Book Reviews

States' Rights in Radiation Control

Nuclear Power and the Public. A symposium, Minneapolis, Oct. 1969. HARRY FOREMAN, Ed. University of Minnesota Press, Minneapolis, 1970. xviii, 274 pp., illus. $9.

"Power" is an ambiguous term, denoting either a physical or a social force. This book is about both forces and the relationship between them. The specific genesis of the volume is in a controversy over the right of the State of Minnesota to set standards for the emission of waste radionuclides by a nuclear power plant licensed by the Atomic Energy Commission and located within the state.

Concern about both the promise and the threat of nuclear energy and radiation has been more manifest in Minnesota than in most other states. In July 1957 Governor Orville Freeman (Democrat) appointed an Atomic Development Problems Committee, composed of a number of prominent scientists, such as A. O. C. Nier, Maurice B. Visscher, and John H. Williams, as well as of prominent representatives of other interests, including industry, labor, medicine, and numerous others. (To disclose my own interest, I was chairman of the committee.) In February 1958 the committee published an interim report calling for immediate investigation of the extent of radioactive environmental contamination in the state. A program of environmental sampling was undertaken, and samples were submitted to the AEC for analysis. The results showed wide variation in amount of radioactive fallout and uptake and concentration by vegetation throughout the state. The committee worked with the State Board of Health in formulating regulations to control sources of ionizing radiation, which were promulgated in 1958. The committee summarized what was then known about the subject in a group of papers comprehensible to the literate layman and published under the descriptive and pedestrian title "Basic Data Regarding Atomic Development Problems in Minnesota." On 30 December 1958 the committee presented its final report to the governor and dissolved.

In 1966, Northern States Power Company, principal supplier of electricity to the twin cities, applied to the AEC for a permit to construct a nuclear power plant at Monticello, about 40 miles up the Mississippi from the twin cities, which constitute the major metropolitan area of Minnesota, with a population exceeding 1.6 million. In 1967 Governor Harold LeVander (Republican) appointed the Minnesota Pollution Control Agency, empowered to regulate the discharges of nuclear power plants. In 1968 the AEC granted a construction permit for the Monticello plant. In May 1969 MPCA issued a waste-discharge permit for the Monticello plant, imposing standards which the plant was designed to meet but which were considerably more stringent than AEC requirements. The power company brought suit in federal court to test the right of a state to set more stringent regulatory standards for nuclear power plants than were set by the AEC. In December 1970 the Federal District Court in Minnesota held that Congress had intended "to preempt the field" in enacting the Atomic Energy Act of 1954 and the "Cooperation with the States" amendment in 1959. Since that decision, a Democratic governor and attorney general have taken office in Minnesota, but they have indicated that they intend to maintain the state's position in the litigation, and presumably the case will be carried through an appeal.

The controversy has far-reaching interest and significance. There have been about 100 applications to the AEC for authority to construct commercial nuclear power plants in 27 states and Puerto Rico, and construction permits have been issued for about two-thirds of these. Some 20 plants (including Monticello) have been completed and are in operation or ready to go into operation when legal formalities have been completed. About a dozen states supported the position of Minnesota in its litigation. The University of Minnesota symposium recorded in this volume was intended to offer a statement of views by a variety of experts speaking to the public on issues pertinent to this controversy as a basis for reaching some popular consensus. Although this objective was obviously not attained, the symposium format provides an admirable means of presenting controversial technical subject matter, which is probably superior to an exposition by any single author.

The circumstances that make this controversy inescapable are presented in a survey of "industrial energy resources" by M. King Hubbert, of the U.S. Geological Survey. This is probably the most basic of the papers presented and, though it appears near the end of the book, can usefully be read first. Hubbert examines the matter-and-energy economy of the earth as a system, noting that the principal sources of energy entering the system are solar radiation, geothermal energy, and tidal energy from the gravitational and kinetic energy of the earth-moon-sun system. Of these, solar energy is overwhelmingly the largest. The solar energy intercepted by the earth's diametral plane is 100,000 times the present installed electric power capacity. Of this, about 35 percent is directly reflected into outer space, about 42 percent is absorbed and converted directly into heat, and about 23 percent becomes the latent heat of evaporation of water. The latter causes the hydrologic cycles, which provide water power. Less than 1 percent of the solar energy received on earth is captured by the leaves of plants and stored as chemical energy. When oxidized, this organic matter releases chemical energy as heat. A minute fraction of this organic matter is deposited and preserved in an oxygen-free environment; and the accumulation of this small fraction over the last 600 million years has provided the present supply of fossil fuels. The time scale for the accumulation of fossil fuels is such that we have a fixed supply. Coal has been mined for some 800 years, but the amount consumed during the last 31

