icology will no doubt contribute to a better understanding of concepts and methods currently used in the Soviet Union for quantitative evaluation and interpretation of toxicological data.

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Licensing Controversy

Seabrook and the Nuclear Regulatory Commission. The Licensing of a Nuclear Power Plant. DONALD W. STEVER, JR. University Press of New England, Hanover, N.H., 1980. xvi, 248 pp., illus. $15.

The accident at Three Mile Island intensified the debate about the safety of nuclear power in the United States. For some, Three Mile Island confirmed what they believed all along, namely that nuclear power plants can never be made completely safe. All existing plants should be shut down and new construction should be halted. For others, Three Mile Island was an isolated and preventable episode in the history of an industry that has an enviable safety record. Following minimal improvements in existing safety procedures, nuclear power should continue to help meet our energy needs. A third view, located between these two extremes but closer to the second, is that nuclear power will become a safe alternative worthy of public trust only when the governmental process by which the industry is regulated undergoes significant reform.

In a timely volume, Donald Stever gives weight to this third position by examining the controversial licensing of the Seabrook, New Hampshire, nuclear facility. From his vantage point as New Hampshire's assistant attorney general in charge of the Environmental Protection Division, Stever offers a fascinating insider's view of the six long years of licensing proceedings. He argues that it is a process with serious shortcomings, one that is likely to favor industrial interests over health and safety concerns and one that makes an accident like that at Three Mile Island a very real possibility.

Stever identifies several groups of problems that plague the Seabrook case. First, he points to the woefully inadequate preparation and examination of the application for license. Environmental impact studies were poorly conceived and inadequately executed; the assessment of risk to health and safety was based on questionable methodologies; the determination of the need for additional power was calculated on economic projections that proved wildly inaccurate; and the judgment about the financial resources of the applicant firm proved far too optimistic. The absence of reliable information makes a reasonable and prudent licensing judgment difficult at best. According to Stever, poor information results primarily from a shortage of resources—regulators don't have the time or money to conduct the necessary studies, and private interests lack the skill and incentive to gather the relevant data.

A second group of problems centers around jurisdictional divisions among the regulatory authorities involved. The divisions of authority between states and the Nuclear Regulatory Commission, between the NRC staff, its appeals board, and the Commission, and between the NRC and the Environmental Protection Agency all contribute to a complicated process that repeatedly postpones and delays decisions.

The remedies Stever offers are procedural—methods to generate more reliable information and ways to streamline the regulator's decision-making process. Both are designed to restore public trust in the regulatory machinery and head off the extralegal opposition that has plagued Seabrook. Better siting decisions are the key to an improved process. Establishment of a public planning agency would assure early public involvement in the examination of alternative sites, and adopting sites in areas removed from heavy population concentrations and fragile environmental conditions, so-called remote siting, would cushion against the uncertainties of environmental impact and risks to health and safety. Both recommendations should forge an early consensus for a chosen site.

Greater public involvement in early siting decisions would also address another weakness—the bias in favor of the applicant over those opposed to the granting of a license. Once private utilities have sunk considerable money into a chosen site or have even begun construction of the facility (a permit to begin construction can precede a license to operate) economic calculations weigh heavily in favor of the utility and, as Stever shows, are incorporated into the licensing decision. The quasipublic and monopolistic character of utility firms would appear to justify some form of public participation in decisions that affect public health and safety as well as the price and availability of power.

On the whole this is a most competent case study that uses its extensive documentation to draw well-reasoned and prudent recommendations. Yet this reader remains unconvinced that the procedural reforms suggested would do much to restore public faith in the licensing process and allay fears about the safety of nuclear power. The procedural fix is too simple. The assumptions on which it is based are questionable at best.

For any regulatory scheme to enjoy public confidence, its objectives must be broadly acceptable and clearly drawn, compatible with one another, and enforced by effective rules and procedures. The definition of public objectives is logically prior to the making of rules. Unguided by strong public consensus, rulemaking becomes a highly politicized process in which competing interests attempt to shape the rules to their benefit. Regulatory schemes in the hands of private interests seldom enjoy public confidence. Reworking the rules may alter who wins and loses but, without a clear definition of public purpose, is unlikely to generate public consensus.

