U.S. high technology toward military objectives and the consequences for the civil economy, both in terms of opportunity costs and in terms of strategic orientation of corporations. None of them address the problem of the U.S. capital market and its influence on long-term strategies or the lack of them. Only Sidney Winter's chapter "Knowledge and competence as strategic assets" examines in depth the complementary roles of R&D, tacit knowledge, and various other forms of technology accumulation in firms.

Until more American industrialists and the U.S. government are prepared to confront the strategic issues raised in this book (and some of those that are not raised), it is improbable that the relative decline of U.S. manufacturing will be reversed.

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Nuclear Waste Disposal

Nuclear Imperatives and Public Trust. Dealing with Radioactive Waste. LUTHER J. CARTER. Resources for the Future, Washington, DC, 1987. xiv, 473 pp. $25.

Nuclear Imperatives and Public Trust attempts to sort out the "sticky tangle of political and technical issues" surrounding nuclear power and the exceptional demands imposed on it by a wary public. The title of the book refers to the imperatives to safeguard potential nuclear explosives and to contain radioactivity throughout the nuclear fuel cycle, both of which must be satisfied to assure public trust. Although nuclear waste disposal is only part of the overall problem of meeting the safeguards and containment imperatives, it is crucial to the future of nuclear power that this problem be solved.

Carter's emphasis throughout is on the need for simplicity in dealing with complex problems. This is reflected in his convincing arguments in favor of the geological disposal of spent fuel and against its reprocessing and in his argument favoring the early selection of a single disposal site relatively free of land-use and environmental conflicts versus an emotionally demanding and politically unrealistic nationwide search for the "best" site.

The book is divided into four parts. In part 1, Carter documents the "sources of public unease." As a "technology ahead of itself," nuclear power was developed before many of the health and safety issues associated with nuclear technology had been dealt with, "in particular the waste issue, the reactor safety issue, and the safeguards dilemma inherent in the fact that plutonium is a nuclear explosive as well as a nuclear fuel." There were early efforts to confront these issues by the Atomic Energy Commission, but for the most part the AEC "plunged ahead with commercial reactor development as though no hazards or major problems of containment existed." The public response to leaking waste tanks at Hanford, the selection and eventual rejection of a salt mine near Lyons, Kansas, as a repository site, the accident at Three Mile Island, and the threat of nuclear proliferation associated with reprocessing was predictable. Nuclear power had come too far, too fast.

In part 2, Carter takes us on the long search for a waste policy—a search that begins in the Ford Administration in the mid-1970s and ends in 1982 with the signing of the Nuclear Waste Policy Act by President Reagan. He describes and analyzes the policy struggles in the bureaucracy as AEC's replacement, the Energy Research and Development Administration, attempts "to get the waste program off the limb where it was put when ERDA informed thirty-six of the fifty governors of its plans to search for repository sites in their states." Carter examines the investigative effort and problems with regard to each of the potential sites in the ten states selected for further study by ERDA's successor, the Department of Energy, and concludes that the abstract approach to policy analysis practiced by a bureaucracy far removed from local decision makers and from DOE people in the field has "little relevance to the real world."

The blow-by-blow description of the behind-the-scenes struggle in Congress to forge a consensus on a national waste policy is not appropriate reading for the timid. The four major interests—the nuclear industry, the environmental and antinuclear groups, the potential host states, and the Department of Energy—shaped a legislative answer to the waste problem that was "an unusual mix of strong and weak points." Whatever its faults, the Nuclear Waste Policy Act of 1982 did get the program moving again. The act created a source of funding, set up a schedule (yes it was unrealistic, but it gave DOE something to shoot for), spelled out the rights of the host states, and provided for two repositories with the informal understanding that one would be in the West and one in the East. The Nuclear Waste Policy Act was hailed by its creators as a final solution—at best it was "a rough blueprint for an effort that would have to continue over two decades and that would almost certainly require some major midcourse changes to succeed."

