tutional aspects remain little examined and poorly understood. This book on the problems of and solutions to acidic precipitation is thus a welcome addition to a scanty literature.

The book incidentally represents an innovative approach to teaching policy analysis. Comprising a collection of papers written by graduate students in a special seminar at the University of Texas Lyndon B. Johnson School of Public Affairs, with an introduction and conclusion written by the editors, it provided a mechanism and objective for more than a year's worth of intensive study into a current and complex public policy issue by each contributor, including field research, capped by an international conference at which each of the papers was subjected to intense scrutiny. This is, perhaps, the public policy equivalent of a language immersion program and a pedagogical model to be emulated.

The breadth of the treatment is impressive, including the physical, chemical, and biological nature and effects of acid rain, American and Canadian air pollution policies and domestic political interests, existing intergovernmental institutions and negotiations, and precedents in international environmental cooperation. With a developing issue such as acid rain, however, the decision to produce a book through a university press may have given rise to the perhaps predictable problem of datedness.

In some respects that problem is a serious one here. Not only was mention of some recent key scientific assessments, including a new National Research Council study of whether there is or is not a long-term trend in acid precipitation, impossible, there is no mention of the 1985 appointment, let alone the 1986 report, of the Canada-U.S. special envoys on acid rain or of the 1985 federal-provincial agreement in Canada to reduce SO_2 emissions. Missing too is analysis of what has now emerged as the control technology most likely to be adopted—the so-called "clean coal" or cleaner burning techniques for smelters and thermal power plants. In a contribution to an ongoing science and policy debate, these are unfortunate casualties of publication lags.

The book also makes strongly the argument that, as is stated in the title of the introductory chapter, "acid rain is different." As a result there is a need to "consider alternative regulatory concepts and control strategies" (p. 29). This conclusion appears both too grand and too little, too late at a time when even an advisory committee to the president's science adviser has called for an immediate start to control actions. The undertaking now embarked upon by both countries to test and presumably to implement clean coal technologies, however slow, appears by comparison a good deal more direct and less problematic. Acid rain is different in degree, to be sure, from other air pollution problems, but probably not so different in kind that it requires a completely new approach to regulation.

If the overview chapters overstate the extent to which acid rain is a novel policy problem, they also understate and even misstate the extent to which Canada is a different policy and political environment from the United States. Arguing for a fundamental change in the nature of U.S. environmental policy-making, the editors suggest that "EPA and similarly Environment Canada . . . should be involved in policy formulation, because field experience is needed for the legislature to write a detailed acid rain statute" (pp. 29–30). This statement both implies wrongly that EPA officials never participate in policy formulation processes and indicates a failure to appreciate that in the Canadian parliamentary system it is virtually always the civil service and not the legislature that drafts legislation for cabinet and parliamentary approval. The authors recognize and emphasize some key political factors in the search for solutions to the North American acid rain problem—that international agreement must await domestic policy action, that what actions the U.S. government takes will largely determine the international outcome, and that Canadian politicians and diplomats are severely limited in the measures they can take to encourage American actions. They also overlook or understate others. For example, the inattention to policy responses on the part of the bilateral working groups was due less to "caution" than to political constraints, most of them from senior U.S. administration officials. And the lack of a U.S. control program to date is due less to a lack of public support than to strong opposition from interest groups, congressional factions, and the administration. Moreover, the proposal for a Canada-U.S. agreement that would not include control commitments overlooks the position of most experts that an immediate start on reductions is both warranted by existing knowledge and needed for environmental security.

Acid Rain and Friendly Neighbors is a commendable and useful effort for the information it provides on the environmental problem; it is, however, flawed as a guide to policy solutions. Its prescriptions seem unlikely to hasten either a reduction in acid rain or an increase in neighborliness.

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An Astrophysical Concept

Accretion Power in Astrophysics. J. FRANK, A. R. KING, and D. J. RAINE. Cambridge University Press, New York, 1985. x, 273 pp., illus. $59.50. Cambridge Astrophysics Series.

The 1940's and 1950's were the years in which astronomers came to understand the structures of real stars, from stellar model calculations based on well-founded physics. From the 1960's onward, more sophisticated evolutionary models have made it possible to trace how stars age and change with time, as a consequence of the nuclear reactions that convert their hydrogen to helium and then to heavier elements.

Now in our decade astronomers are coming to understand the very late stages of the evolution of some stars, in which the even more powerful energy "source," gravitational energy release, is important. Of course it is only when the objects are very compact, so that the gravitational binding energy per unit mass is very large, that this mechanism can be of primary importance. Thus it is in binary stars in which mass flows from a normal or giant companion star to a white dwarf, neutron star, or black hole that the energy release in an accretion disk leads to observable consequences. Many of the "peculiar" binaries and variables, almost incomprehensible to the previous generation of observational spectroscopists, are now understood quantitatively in these terms.

