Debates Involving Science

Scientific Controversies. Case Studies in the Resolution and Closure of Disputes in Science and Technology. H. TRISTRAM ENGELHARDT, JR., and ARTHUR L. CAPLAN, Eds. Cambridge University Press, New York, 1987. x, 639 pp. $59.50; paper, $19.95.

This is an ambitious and at the same time frustrating book. In over 600 pages one might assume that most things that could be said about scientific controversies would indeed be said. But here we get at once too little and too much. Despite valiant attempts by many of the contributors to relate what they are saying to more abstract considerations and the almost heroic effort of Ruth Macklin to wrap up the contents of the book in a final chapter, the reader is met by a kaleidoscope of approaches, topics, and styles of writing.

A major source of frustration, at least for this reviewer, may lie exactly in the book's title. Why call it *Scientific Controversies* when its scope is at the same time both narrower and broader than that? The book is, in short, not principally about controversies *in* science. Its emphasis is, rather, on public-policy debates where scientific (and other) arguments have been used. Furthermore, as the subtitle indicates, it is not about controversies as such, but about a more limited issue: how "closure," that is, termination or resolution, is (or, in some passages, should be) reached.

One explanation for the title may lie in the editors' belief, voiced in the preface, that contemporary societies "presume that science can resolve disputes over factual issues such as the question of whether Laetrile should be used to treat cancer, whether homosexuality is a disease, whether nuclear power is safe, or whether a particular concentration of benzene in the workplace is tolerable." In my opinion, it is unnecessary to postulate such a thing. In fact, the case studies in the book make manifest the complicated interplay among epistemic, professional, political, ethical, and other interests in debates involving scientific and technological issues.

The book is divided in three major parts, Theoretical Perspectives, Contemporary Case Studies, and Controversy, Closure and the Public. The authors in the first part strive, in various ways, to develop general frameworks for analysis of controversies and typologies of closure. (The reader who needs aid in getting a metagrasp of these varied theoretical attempts should read the editors' introduction and Macklin's last chapter.) The second part, by far the longest, deals with four major topics: laetrile, homosexuality, safety in the workplace, and nuclear power, devoting three or four chapters to each. Here we find various (but not systematically divergent) views on the same issue by writers of different professional training. The third part, containing among others an all too brief chapter by Rae Goodell on the role of mass media, seems disproportionately truncated.

I found the first part most stimulating. Here are some very good efforts to analyze the meaning of "scientific controversy" and its difference or lack of difference from other types of controversy. Ernan McMullin and Everett Mendelsohn provide an interesting contrast in their views of the relative roles of epistemic and "extrascientific" factors in the resolution of controversies in science. Whereas Mendelsohn appears sympathetic to various "interest" explanations, McMullin is critical of "the use of carefully selected case studies like those of craniology or eugenics to suggest a broadly inductive argument for the pervasive and decisive presence of socio-political factors in all aspects of scientific work, specifically in the termination of controversy" (p. 88).

Tom Beauchamp's general taxonomy of closure in controversy is perhaps the most useful one in the context of the book, in view of the concentration on public-policy–related controversies. Beauchamp distinguishes sound-argument closure, consensus closure, procedural closure, negotiation closure, and natural-death closure. He also discusses for which types of issues these various kinds of closure are most likely to occur and why. The first kind of closure is dependent on the finding of a "correct" resolution; the second occurs through agreement that a "correct" or "fair" position has been reached, independent of whether this is indeed the case; the third comes about through arbitration procedures, for example of a legal kind; the fourth is a product of a negotiated compromise from absolute positions; and the fifth comes about when there is lack of interest in continuing the debate.

Loren Graham points out that in biomedical debates negotiation closure, the type most common in the United States, is the rarest type in the Soviet Union, where issues are typically settled by sound-argument closure. He locates a fundamental reason for this in the fact that in the Soviet Union moral theory is itself considered a science. In fact, because of memories of Lysenko, Soviet scientists are worried by the increasing inclusion of moral philosophers and lay people on advisory boards and institutional review boards in the West.

