overlooked by many environmentalists have been the fairly well financed research and monitoring programs at certain Atomic Energy Commission (now the Energy Research and Development Administration) installations. These programs have contributed substantially to the art of assessing environmental impacts and recovery and have collected data related directly to solving problems of "thermal pollution." The symposium on which this book is based therefore seemed to serve two purposes: It brought together many researchers, especially from the southeastern United States, mutually involved in research on thermal effects; and it introduced to a wider audience the research program in thermal ecology at the AEC's (ERDA's) Savannah River Plant.

The book consists of 55 extremely diverse papers on physiochemical phenomena, physiological ecology, thermal tolerance and adaptation, population ecology, behavioral ecology, community ecology, productivity, diversity, and models. Eighteen of the papers report research at the Savannah River site; 33 report work from the Southeast. Other regions are sparsely represented. Reports of field studies predominate (38), but there are 14 reports of laboratory work and three reviews. Fish rate the most attention (19 papers), followed by invertebrates (12), algae and microorganisms (ten), reptiles and amphibians (six), terrestrial and emergent vegetation (three), birds (two), and parasites (one).

What information is new? Certainly there is much about the Savannah River Plant that was not heretofore available. The papers provide notable breadth of coverage of the various biotic components in the lake-swamp ecosystem. Some of this information is relevant to questions about electric power station effluents, but some is not. Temperatures produced by plutonium production facilities have exceeded those produced by conventional power stations, so several studies are useful mostly for defining effects of extremes. Most authors concentrate on reporting progress from their own programs. There is no attempt to synthesize the diverse information from the Savannah River Plant to give the reader an overall perspective on that work.

What is new in other reports depends upon the reader's background. There are no great revelations, in my estimation, but a number of good, solid points are made. Some examples from the first few papers are: Gas bubble disease of fish—long hypothesized as a secondary effect of heating water—is shown to be caused by supersaturated gases in the water; behavioral thermoregulation by fish at a power station on Lake Michigan is shown to be affected by fish moving in and out of the heated water, not simply by fish selecting their preferred temperature; weight loss by centrarchid fish in a North Carolina cooling pond at temperatures above 36°C—another hypothesized result of extremely high temperatures—is shown to be related both to metabolic demands of the fish and to the fact that the available food supply is drastically altered by the change in temperature. A striking attempt at synthesis of the ecological and social values related to a thermal discharge is made by H. T. Odum in the last paper. His bizarre energy diagrams and caloric calculations for a large portion of Florida attempt to relate nuclear power and its thermal effluents to the overall energetics of society.

The book has no real summary statement. Where is research on thermal effects going? What should we be doing? Are we near to answering major questions about the temperature dependence of ecological structure and function? Whereas in the preface (p. vii) the editors claim to seek "a reevaluation of approaches, a coordination of efforts, and a general consolidation of current findings," the book achieves no such synthesis.

I cannot provide the missing cohesion in a short review, but certain observations can be made. First, the ecological information related to the siting, design, and operation of conventional electric power plants is not synonymous with thermal ecology. There is much about effects of temperature that simply is not relevant to power stations: hot springs, decimated swamps, and laboratory tests that obscure the basic time-dependence of thermal tolerances of organisms, to name but a few. Second, and conversely, there are many nonthermal impacts of power stations that are of equal or greater importance to the analysis of environmental impact. Some papers in the book conclude as much.

Third, there ought to be some discussion about the ability of small research projects or reports to contribute meaningfully to advancement of ecological perception—especially in the face of a potentially large and pervasive modification of the environment such as a power station cooling system. It is difficult to assemble a pile of cogs into a gear wheel, so to speak. Synthesis ought to be part of the original blueprint. The Savannah River Plant has a real opportunity to direct a broadly integrated research effort on Par Pond, which, despite certain atypical features (the very hot canals leading to it and the exotic species, such as alligators, that live in it), could be an experimental model for a valuable closed-cycle cooling system managed for both its heat dissipation qualities and recreational fishing.

Finally, research approaches should be chosen with objectives in mind. I believe society would like ecologists to concentrate on the effort to provide the nation with reasonably inexpensive electrical energy with the least possible disruption of natural environments. This volume will be of interest to everyone who is involved in that effort.

