers, materials processing, machining, chemical activation and thermonuclear fusion. Quite a remarkable set of notes!

Schawlow and Townes brought fantastically good science and great inventiveness to the birth of the laser. Gould, on the other hand, proved himself one of the most outstanding and insightful inventors of this century.

There is far, far more to Bromberg's book than the birth pains of the laser. Her account of the veritable orgy of discovery and invention throughout the 1960s is a "must read" for those who are interested in the processes of scientific and engineering evolution. And her first chapter, recounting detonative maser developments of the 1950s, is simply superb. Townes, Robert Dicke, and Nicolaas Bloembergen are just a few of the scientists blended into her fascinating history of the early "maser days."

The epilogue, "The Laser Now and in the Future," was written by Arthur Guenther, Henry Kressel and William Krupke. It is a very nice piece that in its style and substance simply underscores the remarkable triumph of Bromberg's book.

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Too Hot to Handle: The Race for Cold Fusion

Frank Close
Princeton U. P., Princeton, N. J., 1991. 376 pp. $24.95 hc
ISBN 0-691-08591-9

After agreeing to review Frank Close's book, I was concerned about wasting more time on cold fusion than I had already spent doing research in this "field." However, two months and a long airplane flight later I concluded that the book was entertaining and that Close did a reasonable job describing the history of cold fusion.

It all started on 23 March 1989, when Martin Fleischmann of the University of Southampton and Stanley Pons of the University of Utah announced to the press that they had attained nuclear fusion—a phenomenon that for over 60 years had eluded physicists—in a jar. As Close points out, their claims were based on data that had undergone no peer review. Even today much of the data has not yet been shared with the scientific community. Close describes the relations between the University of Utah and Brigham Young University that precipitated the press conference: After Fleischmann and Pons had found that BYU scientists were planning to present their own results on neutron emission at the upcoming Americal Physical Society meeting in Baltimore, they broke off all agreements between the two groups on joint publication.

Close follows quite carefully the scientific events that took place after this news conference, focusing on only a few of the laboratories that systematically showed how the Fleishmann–Pons results were flawed and discussing some of the positive results that other groups obtained immediately following the initial announcement. The BYU group, also involved in the early hysteria, produced its own positive results (which have since been shown to be wrong by at least a few orders of magnitude). However, the claims from BYU were more modest as pointed out by Close.

I found Close to be protective throughout the book of the positive results from well-established laboratories and institutions. Well after the dust had settled there were still, to put it modestly, believers at these laboratories, but Close glosses over that story. He emphasises, however, the crucial observation that the scientific community is robust in correcting bad science, even though many events described in the book were personal and unprofessional attacks, not scientific debates.

All in all, if you are interested in learning how experiments should *not* be done or if you want to know a little more of the history of the events surrounding cold fusion, I recommend reading *Too Hot to Handle*. An undergraduate could learn some basic nuclear physics from this entertaining story. I am sure more books on this topic will further elucidate this surprising event in science.

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Fractal Physiology and Chaos in Medicine

Bruce J. West
World Scientific, Teaneck, N. J., 1990. 278 pp. $58.00 hc
ISBN 981-02-0127-3

In his preface, the author describes this book as being "concerned with the application of fractals and chaos (as well as other concepts from nonlinear dynamics systems theory) to bio-medical phenomena," evidently addressing the book to life scientists rather than physical scientists. To cater to this intended readership, he explains clearly and in exquisite detail the elementary concepts underlying the discipline of dynamical systems (irritatingly referred to by the author as "dynamic systems" or sometimes—as in the above quotation—"dynamics systems").

Among these elementary concepts (and by "elementary" I mean "fundamental," as in elementary particles, rather than "simple") are linearity vis-à-vis nonlinearity; fixed points, limit cycles and attractors (including strange attractors); the geometrical foundations of chaos, neatly illustrated by the baker's transformation; fractals and fractal dimension; maps of the interval, bifurcations, period doubling and universality (or self-similarity); and Lyapunov exponents. The level is sufficiently simple that those with only a limited knowledge of physics or mathematics should

understand and profit from West's explanations. Physics students looking for a simplified introduction to the subject might find the book useful (but they would have to overlook what appears to be a misapplication of Kirchhoff's laws on page 97).