Part 3 (more than a third of the book) deals with the international aspects of nuclear waste disposal. "Like the Americans, the Europeans and Japan launched nuclear development on a commercial scale without the means to dispose of radioactive waste to be generated." Carter describes in detail the history of nuclear power and the approach to nuclear waste disposal in the United Kingdom, France, Germany, Sweden, and Japan. Unfortunately, the well-developed waste program in Canada, our closest ally, along with the cooperative work of Canadian and U.S. researchers, is given only a brief mention. Carter concludes that "an international system of spent fuel and waste management is still very much needed, but despite a few encouraging signs is still beyond the horizon."

Carter completed the book manuscript in October 1986, at a time when the nuclear waste program was caught in a "morass from which some way of escape must be found." In May 1986, DOE named sites in Washington, Nevada, and Texas as candidates for the first repository. At the same time, under strong political pressure from eastern states named as potential hosts, DOE cancelled the second repository, stating that it was no longer needed. The delicate balance between east and west was upset. In anger, the states turned to members of Congress, who responded by introducing more than 50 pieces of legislation during 1986 and 1987 amending the Nuclear Waste Policy Act. It is in the midst of this turmoil that the book ends—as if the last chapter had been lost.

In his summary, Carter identifies what is needed for a new nuclear waste policy to be adopted. As "a way out," he recommends that emphasis be placed on a single primary-candidate site (Yucca Mountain in Nevada is his first choice), that the role of engineered barriers (for example, the waste package) be strengthened, that the National Academy of Sciences study the program and address the key issues, that an independent peer-review board be given the authority to look into any technical issue at any time, and that states that agree to accept a repository be given substantial economic benefits.

On 21 December 1987, President Reagan signed the Omnibus Budget Reconciliation Act. Among its many provisions is a restructuring of the nuclear waste program in the form of an amendment to the Nuclear Waste Policy Act. Under the leadership of Senator Bennett Johnston (D–LA), a compromise was worked out in the final hours of the first session of the 100th Congress that selects Yucca Mountain as the first repository site,

creates an independent peer-review board, gives $20 million a year to the host state, creates the Office of the Negotiator to enter into negotiations with the states on behalf of the federal government, provides for an on-site representative from the state to conduct oversight activities, and cancels the second repository.

Did Carter's book influence the restructuring of the nuclear waste program? A summary of the book published in 1987 in *Issues in Science and Technology* (vol. 3, no. 2, pp. 46–61) was widely distributed among congressional staff. At a Senate hearing, Senator Johnston referred frequently to Carter's summary in his questioning of the former Governor of Nevada, Grant Sawyer. The summary was subsequently reprinted in a Senate hearing report (S. HRG. 100–230, Pt. 1). The similarity between Carter's recommendations and the provisions in the legislation is striking. Yes, Carter's work had an impact.

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Response Hierarchies

Higher Brain Functions. Recent Explorations of the Brain's Emergent Properties. STEPHEN P. WISE, Ed. Wiley-Interscience, New York, 1987. xxii, 382 pp., illus., + plates. $79.95. Wiley Series in Neurobiology.

Higher Brain Functions is a collection of essays on approaches to those emergent aspects of brain function that do not lend themselves to strictly biological analyses. The general focus of the collection is on high-level motor programming and the modulation of sensory processing by behavioral context.

The book is divided into three parts: Motor Aspects of Higher Brain Function, Effects of Preparatory Set, and Cerebral Organization. Parts 1 and 2 focus on presentations of the authors' research, whereas part 3 includes syntheses of research on the intrinsic circuitry of cerebral cortex, the evolution of language, imaging techniques, and the evolution of neocortex. The third section is not as thematically integrated as the first two, but the syntheses are interesting in and of themselves.