Henry Frankel's analysis of the continental drift debate is a lucid study of what, as he represents it, would appear to be a rather archetypal case of closure on the basis of "better" epistemic arguments. He regards the other cases in the book as typically involving a scientific controversy accompanied by a public-policy controversy. According to Frankel, there is a relative independence between the scientific merits of a specific claim and its possible social consequences. For instance, with respect to eugenics, Frankel asserts that "even if the eugenicists were right, there remained questions such as whether the United States should invoke immigration quotas, and, if so, against whom" (p. 245).

Compare this to Garland Allen's attempt at a Marxist analysis of the eugenics controversy in the United States. Allen is preoccupied with the use of scientific experts as pawns for capitalist purposes. He examines in detail how one key figure, Charles Laughlin, was first used in congressional hearings to justify, in a post hoc fashion, the notorious immigration laws, and how later, when his services were no longer needed, his research support was withdrawn. Allen does not heed Frankel's advice to separate scientific issues from issues of value. On the contrary, he seems to wish to indicate that the eugenicists were doing both scientifically and morally "bad" science—a "coupled reasoning" quite prevalent in current American left-wing thought. He maintains that the eugenicists were sticking with outdated views of genetics and evidently thinks they ought to have listened to their scientific critics. But why would one expect different behavior from the eugenicists than from other scientists involved in controversy, given that the matters at issue often involve conflict between "old" and "new" views?

At this point I wished that the book contained other case studies of supposedly epistemic controversies to acquaint the reader with actual scientific practice as against idealized accounts. Mendelsohn and McMullin do their bit, but it does not seem sufficient, as Frankel's study is systematically held up as a foil against the case studies in the second part of the book.

Frankel, with his ostensibly clean epistemic case, can easily say that "participants in the drift controversy, qua participants, were

interested in the question, 'Does drift occur?' not 'Ought it to occur?', or . . . 'Is drift consistent with certain moral principles?' " (p. 246). He also concludes that "it would make little sense to analyze controversies such as the drift one in terms of negotiation closure." To the second statement one could perhaps hold up Martin Rudwick's *The Great Devonian Controversy*, which in my view successfully employs just such a negotiation approach.

A very useful chapter in view of the case studies to follow is Dorothy Nelkin's discussion of controversies and the authority of science. Alasdair MacIntyre's chapter on philosophical causes of scientific disagreement, although the idea of philosophical commitment is a central one, remains rather hanging in the air, dealing as it does specifically with post-Skinnerian and post-Freudian psychology.

In the case studies section of the book, we find at least two divergent viewpoints as to the relationship between scientific or epistemic and other concerns. Robert Schwartz discusses the "judicial deflection of scientific issues" in the case of laetrile. He believes that the result of legal intervention was to force scientists to do necessary research to bring forward arguments needed for a sound-argument closure. Mark MacCarthy, on the other hand, in his analysis of controversies dealing with occupational safety and health, is more skeptical. In fact, he seems to believe in an endless regression to issues that ultimately are normative. He comes to the conclusion that the problem of closure lies with the criteria used by the regulatory agencies, but argues that cost-benefit and other considerations in turn decide whether or not regulatory action will be taken in the face of scientific uncertainty. But such considerations cannot determine whether a regulatory action is actually in the public interest. Therefore, MacCarthy arrives at the conclusion that "the public's best assurance that regulatory officials reflect the public interest is in the ballot box" (p. 527).

For those who are interested in how arguments in specific public-policy–related controversies have proceeded and have led—or failed to lead—to closure, the case studies are a gold mine. But it is by no means easy to relate them to the taxonomies of closure outlined in the first part of the book, and the effort to do so may be undermined by the earlier-mentioned idealization of scientific controversy as basically representing sound argument. It would have been important to consider the possibility that moral and political considerations may affect sound-argument closure in science. I think for instance of the study by William Provine portraying the revision of geneticists' views regarding race-crossing and hereditary mental differences between races between 1930 and 1950 as chiefly a revulsion to Nazi doctrine, not as dependent on new data. In this light, the American Psychiatric Association's decision to settle by vote whether homosexuality should be considered a pathology may not appear particularly surprising (see Irving Bieber's chapter on how the vote was arrived at).