Several contemporary scientific issues have recently entered the regulatory arena without sufficient attention directed to the definition of regulatory objectives, public acceptance of such objectives, and their compatibility with one another. The control of toxic substances, regulations regarding recombinant DNA technology, and the licensing of nuclear power plants are all examples of attempts to make policy in the absence of explicit and accepted objectives. While Stever is quick to condemn the process of regulatory decision-making and therefore looks for procedural remedies, it is also important to examine the substance of these issues as an explanation of regulatory deficiencies. I would argue that some scientific and technological issues are particularly difficult to regulate because acceptable objectives are impossible to define. First, experts are unable to agree about what exactly constitutes a risk to health and safety or a threat to the environment. As Stever notes, the methodological remedy promoted by advocates of risk assessment provides no panacea. Second, experts are often asked to do cost-benefit analyses, to weigh health benefits against environmental costs, safety costs against economic benefits, that presuppose an agreed-upon ranking of values in the public mind. These conditions of scientific uncertainty and disagreement over values guarantee the politicization of regulatory activity. Moreover, interest groups have been quick to recognize the power of scientific advice.

More and more, science is dragged into politics.

In these circumstances, Stever's procedural prescriptions remain appropriate, though for reasons other than those he identifies. Procedural changes will neither produce appreciably better information nor depoliticize the issues. What they can do is to manage the political debate more effectively by granting meaningful access to all affected parties and balancing the power of competing interests. Where the substance of regulation remains ill-defined and highly politicized, the fairness of the process of regulatory decision-making assumes greater importance. Stever's prescriptions are likely to do little to reduce the vigor of the debate in arenas like Seabrook, but they may restructure the debate in ways that encourage a more even-handed treatment of the participants.

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Structures of Proteins

Protein Folding. Proceedings of a conference, Regensburg, Germany, Sept. 1979. RAINER JAENICKE, Ed. Elsevier/North-Holland, New York, 1980. 588 pp., illus. $73.25.

This proceedings volume contains a number of substantial, well-written papers that offer novel approaches to exciting problems. The question addressed is How do proteins fold up? It has been assumed, since the early experiments of Anfinsen, that the protein sequence must contain all the information needed to create the "native" structure as at least a kinetically stable state. There have been three broad approaches to protein folding.

Experimental studies of protein denaturation showed the process to be highly cooperative and led to a "two-state" model in which only "native" and "denatured" species were recognized. In the last ten years, however, various trapping procedures, fast kinetics techniques, and cryoenzymology have provided undisputable evidence that there are kinetically important intermediates. Much of this work is presented in this volume, the accounts provided by R. L. Baldwin and T. E. Creighton being exceptionally valuable. The message from the experimenters is that the folding pathway seems to be complex; intermediates with considerable tertiary structure form well before the final state Obligatory but incorrectly folded structures that must rearrange to yield the native protein have been found for trypsin inhibitor. A long-standing puzzle that emerges more forcefully on reading several of the experimental papers is that clipping a few residues from the carboxyl end of a number of proteins has a profound effect on the refolding kinetics and the stability of the native state. No general explanation is offered.

The second—some would say the major—approach has centered on the proliferation of structures determined to high resolution by x-ray crystallography. This volume is not a structural compendium, and no new structures are reported. There are, however, many papers that use the known structures as data for further analysis. The attempt to see classes of structures has a long and honorable history, beginning, in the protein field, with Pauling's insights into secondary structures. Current efforts are, on the one hand, more detailed, focusing for example on arrangements of strands in beta sheets, and, on the other, aimed at higher levels of structure, such as investigations of beta sheet stacking and domain structures. These efforts are well represented, with a well-illustrated summary of protein structures by J. S. Richardson and contributions by a number of other well-known workers. It is increasingly clear that, at least on a structural level, there are a relatively small number of domain-sized building blocks that are reused in quite similar ways from one protein to the next.

The third approach has been mathematical modeling of proteins to attempt to predict or to understand the native structure. Pioneers in this field, such as H. A. Scheraga, O. B. Ptitsyn, and V. Lim, have their latest contributions here, and there is a nice introduction and review by M. Levitt. My general impression is that the direct energy minimization efforts are still considerably short of their goal, largely, but not exclusively, because of the magnitude of the computational task. Approaches that treat only part of the problem—for instance, the combinatorial methods presented by F. M. Richards, T. J. Richmond, M. J. E. Sternberg, and F. E. Cohen—seem very promising if one wants to put a large amount of information together in a model that will produce a low-resolution "protein-like" structure.

The major omissions from the volume are considerations of protein folding in vivo and of internal motions in proteins. The latter topic has been advanced through high-resolution nuclear magnetic resonance spectroscopy, thermal parameter diffraction experiments, and calculations of molecular dynamics. Only the NMR story is offered here, through the elegant studies of K. Wuthrich, H. Roder, and G. Wagner. Fortunately this topic was covered in a recent discussion of the Biophysical Society.

In sum, this is an excellent book for all those interested in protein folding in vitro. It has enough new and thought-provoking material to serve as a source book for an advanced graduate course and certainly belongs on library shelves even in these austere days.

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