The biomedical content of the book manifests itself in two ways. First, the author uses examples from physiology: Stability is illustrated through graphs displaying the strength of bones, fractal geometry is exemplified by models of the lung and chaotic dynamics by the analysis of electrocardiograph traces. Second, the author chooses specific topics at the forefront of medical research and discusses and studies them in some detail using methods he has described earlier for the analysis of experimental data. These descriptions of experimental analyses are by far the most interesting and useful parts of the book—perhaps because such mundane yet essential topics rarely appear in textbooks. The author explains in detail how to compute Lyapunov exponents, fractal dimensions, correlation functions, power spectra, time series and return maps, as well as how to reconstruct attractors. In the last chapter of this short monograph, specific biomedical data are presented and analyzed according to these techniques. Would-be experimenters and data analysts in all areas of dynamical-systems research—not only biomedical fields—might find this chapter useful and informative.

So far I have given only the good news. The bad news is that this book is so badly written that it is painful to read. In all sincerity, I can say that it is the worst-written book I have ever read. There are abundant errors of every type—misspellings, solecisms, mispunctuations and run-on sentences, to name only a few. Part of the problem is perhaps due to poor editing of the manuscript. Be warned: If you buy this book, be prepared to cringe several times per page.

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The Cosmic Water Hole

Emmanuel Davoust
MIT P., Cambridge, Mass., 1991. 206 pp. $19.95 hc
ISBN 0-262-04114-6

Contemplation of life elsewhere in the universe is common to almost all cultures and ages. In ours, discussion of extraterrestrial life involves much more than scientific issues, and for better or worse, opinions are shaped by everything from supermarket tabloids, science fiction, the global economy, religious and intellectual orientation and attitudes about technology, not to mention ambition and turf protection in the sciences.

The Cosmic Water Hole, a translation from the French, is a book for lay audiences concerning the existence and search for extraterrestrial life. Emmanuel Davoust, an astronomer who studies galaxies at the Observatoire du Midi-Pyrénées, surveys current views of the origins of life on Earth and extrapolates to future times and other worlds. Following conventional wisdom, which asserts that evolution and Copernicanism require the ubiquity of life, the author discusses panspermia, the idea that life on Earth began extraterrestrially, and the prospects for our eventual colonization of space, whether driven by curiosity or catastrophe.

Important themes thread the work. First is the connection between life on Earth and geologic and cosmic activity: that life itself has modified the atmosphere significantly, subsequent to the subsidence of volcanic activity. As a counterpoint, the precariousness of life brings up topical issues, such as global warming and the runaway greenhouse effect, along with the near consensus view that an astronomical catastrophe played a key role in the demise of dinosaurs and the subsequent hegemony of mammals.

A second theme is the punctuated manner of scientific progress, discussed through examples of both the misadventures of science (claims of canals on Mars and other spurious discoveries, problems with science in the US space program, debate over SETI) and the successes (understanding of stellar evolution, the general context of big-bang cosmology, studies of Antarctic meteorites, existence of protoplanetary disks, prospects for discovering extrasolar planets). The politics of science is illustrated through the debate over whether searches for signals or other manifestations of extraterrestrial intelligence are worth pursuing. This latter discussion, which reveals the difficulties of communication and concensus among ourselves, is a sobering antedote for heady conjectures about two-way communication with other civilizations.

The book discusses past and current attempts at detecting signals from extraterrestrial sources, beginning with Frank Drake's OZMA in 1960. Detection of and contact with extraterrestrial life require a hierarchy of conditions to be satisfied, the bookkeeping for which is contained in the venerable Drake equation. A short description of the largest SETI project under development, NASA's Microwave Observing Project, to commence in the mid-1990s and proceed into the next century, helps introduce the notion of the waterhole, a microwave band containing spectral lines from atomic hydrogen and hydroxyl molecules. The book finishes with a brief discussion of what it means that human beings exist on this planet, given the physical requirements for our existence, and the likelihood that Earth-like conditions may be produced elsewhere. The impact for us of searches outward is posed in terms of the possible shock of contact and contrasted with the inner glow we might feel if we knew that the universe was generally inhabited rather than empty.

The style of *The Cosmic Water Hole* is broadbrush. As such, the author leaves out details that would be of interest to more technically inclined readers. The author compensates for this lack of depth by weaving into the discussion much of the conventional wisdom about the physical universe, including big-bang cosmology and the arrow of time. The reference list serves as a reasonable gateway to the literature, but the book suffers from the absence of an index. A glossary of terms would have been helpful, particularly for lay readers. In places the translation is coarse, and some of the quantitative aspects are inconsistent in different parts of the book.

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NEW BOOKS

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Advances in Solid State Physics, Vol. 31. Proc. Conf., Münster, Germany, April 1991. U. Rössler, ed. Vieweg, Wiesbaden, Germany, 1991. 387 pp. Price not stated *hc* ISBN 3-528-08039-6

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Condensed Matter Theories, Vol. 6. Proc. Wksp., Elba, Italy, June 1990. S. Fantoni, S. Rosati, eds. Plenum, New