Even more interesting, accretion disks around much more massive black holes appear to be the most likely interpretation of the energetic inner nuclei of Seyfert galaxies, radio galaxies, quasars, QSO's, and other active galactic nuclei. Observational and theoretical studies based on this working hypothesis seem to many researchers to be the most fruitful paths of advance to understanding these objects.

Up to now, the basic ideas of accretion disks in astrophysics could only be found scattered through many research and review papers. In this little book, three active specialists in the field have collected and systematized them for the graduate student or beginning research worker. The concepts and equations of gas dynamics and plasma physics necessary for understanding accretion disks are first reviewed. Then the special ideas of interacting binary systems and the Roche lobes about a star, equivalent to equipotential surfaces in the rotating system in which material can stream from one star to the other, are discussed. This leads naturally to a thorough investigation of the accretion disks that are then expected to form, their structure and stability, and the observational properties that may be pre-

dicted from them. The success of these predictions is the justification of the whole idea of accretion disks.

The last several chapters of the book present a concise theoreticians' description of the essential known facts of quasars and active galactic nuclei, followed by a discussion of the possible nature of the velocity fields within them and of the types of accretion disks and central masses that most probably power them. Much of this material is at the frontier of our present understanding. Part of the analysis is based on well-understood physical ideas, but other parts depend on assumed power-law dependencies, analogous to the polytropic-index stellar models of the 1930's, before all the essential ideas of the internal structure of real stars were understood.

Accretion Power in Astrophysics is an admirable summary of all this material. The concepts are clearly presented. The equations are given in a consistent notation and are well discussed. A good selection of line drawings clarifies the text. The observational data are simplified to their essentials and compared and contrasted quite understandably with the theoretical predictions. This book will be very useful for anyone who wishes to get started on theoretical research on accretion disks and on active galactic nuclei. It will make an excellent textbook for a graduate course. It will be particularly valuable for physicists and fluid dynamicists who want a quick introduction to one of the most fascinating fields of current astrophysical research.

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Events Surrounding EDSAC

Memoirs of a Computer Pioneer. MAURICE V. WILKES. MIT Press, Cambridge, MA, 1985. x, 240 pp., illus. $19.95. MIT Press Series in the History of Computing.

Expecting to find a blow-by-blow account of how Maurice Wilkes managed to construct the world's first fully functional electronic stored program computer at the University of Cambridge, I was pleasantly surprised when I found that the contents of this book were far from being a simple list of achievements during the late '40's and early '50's.

The book traces Wilkes's life from his early school days, when he was just getting interested in "ham" radio, through his undergraduate and graduate experiences with radio propagation research, to his war-related exploits involving the development of radar. This account clearly shows the influences, both social and scientific, that led Wilkes into the position where he could become one of the great pioneers of the development of the computer.

"The model differential analyser in Cambridge." *Left to right*, A. F. Devonshire, J. Corner "following a curve on the input table," and M. Wilkes. [From *Memoirs of a Computer Pioneer*]

The first few chapters are full of short asides describing Wilkes's Cambridge student friends and professors, where they ended up, and what line of research they eventually adopted. Though some of this is just plain distracting from the main narrative, there are some descriptions of people who made important contributions to the development of automatic computation. Included in this set are such people as R. R. M. Mallock and D. R. Hartree, the latter being of great influence in the development of both British and American computers.

Wilkes's wartime experience in the development of radar makes up about a quarter of the book. The descriptions, apart from sometimes reading as if copied from diary entries, make an interesting tale that shows only too clearly just how fragile the British air defenses really were.

The story of Wilkes's involvement with the very early computer developments begins halfway through the book. The account of how he was invited to the famous Moore School Lectures in 1946 and, from them, developed the design for his machine is truly fascinating. In this last half of the book the names of all the great computer pioneers appear in one connection or another. Wilkes worked with, was consulted by, or exchanged visits with von Neumann, Eckert, Mauchly, Goldstine, Turing, Aiken, and many others.

The description of the building of the Cambridge EDSAC I and EDSAC II computers is well balanced, with just enough technical detail to keep the interest of the electronic engineer yet not enough to bog down the reader more interested in the human side of large research and development projects. Although any memoirs should be read with some skepticism, this story clearly shows that Wilkes had insight into the long-range impact of the computer when most of his contemporaries were still thinking of it as a mathematical research toy.

Not content with simply describing his achievements, Wilkes adds one last chapter that should be compulsory reading for all involved with the administration of research projects. In it Wilkes describes how and why he chose various projects to be the central research themes for his department and gives detailed reasons why some of them were failures.

The style of writing changes slightly from one part of the book to the next. In some places the inclusion of many small anecdotes gives a chatty feeling. In other sections, presumably where Wilkes is in his more usual academic report writing areas, the style is crisp and clean.

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