Against existing historical, societal, and moral or political variation in assessments of "good science" or sound argument in science, it appears strangely artificial to discuss closure in science as having norms of its own. This is an exercise that the present book occasionally indulges in. The norm for scientific closure arrived at in Macklin's final chapter is, "There should be no negotiation closure in pure science" (p. 620). This norm is not presented as derived from a belief held by, say, scientists, philosophers, ethicists, politicians, or the general public as to how scientific disagreements *ought* to be settled. Instead it is supposedly derived from descriptive statements. (To be sure, the participants in the Closure Project—the name of the series of seminars between 1978 and 1982 constituting the bulk of the book—did not achieve closure about even descriptive matters, much less about conceptual and normative ones, as Macklin readily admits.)

My overall conclusion is that the project would have benefitted from inclusion of more sociologists of science. I do not believe that necessarily would have helped settle the issues; it would perhaps have muddied them even further. But as it is, the book too often represents scientific discourse as unproblematically guided by "sound argument." This could backfire by reinforcing the very belief in the authority of science that the editors avowedly want to counteract. Thus, I am not satisfied with the way the book has been "brought to closure."

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Plant-Water Relations

Stomatal Function. EDUARDO ZEIGER, G. D. FARQUHAR, and I. R. COWAN, Eds. Stanford University Press, Stanford, CA, 1987. xvi, 503 pp., illus. $65. Based on a meeting, Honolulu, HI, April 1983.

As the principal regulator of leaf-gas exchange, stomata attract considerable interest from plant scientists. Research has focused on mechanisms by which they sense the environment and transduce signals into the actions of opening or closing. *Stomatal Function* is a compendium of 20 papers that grew out of a meeting sponsored by the U.S.–Australia Cooperative Science Program. Although published four years after the meeting, most of the papers include recent literature.

The 20 chapters cover a wide variety of topics, from structure and guard-cell metabolism to whole-canopy transfer processes. Hans Meidner leads off with an account of the history of stomatal research. This is indispensable reading for all students of plant-water relations. The second chapter, by Hubert Ziegler, is a clear and informative discussion of the evolution of stomata. Although most of our understanding of stomata comes from just two or three species, Ziegler conveys the diversity of stomata across the plant kingdom.

The largest section of the book contains predictable chapters on energetics, metabolism, ion transport, and responses to light, carbon dioxide, and humidity. These chapters are an appropriate blending of individual ideas and relevant literature. They provide a scientific foundation on which to build the next level of experiments.

An indication of the recent explosion of interest in plant growth regulators is the inclusion of three separate chapters on this subject: "Action of abscisic acid on guard cells," "Cytokinins and stomata," and "Auxins and stomata." Although these chapters are not well coordinated with one another (for example, the auxin chapter has a wealth of information on abscisic acid), they document the view that stomata are not passive respondents to the environment and to leaf-water potentials but that stomatal aperture is coordinated in part by chemical messages from other parts of the plant.

The remaining chapters are more whole-plant–oriented than are the first two-thirds of the book. For example, responses to drought, diurnal variations, crassulacean acid metabolism, and leaf-age effects are discussed and successfully integrated with the physiological and biochemical responses described earlier. These chapters provide a framework for the interpretation of data and the construction of hypotheses.

The description of canopy transfer processes in chapter 18 relies heavily on partial differential equations and jargon that will be difficult for many physiologists to follow. The final chapter, "Calculations related to gas exchange," includes the equations necessary to understand the process of gas exchange and the related measurement procedures and at the same time describes the assumptions, pitfalls, and limitations of these measurements. This chapter will be useful not only for those making such mea-