BOOK REVIEWS

Retrospective on Hanford

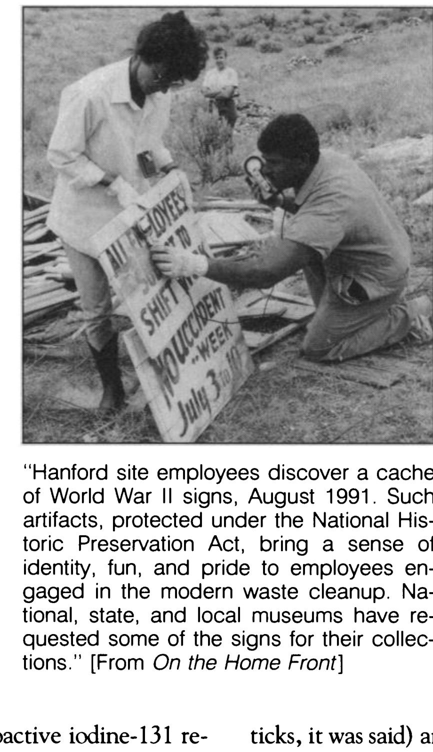
On the Home Front. The Cold War Legacy of the Hanford Nuclear Site. MICHELE STENEHJEM GERBER. University of Nebraska Press, Lincoln, 1992. x, 312 pp., illus., + plates. $35.

"Having examined the first twenty years of operation at the Hanford site," asks Michele Stenehjem Gerber as she concludes her study, "what lessons can we learn?" Her answer is a classic of understatement: "Clearly, the Hanford experience underscores a need to examine issues of secrecy and openness." Under the management of, successively, the U.S. Army's Corps of Engineers, the Atomic Energy Commission, and the Department of Energy, reactors and chemical separation plants for the production of plutonium at the Hanford reservation in eastern Washington State had a tremendous environmental impact. Gerber's book explores its extent and demonstrates convincingly that secrecy and openness shaped both Hanford's past performance and the problems of understanding it today.

Still the least known of the wartime Manhattan Project installations, Hanford was built on a fast-running stretch of the Columbia River and given the task of constructing a series of production reactors during World War II and the Cold War. During 1943–1945 the supply of fissionable uranium-235 from Oak Ridge, Tennessee, depended on a series of uncertain isotope separation schemes, and Hanford was built to provide a separate route to secure fissionable material for a bomb: the radiation within its uranium piles transformed a part of their fuel into the readily fissionable plutonium-239, which could be extracted from used fuel by chemical means. The Columbia provided electricity, from upstream hydroelectric generators, and an abundant supply of cooling water for the reactors.

"Forty-two-year-old drums containing methyl isobutyl ketone ('hexone') from REDOX process development in the late 1940s are retrieved in the modern waste cleanup at the Hanford site, March 1991." [From *On the Home Front*]

As Gerber points out, the environment not only provided these necessary inputs but also took away the waste products of plutonium production. Initially guessing at how wastes might best be handled, Hanford's designers and operators established a pattern of temporarily retaining some of the waste and then releasing it into the world at large. Large amounts of chemically and radiologically hazardous materials are still kept in storage tanks, but less concentrated wastes were released directly into the environment. Cooling water, made radioactive by its passage through the reactors, was held briefly in reservoirs to allow short-lived radioactive substances to decay away and then dumped back into the Columbia River. Gaseous radioactive material, primarily radioactive iodine-131 released during the chemical extraction process, was partially trapped in filters, with remnants released to the wind currents passing over the processing plants. Some liquid wastes were dumped into dry wells on a plateau above the river, while other contaminated solid objects were buried, with the expectation that the radioactive materials would very slowly percolate through the earth, be diluted, and bond with the soil.



"Hanford site employees discover a cache of World War II signs, August 1991. Such artifacts, protected under the National Historic Preservation Act, bring a sense of identity, fun, and pride to employees engaged in the modern waste cleanup. National, state, and local museums have requested some of the signs for their collections." [From *On the Home Front*]

But the environment conspired against these plans, and experience taught Hanford's environmental monitoring staff that dilution did not occur in a simple fashion. Plants such as sagebrush and Russian thistle, the Columbia's currents and its organisms, the birds and animals living along the river's banks, and even the mosquitoes concentrated the radioactive materials to a dangerous degree. Rather than holding the wastes, the site's grainy volcanic soil allowed them to pass quickly into the water table and refused to bond chemically with the disposed material. And filters in the processing facilities' exhaust stacks occasionally failed or were overwhelmed. On more than one occasion (most important, the notorious "green run" of December 1949) processing experiments with reactor products relatively fresh from the reactors released huge amounts of radioactivity into the environment, where it was concentrated by weather conditions. By several routes, then, concentrated radioactivity entered the food chain and ultimately was ingested by Hanford's human neighbors.

To interpret this and other events, Gerber necessarily resorts to a certain amount of reasoned speculation, as the truth remains a secret. The green run, she argues, was probably not primarily a test of how radiological warfare agents moved through the environment (although it would function as one), but rather served to provide a set of fission products of known origin for comparison with the radioactive remnants of Soviet weapons development. Gerber also points to the repeated civic cleanliness and health campaigns waged in the federally managed city of Richland: citizens were urged to root out sagebrush (a home for disease-carrying ticks, it was said) and Russian thistle, to drink milk only from approved dairies, and to accommodate vigorous mosquito-control measures. All of these campaigns, she notes, could have been attempts by Hanford's staff to protect the citizens from agents that concentrated the radioactive substances without actually, publicly identifying a danger.

