

such schemes need large-scale planning. But will the planners be able to take into account all the consequences and foresee the far-reaching ecological and social changes involved? G. W. Thomas and T. W. Box state that "we cannot point to a single example of good advance planning involving the entire scientific community." Furthermore, large-scale transfer of water may in time cause a profound change in the soil-water relationship, resulting in a considerable increase of water salinity at the terminus of the line. The existing Colorado River scheme is cited as an example.

Some papers (S. Resnick's especially) deal with such alternatives to large-scale water transfer as desalination of sea water, water harvesting, a dual or possibly even triple supply system ("water hierarchy," D. A. Okun), reuse of waste water, and increasing irrigation efficiency. There are more alternatives than those mentioned. Much wasting of water could be avoided (Israel is a good example) by installing new types of faucets, by educating people to be water-conscious, and by irrigating at night and not at noon of a burning hot day, for example. But in contrast to the gigantic water-transfer schemes which entice most people so much because they seem to be *the* magic solution of all water problems, these alternatives—though in my opinion most effective—are unspectacular and need the "courage of the small deed," and that is not very popular. Two possibilities need special comment. The conventional treatment of waste water for reuse as drinking water is inadequate because water so treated may and often does contain dangerous viruses (D. A. Okun); more research is needed to solve that problem. Increasing the efficiency of irrigation and water use is in my opinion one of the most urgent needs. This could save considerable amounts of water. For instance, in Israel at least 30 percent of irrigation water is wasted. To use on Texas ranges 200,000 kilograms of water for the production of 1 kilogram of beef (G. W. Thomas and T. W. Box) seems also to be an avoidable waste.

Taken as a whole, *Arid Lands in Perspective* is, like *Deserts of the World*, indispensable for everybody who has to deal with arid lands and their development. One feels that most of the authors have lived the problems they deal with and do not talk merely ex cathedra. Their judgment is sound

and based on vast knowledge of the areas concerned. I hope that the editors will continue to publish similar volumes—as they promise to do—of an equally high standard. There is very little to criticize. The paper on quantitative analysis of desert topography is possibly out of place in such a volume since it is too specialized. The paper on the new system of soil classification contains either too little or too much because it throws a whole new nomenclature of orders, suborders, and great groups (Vertisols, Alfisols, Ustults, Ustorthents, and the like) at the reader without giving sufficient explanation for most of us who are still thinking in the old terms of soil classification. It would also be most advisable in a scientific book to use the decimal system and to do away with miles, yards, inches, acre feet, and Fahrenheit.

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## Deciding about Water

**Strategies of American Water Management.** GILBERT F. WHITE. University of Michigan Press, Ann Arbor, 1969. xvi + 160 pp., illus. \$5.95.

"The theme of this volume," Gilbert White says in his preface, "is that by examining how people make their choices in managing water from place to place and time to time we can deepen our understanding of the process of water management, and thereby aid in finding more suitable ends and means of manipulating the natural water system."

The model of decision making that he offers is new. It is not that of engineering-economics relative to the optimization of the use of resources, or of political science examining the political processes of decision, or of sociology studying "community organization and process relating to the formation and support of agencies making decisions about water management." Instead, social institutions are taken to be the instruments of water resource management. They are seen as affecting the freedom and incentives of their managers and also as affecting managerial perception with respect to (i) range of choice, (ii) water resources, (iii) technology, (iv) economic efficiency, and (v) spatial linkages (such as ecological effects). All five factors are seen as

"being profoundly influenced by the culture of the area and as manipulated by the organization and character of social guides."

Within this framework White identifies and assesses six strategies of water resource management: (i) single-purpose construction by private managers, as in farm water supply; (ii) single-purpose public construction by public managers, as in navigation; (iii) multiple-purpose construction by public managers; (iv) single-purpose action by public agencies using multiple means, as in flood loss reduction; (v) single-purpose action using multiple means where research is included as a conscious management tool, as in weather modification; and (vi) merging of multiple purposes and multiple means, greatly enlarging the span of possible actions.

Who makes what choices? What is their effect upon the public welfare? What is their effect upon the natural environment? These questions are asked of each of the six strategies. Fully adequate answers are not presented. The inadequacy is partly due, as the author notes, to the imperfection of economic and ecological analytical methods for determining effects. It is also due, he notes, to the fact that few attempts have been made to apply the available methods to the appraisal of completed works, so that he is forced to be "largely speculative" and to draw from "scraps of evidence." Nevertheless, his comprehensive examination (which he presented originally as the William W. Cook Lectures on American Institutions at the University of Michigan) provides us with a very valuable book.

Few others, if any, are so well equipped as Gilbert White to undertake this appraisal. A geographer, he has served since the 1930's on national planning and advisory boards and committees and has been closely enough associated with water and related land resource matters to know what has been going on, yet in a position to maintain perspective and to avoid commitments to particular programs. Drawing upon knowledge derived from these official involvements, as well as his wide-ranging intellectual inquiries as professor of geography at the University of Chicago, White discusses many specific matters of significance thoughtfully, sensitively, and with historical insight. Some readers will be disappointed that he avoids conventional judgments, pro or con, with respect to, say, Western irrigation and navigation developments. Others will agree that

studies of these and other matters are not yet sufficient to support well-rounded judgments. All will agree, one may hope, with the main argument of the book: that full consideration should be given to multiple means of carrying out multiple purposes.

