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
University of Wisconsin, Madison

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 cliches 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
University of Florida, Gainesville

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 fiberoptics 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