

scissors–paper” trial of the familiar children’s game, a random choice will always prove the optimum strategy in the long run. He also illustrates the applicability of stochastic calculus, a descendant of Albert Einstein’s treatment of Brownian motion, to such diverse topics as radar filters and investment strategy.

In a chapter on chaos, Ekeland introduces some laudably simple examples, while also briefly describing the Lorenz and Smale attractors. He traces the connection of chaos to fractals and shows how reasoning of this sort by Andrei Kolmogorov led to a successful treatment of turbulence. Henri Poincaré first drew attention to the chaotic nature of the classical three-body problem and opined that such nonintegrable cases represent the rule rather than the exception in nature. Ekeland thus credits Poincaré as the true father of chaos theory. Here we learn that our solar system, seemingly so stable over the span of recorded history, is almost certainly chaotic on a time scale of 10^8 years, making it a near-miracle that Earth has remained reasonably hospitable to life long enough for our species to evolve.

In only a few short passages does appreciation of Ekeland’s treatment require more mathematical sophistication than that of an average college graduate. The translator has rendered the text into English so fluent that only an occasional sentence hints at its French origins. *Broken Dice* is recommended reading for anyone who wants a brief introduction to the science of chance.

ROBERT MARCH

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Civilizing Mission. Exact Sciences and French Overseas Expansion, 1830–1940

Lewis Pyenson

*Johns Hopkins U. P.,
Baltimore, Md., 1993. 377 pp.
\$45.00 hc ISBN 0-8018-4421-5*

Lewis Pyenson is the world’s leading scholar and most prolific writer on the interaction of science and imperialism, a new growth area in the history of science. This book, on the role of the exact sciences (physics and astronomy are his virgin queens) in French overseas expansion, is the third volume by Pyenson on the exploitation of science in the economic,

political and cultural expansion of the great European powers.

This volume on the great French empire lays bare the role of science in the working of “mechanisms of political dominance” and the consequent subjection of science to a central authority. He has even the Society of Jesus, whose scientist–priests are the culture heroes of *Civilizing Mission*, finally subjected to the Parisian Leviathan. Pyenson sees here the pioneering role of the French model in the birth of the bureaucratic and military control of science. The importance of the book is thus as much in its general thesis as in the details of the antics and activities of French scientists in North Africa, Indochina, Brazil and many other parts of the world.

Civilizing Mission is part of Pyenson’s broader body of work in comparative history, in the style of *Annales*: a vast study of the objective discourse of the exact sciences in many settings. Frequent comparisons of the French with other imperialists, especially the Germans, pop up in the book. These comparisons conform to all the old clichés about German original research and French second-rate stuff, mostly the collection of data. For example, in Chile, he writes, the French produced “geographical chronicles rather than theoretical or observational undertakings.”

A simplistic interpretation of the notorious concept of French centralization dominates Pyenson’s analysis of the activities of French scientists overseas. He sees the explanation of the mediocrity of French overseas scientists in their obsession with pleasing Parisian mandarins in order to be rewarded with good jobs and honors back in France, preferably in Paris. This explanatory model is not without its redeeming vices, but a little more nuance is certainly needed in its application. Pyenson even resurrects the defunct thesis of French scientific decline to provide a background for his statements on the superiority of German, English and American science—exact, of course.

On a more petty level, a reader or two may find some of the author’s obsessions a little tiring, if not irritating. A striking example is his reference to the military as professional killers. Well, that’s one way to put it. (The endpapers reproduce Henri Rousseau’s painting *Le Rêve*; *La Guerre* might have been more appropriate.) Curiously the French military, according to Pyenson, was Christianized by the Jesuits. The author turns clinical in detecting the spread

of “the cancer of French presence” in North Africa. One could make many other minor criticisms of this idiosyncratic work, but it is more just to end on a note of envious admiration for an original, seriously researched and controversial work.

