As Irwin Feller's study demonstrates, the answer to this question lies in the fact that, although they work in close geographical proximity to one another, there is a very long distance between the culture in which state policy-makers operate and the milieu in which university professors to whom they may look for help function. The policy-makers inhabit a world in which great pressures exist to find quick answers to questions for which we may not yet have very good answers. The university's professors, on the other hand, are members of professions that provide recognition and status for finding answers to questions that the profession regards as important, even though the world at large may not share that opinion.

This is hardly a new problem. Universities, private as well as public, have been wrestling with it in the United States since most of them came into existence. What gives Feller's study its greatest significance is the fact that it is focused on one decade—the 1970's—when there was widespread acceptance of the idea that universities ought to be more involved in solving the world's problems. If a university was not part of the solution it was part of the problem, in the cliché of that day. Many members of the professoriate then began to feel that they should make themselves useful as well as ornamental, and a certain amount of guilt emerged on campus over the ivory tower immunity of the university from the ills of society.

However, from the evidence that Feller has gathered, the 1970's produced no breakthroughs in the relationships between state government and state institutions of higher education. Even in this very propitious climate of opinion, successful cooperation between states and their universities in coping with policy problems hardly became commonplace.

Feller does identify several interesting experiments at linking the expertise of universities with the needs of the state for assistance in policy-making that were undertaken during this period. In California a Policy Seminar was established to bring university professors and state officials together in order to forecast and find ways of coping with problems that loomed ahead on the state's policy agenda. In Iowa a Legislative Extended Assistance Group (LEAG) was set up and enjoyed modest success in promoting research by faculty members as well as informed discussions with state legislators on a variety of problems the state faced. In Pennsylvania a Legislative Office for Research Liaison (LORL) began to play a leading role in finding faculty members who could help state policy-makers—particularly on scientific and technical issues. Similar arrangements were set up in Illinois and Maryland. Finally, in 1978 the Ford Foundation initiated a State Environment Management Program (SEMP) that funded a variety of projects around the country involving cooperation between states and their universities.

All these programs were affected by the difficulties that have long plagued the relationship between the state and the university. From the state's point of view, university researchers do not always address the specific problems the state faces or offer very practical remedies for them. From a university faculty perspective, a heavy involvement in "localistic" research may be costly in terms of career prospects and tenure. But, as Feller indicates, the modest successes achieved in this area in the 1970's may provide precedents for building stronger relationships in the future. The evidence also suggests that there needs to be greater awareness on both sides that the relationship will always be a thorny one. If the partners in the relationship are doing their job well, the different imperatives by which they are driven will frequently bring universities and state governments into conflict.

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Aquatic Plants

Phytoplankton Ecology. Structure, Function and Fluctuation. GRAHAM P. HARRIS. Chapman and Hall (Methuen), New York, 1986. xii, 384 pp., illus. $45.

Phytoplankton play vital roles in sustaining life on earth, affecting the supply of oxygen and the global cycling of carbon and essential nutrients. Additionally, as first links in aquatic ecosystems, they set upper limits on the quantity of food the sea can provide. In recent years there has been a growing realization that the temporal and spatial scales upon which we have traditionally focused our attention in studying these very small organisms are not at all representative of the real world they must cope with. Harris is a champion of this point of view. He contends that to understand phytoplankton community structure, seasonal and longer patterns of speciation and production, and the dynamics of nutrient-phytoplankton interactions we must recognize that non-equilibrium conditions prevail at the species level. Large aquatic systems often may seem to be at steady state, but such a representation may be an artifact of the averaging processes built into our sampling and measuring techniques. In short, the scales upon which our observations of phytoplankton are made frequently are mismatched with those of the physical and chemical events that influence the ability of phytoplankton to exploit nutrient and energy sources and to grow.

To advance his argument, Harris follows a systematic course in first introducing the reader to some basic concepts of ecological theory, particularly in outlining the historical conflict between equilibrium and non-equilibrium proponents and in advocating the idea that phytoplankton make an ideal model for studying population ecology. Classical population ecologists may argue these points, but there is little doubt that the non-equilibrium concept has become the basis for most of contemporary research in phytoplankton ecology. Thus to the experienced researcher Harris's plea that non-equilibrium theory should be the cornerstone of phytoplankton ecology may seem like unnecessary proselytizing. To the student, however, the ideas advanced in this book will be timely food for thought.