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Geology and Oil

Petroleum and Global Tectonics. Papers from a meeting, Princeton, N.J., Mar. 1972. ALFRED G. FISCHER and SHELDON JUDSON, Eds. Princeton University Press, Princeton, N.J., 1975. xii, 324 pp., illus. Cloth, $16.50; paper, $8.95.

The papers in this volume were first presented at a conference held (in honor of H. D. Hedberg) in 1972. Hence, a number of the most current facets of the topic are not treated. In fact, the conference dates back to the time when the first full rush of new insights from plate tectonics had just struck the practice of petroleum geology. The strength of the published volume consequently lies in the breadth of the view taken by the dozen or so knowledgeable and thoughtful geologists who contributed to it. Each was evidently confronted with the task of preparing an initial summary of the impact of the new global tectonic theory on some particular aspect of geologic thinking related to petroleum accumulation. Under the circumstances, no one could offer fully integrated syntheses of the matters at hand, and the reader thus receives selected stimulation rather than full satisfaction from the collection of articles.

It seems clear that plate tectonic theory exerts three main types of leverage on plans for petroleum exploration: a fresh view of the causes and patterns of basin subsidence that allow the accumulation of sediment in which oil and gas deposits can be lodged; a fresh view of the reasons for and variations in the geothermal gradients that largely control the generation of hydrocarbons from initial organic precursors; and a fresh view of the tectonic deformation that underlies the conditions, favorable or unfavorable, for the subsurface migration and entrapment of fluid hydrocarbons.

Of these three factors, the first two embody the most straightforward corollaries of plate tectonics, and they are addressed in some detail by several authors. With re-

gard to basin subsidence, W. J. Morgan contributes a general discussion of vertical movements of crust in response to the generation of hot lithosphere and its subsequent cooling, A. G. Fischer examines both the isostatic consequences of changes in crustal thickness and some of the ways in which dynamic plate interactions can counteract or override tendencies for static balance from crustal isostasy alone, and D. J. J. Kinsman makes a provocative analysis of the joint effects of thermal tumescence and decay combined with effects of crustal thinning and rupture during the evolution of rifted continental margins along so-called trailing edges. The variable relationships of oil formation to different tectonic settings with different characteristic geothermal environments are explored tentatively in separate papers by J. G. Erdman and H. D. Klemme.

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Theoretical General Relativity

Homogeneous Relativistic Cosmologies. MICHAEL P. RYAN, JR., and LAWRENCE C. SHEPLEY. Princeton University Press, Princeton, N.J., 1975. xvi, 322 pp., illus. Cloth, $15; paper, $7.50. Princeton Series in Physics.

During the last five years it has become increasingly evident to theoretical workers in the field of "homogeneous relativistic cosmologies" that the time is ripe for the appearance of a monograph to review and consolidate the enormous recent progress in this area and to pave the way for future research. With this in mind, and knowing the authors, I approached this book with optimism. I came away disappointed. This book is not the monograph we need.

Nevertheless, since someone must make the first attempt, the authors are to be congratulated for their valiant, if not wholly successful, efforts. The author of the still-awaited monograph may well benefit from this book by emulating its good points and avoiding its pitfalls. In the meantime, moreover, this work of Ryan and Shepley is the only one we have, and it may, with reservation, be recommended to graduate students of theoretical general relativity.

Where did the authors go wrong? Since the book is a potpourri of good and bad items, let us begin by advertising its more desirable aspects.

In keeping with the other books in the Princeton Series in Physics, this book is reasonably well produced for the price. Graduate students can profit from the clear—almost intuitive—mathematical discussions of gravitational singularities and the singularity theorems in chapters 4, 5, and 8 through 10; and it is useful to have a straightforward treatment of differential forms and isometry groups (especially chapters 2 and 6) in the same book. Finally, there is a bibliography of nearly 500 important references (covering the years 1892 through 1973) on mathematical cosmology.

The debit side of the ledger is more extensive. Nowhere in the book are we really told what it intends to do, its purpose, or its reason for existence. We *are* informed in the preface that the first half of the book has something to do with "the singularity theorems of 1965–68" and that the second half addresses itself to "specific cosmological problems" and "the application of Hamiltonian techniques." In essence, the book consists of 15 rather arbitrary "chapters" tenuously held together by a single gossamer thread, the (disparate) research interests of the two authors. The result is a confusing juxtaposition of previous works and papers, and not a coherent book.

