mals, and workers in comparative physiology will find authoritative chapters on the various organ systems. The life history involves planktonic larvae, with a relatively short planktonic stage (a few weeks) in clawed lobsters, but a long, complex planktonic larval development (3 to 22 months) in spiny lobsters. Clawed lobsters tend to live in solitary shelters that they defend against all comers, but spiny lobsters occupy communal shelters. Clawed lobsters may migrate offshore and inshore on a seasonal basis, but certain spiny lobsters make spectacular migrations, the best-known being the appearance of as many as 100,000 in the waters west of Bimini, moving in a southerly direction, single file, day and night.

Yet, with all this information available there is an unfortunate lack of the data needed for good management. Lobsters, unlike finfish, leave no record in their skeletons by which age and growth rate can be calculated. The young stages often inhabit burrows on rocky ground and hence are extremely difficult to sample quantitatively, so that prediction of recruitment to the fishable stock is almost impossible. Managers do the best they can with analyses of catch data, and R. L. Dow of the State of Maine Department of Marine Resources concludes that major fluctuations in natural abundance are associated with fluctuations in sea temperature during climatic cycles. However, attempts to get fishing effort regulated to match the expected changes in stock have met with little success. Dow concludes, "Fishermen are suspicious of change and are unwilling or unable to understand why the resource, in terms of scientific management, should be given first consideration rather than the industry or the public."

Meanwhile, a hypothesis with which the present reviewer is associated is given scant attention in the volume. It focuses on the role of lobsters as key predators in their ecosystem, controlling the population densities of herbivores, notably sea urchins. When American lobster populations are drastically reduced sea urchin populations explode and overgraze the subtidal seaweeds that are both the primary producers in the food chain and the habitat in which young lobsters hide from their predators. Destruction of seaweed beds has been accompanied by a drastic decline in lobster landings on the Atlantic coast of Nova Scotia, and the same type of phenomenon has been observed in parts of Maine. There is abundant evidence from many ecological systems that predators play a major role in determining the balance between plants and herbivores, from which we may infer that gross interference with a predator stock density will have far-reaching effects.

These two volumes set out with admirable clarity the basic life history, physiology, and behavior of lobsters, catalogue numerous ecological observations on the various species, and describe the important attributes of the fisheries. After the conclusion that fisheries on the main clawed lobster stocks appear to be in biological and economic trouble, the editors offer us an account by Van Olst, Carlberg, and Hughes of attempts at lobster aquaculture, which is difficult mainly because spiny lobsters have such prolonged larval development and clawed lobsters are aggressive cannibals. What I found lacking in any of the chapters is a broad ecological perspective on the problem. How reasonable is it for humans to remove 50 to 90 percent of the lobsters in the year they become big enough to be legally caught and expect the ecosystem that supports that predator to retain its structure and function decade after decade? In a situation where numerous fishermen are exploiting a common resource, ecologically sound management strategies must be found or the exploitation of lobsters will become just one more chapter in the tragedy of the commons. These volumes are admirable source books for a description of the nature of the problem, but a radical discussion of solutions must await some future work.

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Energy in the Earth's Crust

Geothermal Systems. Principles and Case Histories. L. TYBACH and L. J. P. MUFFLER, Eds. Wiley-Interscience, New York, 1981. xiv, 360 pp., illus. $61.95.

Although geothermal energy utilization is not new, it has increased dramatically in the last 15 years. Because the form and temperature of geothermal resources can vary, the exploration and exploitation of geothermal energy have always been semi-experimental. Highly refined and conventional techniques have not yet been fully developed. Therefore, there is a need for understanding the principles that govern the occurrence and dynamics of geothermal systems.

This book is divided into two sections, Principles and Case Histories. The principles section is heavily weighted toward heat and mass transfer and heat extraction, as probably should be the case. However, the chapters on these subjects (three out of the seven in the section) are written at a much higher technical level than the remainder of the book, although they are not beyond the probable reader. The group of chapters on heat flow starts with the basic equations of heat and mass transfer and works its way through to more specific models and examples from different geothermal regions. A chapter by I. Donaldson and M. A. Grant on heat extraction from geothermal reservoirs is particularly enlightening. The chapter is written with consideration for those not intimately involved with fluid dynamics but still encompasses all the basic aspects of the different types of geothermal systems.

Also of note is a chapter by R. Fournier on the geochemistry of geothermal systems. Again the chapter is written for a varied audience yet is comprehensive enough to be of use to those having a need to understand the water geochemistry of geothermal systems. It covers all the well-used geothermometers and mixing model schemes, for both geothermal exploration and reservoir engineering.