years equals the amount consumed during the preceding 800 years. Similarly, we have consumed half of all the crude oil produced to date during the last 16 years. Most of the world's production and consumption of energy during its entire history has occurred during the last 20 years. Hubbert graphs the past and future production of fossil fuels, showing that although the total time during which some oil and gas will be produced is probably several centuries, the preponderance of this will be produced in the period of a single lifetime, and the maximum length of time that coal, or any other fossil fuel, can serve as a major energy source can hardly exceed three centuries.

For further energy needs, technology offers little hope that solar power will be a large-scale source. Water power requires dams and reservoirs, which fill with sediment. Since geothermal plants operate principally by depleting natural reservoirs of stored thermal energy, their life expectancy is on the order of only about 50 years. The total capacity of all practical sites for utilizing tidal power amounts to about 64,000 megawatts, which is a small fraction of world power needs. With the types of nuclear power reactors now in operation, now planned, or already authorized by the AEC, an acute shortage of uranium supplies is likely to occur within the next 25 years; and nuclear power from the fission reaction based principally on uranium-235 would be relatively short-lived, probably less than a century. Thus only breeder reactors merit serious consideration in any long-term program of nuclear-fission power. These promise an adequate industrial energy supply for an indefinite period. However, they involve the problem of disposal of radioactive wastes, all of which are dangerous. Energy obtainable from a deuterium-deuterium controlled fusion reaction is of the order of a billion times more than from the world supply of fossil fuels. But the controlled fusion reaction has not yet been achieved, and may never be. This leaves only nuclear energy as a source of sufficient magnitude to supply the world's power requirements for several additional centuries.

The risk/benefit calculus in nuclear power licensing is summarized ably by Harold P. Green, a lawyer. The basic facts that he says are established are, first, that "the atomic energy establishment" tends to dismiss health and safety hazards, but there is a legitimate basis for apprehension. Second, the AEC regulatory program is the most comprehensive and stringent in American history. Third, nuclear power risks could be reduced by spending more money. Fourth, to date there has been a remarkable health and safety record in this industry. Fifth, nuclear power plants offer benefits, such as freedom from sulfur-dioxide pollution, against which risks must be weighed. However, even the low levels set by AEC guidelines for discharge of radioactive effluents or "calculated radiological doses" in the event of accident are not known to be safe. Green suggests that the AEC licensing process neither involves participation of any decisional body qualified to deal with the ethical questions of weighing the risks to life and health against the benefits of nuclear power nor encourages intervention or participation by parties likely to represent the views of conservationists or environmentalists. Further, the AEC itself has an inherent conflict of interest, since it has a mandate simultaneously to promote nuclear technology and to regulate that technology in the interest of health and safety. As Green points out, nuclear technology is not developing within the market system but as a result of government investment and support. Particularly in the absence of market constraints, Green urges greater public participation in the risk/benefit determination.

The Debate over Standards

The viewpoint of government and industry is well represented, two-thirds of the contributors being from one or the other. Stanley I. Auerbach, of the Oak Ridge National Laboratory, argues that the present MPC's (maximum possible concentrations) established by the National Committee on Radiation Protection and contained in the Code of Federal Regulations (10 CFR 20), which constitute present controlling standards of exposure to radioactivity from wastes of nuclear establishments, do not permit radiation doses large enough to evoke an unequivocally detectable biological response. He suggests that low dose rates, at or around MPC levels, may present an intractable problem in detection and proof of effects on ecosystems that are clearly and uniquely attributable to ionizing radiation. Arthur R. Tamplin, of the Lawrence Radiation Laboratory, responds that using air and water MPC values without considering food chains is meaningless, because food chains are biological concentration mechanisms. Consequently, Tamplin contends, even pollution a hundredfold less than MPC levels may result in human exposure above accepted guidelines, and thus use of MPC values for pollution leads to unacceptable risk estimates.