HARRY W. PAUL

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AIP Handbook of Modern Sensors

Jacob Fraden

*AIP, New York, 1993. 552 pp.
\$80.00 hc ISBN 1-56396-108-3*

Should experimenters be attracted to a book on sensors? They certainly ought to be, considering the importance of sensors in determining the quality of the data we feed into our computers. The ability of computers to acquire, store, process, analyze and otherwise massage that data doesn’t alter the “garbage in, garbage out” syndrome. It pays us to know how information is converted from physical, electrical, optical, mechanical, thermal and chemical measurands to the voltage or current signals that cross the computer’s analog–digital threshold. We may then be better able to select an “optimum” sensor, while still recognizing the deficiencies that may make it incompatible with, for example, 16 bits of resolution.

In this *Handbook* Jacob Fraden addresses his subject in a logical way. Early on, he defines some terms the meanings of which are not always well understood in the science and engineering community. For example, what exactly distinguishes accuracy, repeatability, linearity and resolution from one another, and why is it important to consider hysteresis, saturation and dead band in the measuring process? (Those parameters may all be involved in the process of intelligent sensor selection.)

Rounding out the first section of the book is a long chapter—130 pages—titled “Physical Principles of Sensing.” Here, Fraden catalogs the many kinds of effects on which sensor designs are based. It is a tribute to human inventiveness that such a large number and variety of physical effects have been exploited. Under the heading “Optical Components” is a brief discussion of fiber optics and waveguides. Entire books have been written about this “new kid on the block,” see, for example, *Fiber Optic Sensors*, edited by Eric Udd (Wiley, 1991).

For the sake of completeness, the author includes a pertinent chapter

on "Interface Electronic Circuits." Space limitations prevented him from doing justice to this complex, wide-ranging technical area. Fraden suggests some references; my choice would be the third edition of the *Analog-Digital Conversion Handbook*, edited by Daniel H. Sheingold (Prentice Hall, 1986).

The third part of the book, covering 13 chapters, is organized by type of variable measured. I agree with the author's apparent intent: to try to make the reader aware of the remarkable number of choices that exist. I like his inclusion not only of commercially available versions but also of, as he puts it, devices that "have only been patented and still remain just bright ideas on paper."

Many of us depend on files containing journal articles, trade-magazine clippings and manufacturers' catalogs to help us locate design and performance information on instruments, equipment and devices, including sensors. The *PHYSICS TODAY Buyer's Guide* has helped to bring order and logic to that search-and-find mission. Now Jacob Fraden has produced a valuable, single-volume reference on the devices that bridge the analog and digital worlds. I highly recommend it.

LAWRENCE G. RUBIN

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The Physics of Three-Dimensional Radiation Therapy, Conformal Radiation Therapy, Radiosurgery and Treatment Planning

Steve Webb
IOP, Philadelphia, 1993.
373 pp. \$100.00 hc
ISBN 0-7503-0247-X

The American Cancer Society estimates that in 1993, more than 1.1 million Americans were newly diagnosed as having an invasive and potentially life-threatening cancer. In the same year, more than 500 000 Americans died of cancer. With an expected increase of life expectancy in developing societies and an increased exposure of their populations to diets rich in fat and salt as well as to abuse of tobacco and alcohol, cancer will soon be a major health problem in those countries as well.

In the US, radiation therapy is used in the care of over half of all cancer patients, and it contributes in a major way to the benefit of about one-third of all long-term survivors. It can be argued (but not proved) that it is cheaper to cure a cancer patient (with prolongation of life and function), including the costs of death later from another disease, than it is to fail in the initial treatment and pay for the long-term care of a patient who dies of cancer.

Since 1970 contributions to radiation therapy from physicists have included treatment-planning computers, cast cerrobend blocks (for field shaping to provide better definition and delivery of radiation doses) as well as computed tomography and magnetic resonance imaging (for better establishment of the tumor's location and relationship to sensitive normal structures). Although these improvements are not universally employed because of cost, complexity and

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