Several aspects of this collection make it particularly enlightening. First, the papers represent results and discussions at different levels of inquiry. Because the results were obtained with many techniques (from studies of performance times to studies of single brain cells) and species (from humans to crickets), the collection could have been confusing; instead, moving from one chapter to the next tends to illuminate some interesting general principles. Second, the authors have succeeded in placing their results in a broad context, thus allowing the reader to see the mutual implications of results presented in different chapters. Third, the authors have taken to heart the editor's directive to express opinions and have produced some provocative assertions about how some higher functions are implemented by the brain.

A principle addressed in several chapters is the abstract nature of motor programming. While it seems obvious that motor behavior must reflect high-level abstraction and decision-making, it is not obvious how these processes are organized and implemented. Rosenbaum's chapter presents evidence from performance studies of humans for a hierarchical organization of motor program execution. Sequences of movements are parsed into related units in a branching tree structure. This type of organization explains results in assays of speech and finger movements, as well as some aspects of memory recall. A similar generalization of motor frameworks to higher level functions such as memory and language is the basis of MacNeilage's chapter on the evolution of language.

Another aspect of the abstract nature of motor encoding is represented in the motor equivalence results of Abbs and Cole. It appears that movements are encoded in terms of combinations of muscles, so that for any single muscle there is considerable intertrial variability but sets of muscles covary in a predictable pattern. The authors argue that "motor equivalence is the product of on-line afferent-based judgments among the constituent movements so as to accomplish planned speech goals" (p. 30).

To attain this goal-based motor programming guided by sensory information, there must be an intimate interchange of information between the output programming systems and sensory systems. The section on the effects of preparatory set deals with issues related to the interaction between sensory and motor systems. The problem of making different responses to seemingly similar stimuli on the basis of context is one that all but the most simple animals must solve. Context-dependent changes in sensory responses are presented for animals as diverse as crickets and monkeys. Some of these effects seem attributable to gating of sensory transmission: for example, a sensory response can be turned off or attenuated during certain phases of a movement. Other sensory changes, however, seem to be due to selective attention; sensory responses at several levels can be modulated by many different behavioral processes.

Higher Brain Functions demonstrates that an interdisciplinary approach to questions pertaining to the implementation of behavior by the brain can be very profitable.

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Hosts and Parasites

Genetics and Plant Pathogenesis. P. R. DAY and G. J. JELLIS, Eds. Blackwell Scientific, Palo Alto, CA, 1987. x, 352 pp., illus. $50. From a meeting, Egham, U.K., Dec. 1985.

Populations of Plant Pathogens. Their Dynamics and Genetics. M. S. WOLFE and C. E. CATEN, Eds. Blackwell Scientific, Palo Alto, CA, 1987. viii, 280 pp., illus. $80. From a meeting, Leeds, U.K., Dec. 1983.

Genetic relationships in interactions between hosts and parasites occupy a central and influential position in phytopathological research. Knowledge of the number of genes involved and the ways in which they condition host resistance and parasite virulence has important consequences for studies on subjects ranging from biochemical and cellular aspects of plant pathogenesis to the population genetics of plant pathogens and the breeding of disease-resistant crops. *Genetics and Plant Pathogenesis* and *Populations of Plant Pathogens* are composed of papers given at two meetings of the British Society for Plant Pathology. Together they represent the current approaches employed in examining the genetics of host-parasite relationships at the molecular, individual, and population levels.

Genetics and Plant Pathogenesis describes recent research on the genetics of pathogenicity and virulence of plant pathogens and on the expression of host resistance. In the first paper Peter Day sets the tone of the book by discussing how molecular biology might be used to conduct research deemed to be intractable by classical genetics. The identification of avirulence genes in *Pseudomonas syringae* through transformation, cloning, and nucleic acid hybridization is discussed along with the prospects of using transformation to isolate and characterize pathogenicity genes in fungi. Also included is the use of restriction fragment-length polymorphism (RFLP) to distinguish different *formae specialis* of *Erysiphe graminis*, an important fungal pathogen of cereals. Day concludes by discussing the prospects of