The strength of the book is to be found in the middle chapters that deal with scale, specifically what the important physical, chemical, physiological, and growth scales are that affect phytoplankton growth rates, primary production, and species diversity. Much attention is given to the idea that, because patches of all kinds exist at many scales of interest, competitive exclusion of species in aquatic environments is rare. It also comes through clearly that Harris is a strong advocate of the concept that phytoplankton growth rates in oligotrophic waters are close to maximal and that there is a strong mismatch in the temporal scales of nutrient acquisition and growth in these environments. His treatment of the Redfield ratio as an indicator of the physiological state of phytoplankton populations is innovative and sure to generate additional discussion of this controversial topic.

Currently, there is much debate about the magnitude of primary production in the oligotrophic ocean. Measurements based on long-term accumulation of oxygen in the water column are not consistent with those based on the traditional bottle incubation technique. Harris, while avoiding involvement in the controversy, outlines in clear fashion the problems in relating biological, chemical, and physical scales in confined samples to those in the water column.

The book is well documented with pertinent figures and an abundant and up-to-date reference list. Harris's writing sometimes is a bit verbose, and important points are restated frequently. The last few chapters, dealing with population structure and species diversity on scales greater than generation times, suffer most from these problems.

Overall, Harris has succeeded in demonstrating the importance of scale in studying the dynamics of phytoplankton populations. This book should serve as a somber reminder that the major limitation to a better understanding of phytoplankton in nature is not what we can perceive but what we can measure.

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Bioenergetics Extended

The Vital Force. A Study of Bioenergetics. FRANKLIN M. HAROLD. Freeman, New York, 1986. xx, 577 pp., illus. $37.95.

One aim of this provocative book is to provide an up-to-date account for a wide audience of traditional topics in bioenergetics, such as oxidative and photosynthetic phosphorylations and other processes encompassed by usual treatments of chemiosmotic theory. The first two-thirds of the book are devoted to this purpose, in an authoritative, first-rate summary that draws on the microbial world to illustrate the diversity of successful applications of chemiosmotic principles. Harold is unmatched as an expositor in this arena and is just as good at outlining the underlying details of biochemistry and biophysics. I liked best the discussions of electron transport reactions (including Mitchell's Q cycle) and how they might be coupled to proton movements. To be sure, those who work in these areas do not always agree on the details, but Harold knows the field well enough to distinguish for us the debatable material from the rest. It is especially useful to have his broad perspective on these matters, since specialized reviews typically have too narrow a focus and general texts of biochemistry or physiology usually fail to look beyond their own disciplines. Even on its own, this is a valuable contribution.

The book has, however, a more substantial agenda. We are alerted to this early on by the comment that "bioenergetics has become too important, and too interesting, to be relegated to bioenergeticists," and the implied promise is fulfilled by the concluding 180 pages. At that point the boundaries of bioenergetics are suddenly extended, and to balance the earlier "bacterial paradigm" Harold now emphasizes molecules peculiarly eukaryotic (actin, myosin, tubulin, and so on) and activities normally associated with cell and developmental biology (cell motility, signal transduction, morphogenesis). I suspect his attempt to link bioenergetics and motility will be no more fruitful than past efforts to draw parallels between the performance of chemical and mechanical work. But the appropriation of signal transduction mechanisms (emphasizing Ca^{2+} transport) and morphogenesis (with an eye to Jaffe's circulating currents) now makes perfect sense—and exciting reading. Indeed, Harold gives us a new appreciation of the value of bioenergetics in interpreting more general aspects of membrane function. The book is exceptionally well written, and Harold's delightful array of biological examples adds unexpected charm to the entire work.

Harold has succeeded in writing a book suited to many readers, beginning with the interested undergraduate and extending to the professional. The book has serious lessons for any committed cell biologist.

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