Merrill Eisenbud, administrator of the Environmental Protection Administration of New York City, sketches the development of present standards and defends them as practical and safe. From this he argues that standards in this field should be applicable on a national scale, and not more or less stringent in one state than another. However, he says that the AEC does suffer from a "credibility gap" and that it would be desirable to have some transfer of regulatory authority to minimize or eliminate the present apparent conflict of missions.

J. Newell Stannard, of the University of Rochester, points out that there is a popular tendency to accept familiar hazards while reacting violently to unfamiliar ones such as radiation. He also notes that radiation hazards are different from the familiar ones in several aspects. Our knowledge of the somatic effects of exposure to low doses of radiation is limited, and we aren't even sure whether or not effects have a threshold relation to dose. The biological effects of radiation may be basically different from those of other environmental agents in being irreversible. It is assumed that any exposure produces some effect statistically on the population. Stannard concludes that the controlling parameter in routine reactor operations is not the risk of somatic injury to the individual but the genetic risk in exposure of the population.

Congressman Craig Hosmer, of the Congressional Joint Committee on Atomic Energy, argues strongly that Congress intended to preempt the regulation of atomic activities insofar as radiation protection is concerned, precluding state action. He says that the question is not what the standards should be but who should set them, and that the present system produces "objective" standards, although this goes beyond the position taken by the scientists participating. He argues vehemently that dual regulation of radioactive pollution is undesirable and un-

safe, but the only support he offers for the argument is the alleged unreasonableness of the Minnesota standards.

Commissioner Ramey, of the AEC, offers nuclear power as an answer to the energy crisis that is almost upon us. Nuclear power will permit us to conserve fossil fuels. Breeder reactors will permit us to use all the natural uranium and thorium. Nuclear power, he says, will provide "cheap energy"; but neither he nor any other participant offers any data to support a conclusion that nuclear power will be cheaper, in a purely economic sense, than conventional power. At best (as the earlier Minnesota committee pointed out), nuclear power plants offer potential savings only on fuel, which is a relatively small part of the cost of generating and distributing power. In the present stage of technology, it seems likely that the greater cost of constructing nuclear power plants may make them more, rather than less, expensive power sources. Ramey concedes that nuclear power involves accepting some risks and that the evaluation of benefits and risks is difficult and uncertain. In discussing the statistical hazard, Ramey refers to the "fifty thousand deaths a year in automobile accidents, and about two thousand deaths a year in aircraft accidents." The implicit suggestion that these are comparable illustrates some of the confusion in this field. Most of the concern about nuclear power plants has to do with the effects of radioactive pollution from the normal operation of the plants, not the danger from nuclear accidents—which would be a hazard comparable to that of automobile and airplane accidents. Furthermore, the hazard from radioactive pollution is cumulative, genetic, and statistically almost indeterminable—quite in contrast to the discrete, nongenetic, and quite determinable hazard of automobiles and airplanes. Ramey also argues that dual state and federal regulation in this field "might detract from the public health and safety," but like Hosmer, he offers no data or reasoning in support of this argument.

The final contributor is Barry Commoner, of Washington University, who asserts that "the determination of an acceptable balance between the benefits and risks of nuclear plant operation is a value judgment" that cannot be made on scientific grounds alone and that should involve the public. He also asserts that the calculations made by the government and industry have omitted costs that should be included, notably the social costs of pollution. The biological risk from radiation is not a threshold but a linear phenomenon, and each increment of radiation, no matter how small, carries some risk of biological harm. AEC standards have failed to take into account the increase in nuclear power production, which means that to stay within present protection guidelines there must be a considerable improvement in the techniques for restricting the release of radionuclides into the environment. Commoner outlines work suggesting a calculus for determining the social evaluation of acceptable risk, which, among other things, indicates that a risk imposed on others ought to be lower than a self-imposed risk by a factor of about 10,000. In the light of such considerations Commoner concludes that the Minnesota standards more nearly reflect the social judgment of acceptable risk/benefit ratio than AEC standards. He suggests that the AEC relinquish its control over standards of radioactive contamination. The book also contains discussion among the participants, as well as other papers not mentioned here. Ramey challenges Commoner, saying that his data are wrong. The short statements by participants in response to questions and arguments do much to point up the issues and positions.