A chapter on prospecting for geothermal resources is a slight disappointment. Many different methods are covered, but only in a descriptive fashion. Little attention is given to the physics of the techniques. It is true that it would be an enormous undertaking to review all prospecting methods and how they apply to geothermal exploration, but at least some elucidation of why a particular method is useful would be of benefit. The chapter's saving grace is that numerous references are given.

The section concludes with two short chapters, one on geothermal assessment and the other on environmental aspects. These chapters are brief but comprehensive. It is refreshing that the economic aspects of geothermal energy are ignored.

The case history section of the book stands in contrast with the principles section. After reading the principles section, one is left with hopes of seeing how these techniques are applied in the real world. In most of the case histories, few data are presented and most discussions are at a descriptive level. An exception is the case study of the Krafla field in Iceland. It is fairly complete in its presentation and analyses of the geothermal systems. The other case histories cover a low-temperature area (Hungary), two high-temperature liquid-dominated sys-

tems (the Ahuachapán, El Salvador, and Takinoue, Japan, regions), and the geothermal system of the Jemez Mountains in New Mexico. It is disappointing that such areas as the Geysers, Lardarello (Italy), or one of the New Zealand fields could not have been included. One does not really see from these case histories how the principles developed in the first section can be applied.

In general, the book is well written and the subject is clearly presented. The material is somewhat out of date, but this is probably due to publishing delays. I would recommend the book as a good overview of the behavior and varied nature of geothermal systems.

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Mutation Processes

DNA Repair and Mutagenesis in Eukaryotes. Proceedings of a symposium, Atlanta, June 1979. W. M. GENEROSO, M. D. SHELBY, and F. J. DE SERRES, Eds. Plenum, New York, 1980. xii, 458 pp., illus. $49.50. Basic Life Sciences, vol. 15.

This volume of symposium proceedings attempts to bring to bear on eukaryotes an understanding of the molecular basis of mutagenesis such as has been developed in studies of prokaryotes.

After three review papers, beginning with a summary by Kimball of the concepts of mutagenesis in bacteria, that are intended to set the scene, there are five groups of papers, each ending with a short "summary and perspective" paper.

The fungi are represented by *Neurospora crassa* (three papers) and *Saccharomyces cerevisiae* (four papers). The profitable idea of using the "mutagen-sensitive repair-deficient mutant" as a research tool has been applied extensively in these two lower eukaryotes, in particular the yeast. The paper by Lemontt is an especially useful summary of the impressive progress already made. To date some 70 mutagen-sensitive loci have been identified in yeast.

A phylogenetic quantum jump is then made to *Drosophila* (four papers). The emphasis is again on the use of repair-deficient mutants. In the case of *Drosophila*, however, ultraviolet-sensitive mutants have yet to be isolated, though mutants defective in excision repair of pyrimidine dimers induced by ultraviolet can be found in both bacteria and humans. Culture of somatic cells is now feasible with *Drosophila* and, coupled with the extensive knowledge of the cytogenetics of this organism, should make it possible to achieve a precise analysis of the genetics and biochemistry of mutation.

The most extensive section of the book is devoted to studies of mammalian somatic cells (eight papers) and deals with such diverse matters as chromosome aberrations, the biochemistry of DNA repair, and somatic cell mutations. Again the main message is the utility of repair-deficient mutants.

A penultimate section deals with studies of mouse germ cells (three papers). The importance of repair processes is stressed again, but of course no repair-deficient mouse stocks are available.

Although it is suggested on the dust cover that the volume contains an evaluation of the risk to human health posed by various physical and chemical agents, this is not to be found in it. Apart from the summary and perspective paper the final section, which is concerned with this subject, contains only one paper, by German. In the summary and perspective paper Langley refers to contributions by Paterson and by Swift that are not included. I can only assume that both authors felt that yet another rewrite of their albeit very interesting work was uncalled for.

This point draws attention to a question that confronts contributors to a symposium, particularly when they are working with material or systems where progress is slow—how often does a particular study merit reporting? In this book, to choose examples from the areas with which I am most familiar, the paper by German has inevitable similarities to a paper he presented at the sixth International Congress of Radiation Research in May 1979, and Sasaki and Trosko use data from their earlier papers.

Nevertheless, though I see nothing new in the papers where familiarity breeds contempt, the material is well presented and some, at least, of the discussion (notably that by Bender) controversial. In those areas where I have less experience the papers appear more interesting. If I apply the criteria of excellence that fit the former papers to the latter then I am bound to commend this volume as a useful and worthwhile summary to help those mere mortals who cannot know everything.

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