The flow charts that outline the chapters are a symptom of this malaise. In a good book they would be redundant; here they are far too necessary.

Many times while reading the book I found myself asking, "Why is this part here?" The introductory chapter is weak. Differential geometry and forms (chapter 2) were better handled in Shepley's thesis (1965), and this material, together with that of chapters 3 and 4, has been quite adequately covered in the textbook by Misner, Thorne, and Wheeler (*Gravitation*, Freeman, 1973). The discussion of the singularity theorems in chapters 5, 7, 8, and 10 suffers tremendously by comparison with the lucid and elegant presentation of Hawking and Ellis (*The Large Scale Structure of Space-Time*, Cambridge University Press, 1973). To understand the physical aspects of cosmology, treated in chapters 1, 4, 14, and 15, one is strongly advised to read Peebles's excellent book (*Physical Cosmology*, Princeton University Press, 1971) instead. And the essence of what this book has to say about spatially homogeneous cosmologies and the Hamiltonian method has already appeared in a delightful earlier monograph by Ryan (*Hamiltonian Cosmology*, Springer-Verlag, 1972).

Finally, it would be good to air a number of minor irritations here. There is an excessive "cuteness" to the large number of literary quotations in the book; at the least they should have been accompanied by English translations so that their wit would be more apparent to the reader who does not know Greek, Russian, Latin, and French. The possibility that our universe is "open"—as indicated by much recent observational evidence—is virtually ignored in the book. Another error, which is essentially perpetuated on p. 219, is to continue to believe that "classical matter" has any bearing upon quantum cosmology when we know that matter must be treated quantum mechanically in that regime. The most blatant error of fact appears on p. 265, where a matter density of "about one gram/cm^3" when the universe is at the decoupling epoch ($T \sim 3000$°K) is quoted; the actual value is closer to 10^{-20}. Another irritant (p. 42) is the use of the "Russian school" notation, $w = \rho(1+\epsilon)$ and p, in discussing perfect-fluid matter, when the more widespread convention is to use ρ (in place of w) and p.

The Problems section of the book is a random agglomeration in which some of the exercises are trivial and others are virtually impossible. I see no point to the two short paragraphs on "relativistic astrology and religion" (p. 268), and the final section of the book, which attempts to delineate the observational and theoretical studies that will be most useful in the near future, is vague, ill-considered, and trite.

I trust the consumer is properly warned.

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Books Received

The Adolescent as Individual. Issues and Insight. Carol J. Guardo, Ed. Harper and Row, New York, 1975. xiv, 322 pp. Paper, $6.95.

Aging Gametes. Their Biology and Pathology. Proceedings of a symposium, Seattle, June 1973. R. J. Blandau, Ed. Karger, Basel, 1975. xii, 416 pp., illus. $54.75.

The Alaska Pipeline. The Politics of Oil and Native Land Claims. Mary Clay Berry. Indiana University Press, Bloomington, 1975. x, 302 pp. + plates. $10.95.

American Self-Dosage Medicines. An Historical Perspective. James Harvey Young. Coronado Press, Lawrence, Kans., 1974. xvi, 76 pp. $5. Logan Clendening Lectures on the History and Philosophy of Medicine (New Series), No. 1.

Les Algues. Morphologie, Cytologie, Reproduction, Ecologie. P. Gayral. Doin, Paris, 1975. 166 pp., illus. Paper, 120 F.

Annual Review of Pharmacology. Vol. 15. Henry W. Elliott, Robert George, and Ronald Okun, Eds. Annual Reviews, Palo Alto, Calif., 1975. x, 518 pp., illus. $15.

Attention and Performance V. Papers from a symposium. P. M. A. Rabbitt and S. Dornic, Eds. Academic Press, New York, 1975. xviii, 744 pp., illus. $42.25.

A Beachcomber's Botany. Loren C. Petry. Illustrated by Marcia G. Norman. Chatham, Old Greenwich, Conn., 1975. 158 pp. $6.95. Reprint of the 1968 edition.

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