The Dual-Regulation Issue

Although several of the participants address themselves to the federal-state controversy, which is the occasion for this symposium, that issue receives remarkably little enlightening analysis. How or why dual federal-state regulation of pollution standards would be dangerous, impracticable, or undesirable, or the contrary, is never adumbrated, much less analyzed, by the participants. The basic theory of our federal government system is that the states shall be sovereign, except with respect to necessarily national matters such as foreign affairs, and that the states may serve as social laboratories within which different approaches to social problems may be tried. In view of the great degree of uncertainty regarding the effect of radioactive environmental pollution and the very long time periods necessarily involved in reaching any trustworthy conclusions, it would seem that this is a field in which experimentation by independent state action might be most desirable. On the other hand, no ground for depriving the AEC of jurisdiction in this area appears or is suggested. It is surely the case that many states will not set their own radiological standards, either because they are satisfied with those of the AEC or because they lack the interest or expertise to do so. The federal government, having developed and encouraged the use of nuclear power, should set minimum standards for protection of the public. If a state, such as Minnesota, sets standards more rigorous than those of the AEC, and if these are impracticable and uneconomic, it would seem that the inability or refusal of industry to establish nuclear power plants in that state would bring about some accommodation.

If all states were subject to minimum federal standards of radioactive waste emission and if some states established more stringent standards, it is difficult to see how there could be any more danger or harm to any state, from interstate flow of wastes or otherwise, than would occur in the absence of state regulation with the same federal standards as uniform national rules. Such a dual system of federal and state regulation would provide large-scale, long-term tests of the varying effects of differing standards. It appears—at least the court has held—that present law does involve federal preemption of the power to set radiation standards for nuclear power plants. AEC power to set standards for thermal pollution is now a matter of legal dispute. In any event, there is no legal bar to a system of dual control if Congress should permit it, and if there are technical difficulties with such a system they are not mentioned by any of the participants in this symposium.

The positions taken by the participants in this symposium, considered in the light of their respective professional affiliations, suggest what is probably the determinative principle. Although it has not yet been demonstrated scientifically or quantified, extensive observation indicates that the desire for political power motivates government officials and agencies as strongly and pervasively as the desire for profits motivates business and businessmen. Minnesota, having both the interest and the talent, wants the right to set its own standards in this field and fights against deferring to a federal agency. Those holding the reins of federal power warn of dire consequences

(never specified) if their power is taken away or diluted.

One other observation is stimulated by this generally provocative discussion. The symposium may be epitomized by noting that government and industry say that government standards in this field safeguard the public on the basis of our best present knowledge, and that industry is achieving performance considerably better than government standards in terms of minimizing pollution by radionuclides and thermal wastes. Critics of government action say that government standards are based on ignorance or unrealistically optimistic assumptions and that industrial performance must be several orders of magnitude better than government standards in order truly to protect the population and the environment. It is a currently popular thesis that technology is advancing much more rapidly than social attitudes, and this psychological maladjustment has been called "future shock," at least in one best-selling book. In the field of nuclear power the problem may be the converse of future shock. It appears that public opposition to environmental pollution has progressed considerably faster in recent years than technology in the field. Not only have technology and industry failed to produce a controlled fusion reactor to date, but of about 100 applications to the AEC for authority to construct commercial nuclear power plants only one has been for a breeder reactor, which is what we are obviously going to need and which may be "cleaner" than the reactors now being built, and the one breeder reactor built has been plagued by accidents and has operated poorly. In any event, the standards proposed by Minnesota and urged, explicitly or implicitly, by several participants are not impossible of achievement but simply uneconomic at worst.