For many years White has been urging the use of multiple means to prevent flood losses, and he can take substantial credit for the increasing consideration they are receiving. Multiple means, as he indicates, are available to fulfill most other purposes of water resource management, and science and technology are providing additional means each year. The wider the range of practicable alternatives, the more sensitive management can be to complex human preferences. And to the extent that multiple means are considered, he points out, the number of public—federal, state, and local—and private managers is enlarged.

To provide leadership, focus public attention, and facilitate cooperative study by this increasing number of management elements, White points to the potential of the federal-state river basin commissions whose establishment was authorized by the Water Resources Planning Act of 1965. In the last three years, upon request of the states concerned and with the concurrence of the Water Resources Council, the President has established such commissions in the Pacific Northwest, the Souris-Red-Rainy region, the Great Lakes, and New England. Comprehensive framework studies are under way in these regions that aim to take into consideration long-term needs of all kinds, including the preservation of wild and scenic rivers as well as resource development, the availability of water and related land resources to meet needs, alternative patterns of resource use that might be adopted, and the alternative means of enabling such uses. More detailed coordinated studies, outlining specific alternative means of meeting needs at specific times and places, are undertaken where needed. It should be possible for every type of means to be supplied by one or more federal, state, or local agencies or by private enterprise; therefore, no means should be excluded from the possibility of utilization if it best meets public preferences.

Comprehensive framework studies, it is hoped, will go a long way in enabling public preferences within a region to manifest themselves. Subsequent more detailed, coordinated studies can then be undertaken with greater confidence

than in the past that they will lead to action. With the Water Resources Research Act of 1964 and other means, research as a tool to assist management should be increasingly utilized. Two of the present commissions, the Great Lakes Basins Commission and the New England River Basins Commission, already have established channels of communication with university water research centers within their regions so as to have their inputs in planning studies. To obtain adequate participation of local government and private enterprise, however, much more needs to be done. Also the means, as presently developed, for effective public participation leave much to be desired.

"What is most lacking," White said when the book was in preparation a year or so ago, "is a widely shared sense of strategy, a strategy that recognizes multiple aims, that freely canvasses multiple means, and that places a high value on maintaining flexibility." The legal and financial means are available under the Water Resources Planning Act, fortified by the Water Research Act, to carry out White's proposed strategy. His challenge to carry it through in practice will require aggressive leadership and widespread understanding and consensus on its merit. His book will help all who may be concerned to meet his challenge.

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## Astrophysical Phenomenon

**Mass Loss from Stars.** Proceedings of a colloquium, Trieste, Sept. 1968. MARGHERITA HACK, Ed. Springer-Verlag, New York; Reidel, Dordrecht, 1969. xii + 348 pp., illus. \$19.50. Astrophysics and Space Science Library, vol. 13.

Everyone now believes that many or all stars lose mass at different stages of their lives. Though our understanding of mass loss processes is still very limited for the pre-main-sequence interval, it is clear that assorted mechanisms lead to unique or repetitive slow, fast, or explosive events for many single and double stars after the beginning of nuclear burning. This volume presents the papers and dialogue from a colloquium given over to discussion of stellar mass loss. The first four sessions were nominally devoted to observations and theo-

ries of single-star mass loss and to similar studies of close binary members. A final session dealt mostly with specific episodes in novae and in symbiotic stars.

The introductory review by the late Armin Deutsch is perhaps the finest and most complete examination of mass loss in the literature; its historical perspective and excellent bibliography should ensure its value for a long time. The contributions derived from rocket and ground-based observations of single-star mass loss are familiar, and little new ground was broken. The "theoretical" papers on this theme were clearly more provocative, as may be inferred from the contrasting contributions by Barbaro and his colleagues and Lindoff. Treating overlapping samples of galactic clusters, these two studies arrive at very different answers to the question of whether mass loss has been significant for the member red giants. It would be useful to resolve this problem if only to place in perspective several other papers on subsequent evolutionary stages at the hot side of the Hertzsprung-Russell diagram. There also emerges a consensus that solar-wind-type mass loss, no matter how small the rate, has potentially broad application.

Differential close binary evolution has clearly reached maturity. No disagreement of consequence exists among the theoreticians at this stage of understanding of their separate stylized cases, but these cases must be recognized as limiting treatments built upon systemic conservation of mass and angular momentum. The presentation then is one of mass exchange between the components. A new student of these efforts probably can find no better synthesis than in the session-4 papers of these proceedings. The observers' papers are more of a miscellany, but the summaries by Sahade and Wood can be recommended. There is no explicit treatment of how effective single-star mass loss may be at certain stages of close binary evolution.

The volume is excellently printed with very few typographical errors, but a large number of gauche renderings into English have survived the editing. It is also true that a significant number of individual contributions have appeared in journals or observatory serials before publication of these proceedings.

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