But Gerber's interpretation stops short of explaining how such decisions were made. Although she does not make this point explicitly, it was the Cold War, widely supported throughout Hanford's 1950s expansion, that shaped the contours of secrecy and openness. That is, it seems plain that Hanford's staff could not simply announce the risks to which it exposed its neighbors without giving away the kind of data that would tell the Soviets the basic characteristics of the U.S. weapons production program. And the slowly growing recognition of the routes Hanford's wastes took through the environment came at the same time as Hanford's radiological safety experts also developed an institutional loyalty that convinced them to put the facility's mission ahead of the public's health.

Here one is frustrated by the lack of identifiable characters in Gerber's account, in which the passive voice predominates. Overwhelmingly, decisions "were made" and actions "are taken" with no one actually responsible. The reader looks in vain for some insight into the operation of the institution or the outlook of its staff. One continuing figure is Herbert M. Parker, Hanford's Health Instruments section supervisor, whose job included monitoring the site's releases and measuring them against the evolving public health standards for radiation. But Hanford had little direct accountability for its actions, in part because of the divided authority of the Atomic Energy Commission and its contractor-operators (successively, Du Pont, General Electric, Rockwell, and Westinghouse), and Parker on occasion deemed the outside standards too rigid and recommended that Hanford not abide by them.

Gerber concludes her account by expressing a faith that Hanford's staff can meet the challenges of repairing the damage of its Cold War operations and of becoming a model for openness appropriate to a federal intrusion into the region's economy and the public's health. She has used the fruits of a small measure of openness to good account in beginning to document the environmental history of the site. But her study remains mainly a list of effects, the causes of which apparently remain hidden in the undisclosed records of a still-secretive institution.

Bruce Hevly
Department of History,
University of Washington,
Seattle, WA 98195

Vignettes: Forms of Writing

A foreword is a testimony, a warrant to the reader, from the perspective of great renown, that the following book is worth the time. Ideally, it should also convince the reader that there is a larger context within which the book fits, while persuading the reader of the profundity of the insights to follow, displaying, all the while, hints of even greater profundity on the part of the "foreworder."

—*Ryan D. Tweney*, in the foreword to Michael E. Gorman's *Simulating Science: Heuristics, Mental Models, and Technoscientific Thinking* (Indiana University Press)

It is worth recalling why the research grant was invented some thirty years ago. Government contracts had, over the years, accumulated page after page of "boilerplate," that is, fixed requirements that were incorporated into the contracts as a matter of agency routine. These fixed requirements were intended to be incorporated into government contracts written to procure standard products from the lowest bidder. They put too much of a burden on researchers, who were doing something unique. The grant was an attempt to go back to basics.

—*Joseph P. Martino*, in *Science Funding: Politics and Porkbarrel* (Transaction Publishers)

S-Curves Everywhere

Predictions. Society's Telltale Signature Reveals the Past and Forecasts the Future. THEODORE MODIS. Simon and Schuster, New York, 1992. 300 pp., illus. $21.

Whether the arrow of time is thought of as determined by God or by irreversible entropy processes, attempts to foretell the future seem to be a natural outcome. This book describes a number of excursions into what Theodore Modis calls "futuronics"—explorations that commenced when Modis was hired several years ago by a computer manufacturer to forecast the life cycles of computer products. Trained as a physicist, Modis was attracted to the work of another physicist, Cesare Marchetti, who in the 1970s had been given the task of forecasting world energy demands at the International Institute of Advanced Systems Analysis in Laxenburg, Austria. Marchetti's efforts at prediction led him to the proposition that the Volterra-Lotka laws that govern growth and competition among species also describe human activity and led him to the search for *invariants*—universally valid constants manifested through indicators that do not change over time and that represent some kind of equilibrium.

Inspired by interactions with Marchetti, Modis describes his subsequent conceptualization, development, and multifarious application of a tool kit for the quantitative prediction of human activities that consists of four elements: S-curves, evolution through natural selection, invariants, and an overall historical cycle that governs people's adventures with a period of about 56 years. The simplest mathematical function that produces an S-curve is the logistic, originally described in 1845 by P. F. Verhulst, which is derived by specifying that the rate of growth in some phenomenon is proportional to both the amount of growth already accomplished and the amount of growth remaining to be accomplished. Modis notes interpretations of S-curves in terms of the diffusion of innovations and learning processes, but most generally refers to them as representing "the law of natural growth." His invocation of evolution emphasizes the mutation of innovations (due to "the law which says that when something can happen, it will happen"), selection (governed by competition, which plays a supreme role and should be called the "father of everything"), and diffusion (which proceeds along natural-growth lines, smoothly filling a niche to capacity). When growth is completed, its signature is an invariant that, despite erratic fluctuations, indicates the existence of thresholds and social balance (for example, car users seem to be satisfied with an average speed of about 30 miles per hour, hardly changed since Henry Ford's time). Finally, Modis documents that a 56-year cycle either of occurrences per decade or of percentage deviations from S-curves fitted to trends is encountered over a broad spectrum of human activities—including energy consumption, use of horsepower, appearance of basic innovations, discovery of stable chemical elements, bank failures, energy prices, life expectancy, cirrhosis of the liver, speed of the one-mile run, and women Nobel laureates.

The undeniable fascination of this book, intended by Modis to reach a literate general public, is the large and diverse array of topics to which this conceptual scheme is applied—the cumulative number of words learned by children from birth through 70 months, the cumulative number of European explorations of the Western Hemisphere following and including Columbus's voyage, the cumulative sales in Europe for Digital's VAX 11/750 minicomputer, cumulative oil discovery and production in the United States, the cumulative number of Roman Catholic saints canonized ("Did Christianity begin before Christ?"),