Perhaps the malaise that we sense in much contemporary life arises not from the difficulty public attitudes have in keeping pace with the advances of science and technology but from the inability of science and technology to fulfill the demands of advancing public attitudes. In some fields our problem may be not future shock but technological lag. The evidence offered by the contributors to this volume suggests that conclusion.

LEE LOEVINGER
815 Connecticut Avenue, NW, Washington, D.C.

Aristocracy and Cultural Evolution

Ancient Polynesian Society. IRVING GOLDMAN. University of Chicago Press, Chicago, 1970. xxxii, 624 pp., illus. $17.50.

At a time when much importance is being attached to theoretical models and computerized sociological analysis, it is a welcome relief to encounter an author like Goldman. He does not try to fool himself or his reader by implying the existence of a "hard science" exactness in the social sciences. Of his own book he says in the opening pages, "At bottom this is a work of interpretation. Its findings are to be regarded as hypotheses. I have used methodology to inform my judgments, and not to present Q.E.D. 'laws.'" His judgments appear well honed and are presented in a wholly readable, jargon-free style.

Noting that aristocracies have existed in simple as well as in early civilized societies, Goldman has developed the thesis that status rivalries developing within the aristocratic cadre have been a factor in the evolutionary movement from simple societies toward early civilizations. Since all Polynesian societies were aristocracy-based, he has used this oceanic culture area as his source of data for analysis. His approach is refreshingly historical using, whenever possible, the findings from archeology, glottochronology, ethnohistory, legend, and modern ethnology. Although the manuscript, completed in 1966, later underwent rewriting, Goldman admits that the literature employed in the development of his thesis does not go beyond 1966. However, except for the more recent publication of a few early radiocarbon dates for western Polynesia, and a more generally accepted updating of the probable periods of settlement for the Marquesas and Hawaiian Islands, the basic data pertinent to his work have not changed fundamentally. In fact, even the more recent radiocarbon dates do little harm, since Goldman is interested primarily in the sequence of events and this has not been disturbed.

The opening chapter discusses the principles of status and the various Polynesian concepts of power, such as *mana, tohunga,* and *toa,* that may combine in different ways to modify one another and thus give rise to variants in the status systems of the islands. Goldman groups these variants into three basic status systems. The simplest is called the "Traditional" and is essentially a religious system headed by a sacred chief. The second he calls "Open" and is strongly military and political rather than religious. Finally, there is the "Stratified" system combining the respect and reverence of hereditary rank through seniority with concessions to political and economic power. Whereas the distinction between Traditional and Open is one of gradation, the Stratified type represents a sharp break in that only in this system do the high-ranking hold the ruling power and possess the land, the commoners being landless subjects.

The body of the volume, two-thirds of it in fact, is devoted to descriptions and, where possible, historical interpretations of the societies of 18 Polynesian islands or island groups. Each of these, ranging from coral atolls to high islands, is given a chapter. These descriptions are by no means tightly encapsulated summaries, but neither are they verbose. Each chapter has a short introduction followed by whatever historical data exist that might throw light on the social organizations of the past. The meat, however, is to be found in the discussions of the status system and descent group organization of each island as revealed by the studies of ethnologists. To this reviewer, who was employed as an archeologist on the Norwegian Archaeological Expedition to Easter Island, Goldman's interpretation of the archeological findings on that remote bit of land is a gem of writing. I might not agree with all of his interpretations, but he has added flesh and life to our essentially dead descriptions and analysis of artifacts and stratigraphy. In fact, one might hazard the observation that, given the knowledge and ability of a Goldman, the results of traditional archeological methodology might offer as much for the interpretative reconstruction of prehistoric societies as the "new" archeology is attempting to provide.

Having given ample illustrations of the variety of Polynesian societies, Goldman finishes his study with a series of chapters discussing the various aspects of status. Of these, the chapters on the economics of status and on status and evolution will probably cause a stir among those Polynesianists who hold that the degree of social stratification is largely the result of the interaction of technology with the local island environment. Goldman does not deny the gross effects of poor environment as