lished by the National Academy of Sciences, or to other recent committee reports. Now a commercial publisher has produced a broad treatment of the problem. The book is a compendium, edited by an able marine chemist and containing 26 chapters written by some 30 marine specialists. The introduction states, "This book is not intended to be a comprehensive document on the subject of man's effect on the oceans; it is directed, rather, at arousing serious thought on the subject." However, it is difficult to focus the thoughts of such a multitude of authors, and one cannot escape the impression that the publishers saw this substantial and relatively expensive volume more as a technical reference than as an opinion-molding monograph.

The two major sections, on transport processes and reservoirs and on "artifacts" of man, constitute about 60 percent of the book and contain most of the papers of lasting value. The former includes an important and illuminating review of horizontal and vertical mixing processes in the ocean (Okubo) and useful discussions of river inputs (Turekian) and atmospheric transport (Goldberg). The latter section has nine chapters on major classes of pollutants. Particularly noteworthy are those on lead (Patterson), carbon dioxide (Broecker, Li, and Peng), radioactivity (Rice and Wolfe) and heavy metals (Merlini). The paper on chlorinated hydrocarbons is an interesting mix of fact and opinion; a large paper on the petroleum problem makes good reading but is pretty short on solid information; articles on domestic wastes and on the biological effects of petroleum are disappointingly thin.

There are brief sections on chemical and other models and a section on man's alteration of the coastal environment, the only concession to "impingement" other than pollution. The discussions of coastal engineering, living resources, and marine environment are not substantial, and there is no mention of the effects of major engineering projects such as the Aswan Dam or sea-level canals. The final section, on implications of man's activities in ocean resource development, contains papers on regulation of pollution from offshore oil pollution and on public policy on the ocean, both of which seem out of place in a publication of such permanent nature. The final paper, on uses of the oceans (Hood and McRoy), would have made a good introduction to the book.

Better coverage of the subject might have been achieved if topics had been combined into fewer and more systematically integrated chapters. There is much of value in this book, but it is a less effective weapon against misinformation and propaganda than is wanted.

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Differentiation

Developmental Genetics. CLEMENT L. MARKERT and HEINRICH URSPRUNG. Prentice-Hall, Englewood Cliffs, N.J., 1971. x, 215 pp., illus. Cloth, $6.95; paper, $3.50. Foundations of Developmental Biology Series.

It has been clear since the turn of the century that the central paradox of development—the problem of differentiation—was best stated in genetic terms. Now there is a new language, the language of molecular biology, and a vast new array of powerful laboratory tools. Markert and Ursprung set out to present in modern terms what is known about the various means by which differential gene action occurs, and how differential gene expression is translated into the drama of epigenesis. They tackle head on, in clear prose and well-chosen examples, the issue: why and how are different genes expressed in different places at different times? The new molecular vocabulary now available allows them to state questions with precision in terms of the control of transcriptional, translational, and post-translational mechanisms.

Only one chapter and parts of a few others deal extensively with the materials that would have been found in a book on the same topic 15 years ago—pleiotropy, phenocopies, regeneration, lethal mutants, maternal effects, and interspecific hybrids. Most of the book is devoted to such topics as the evidence for differential transcription and its mechanisms, the control of protein synthesis, the stability of proteins and messenger RNA molecules, the assembly of enzyme subunits, and chromosome structure. Many will wish some other examples had been included, or that some included had been enlarged upon. For instance, cyclic AMP is not mentioned in connection with hormone action, nor is the concept of prepattern introduced (although pattern is), nor is the danger of the use and interpretation of experiments employing actinomycin underlined. One inadequacy is the very short and sometimes cryptic figure legends, especially in the early part of the book. There are well selected, but somewhat short, reference lists at the end of each chapter. The book covers wide ground, its omissions are relatively minor, and on the whole the examples and issues are remarkable for their thoughtful choice and presentation.

The book is aimed at "initiated" undergraduates and beginning graduate students. The explanations are so clear I imagine that undergraduates with only a semester or two of introductory biology could understand and profit from it.

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Experimental Gerontology

Principles of Mammalian Aging. ROBERT R. KOHN. Prentice-Hall, Englewood Cliffs, N.J., 1971. xiv, 172 pp., illus. Cloth, $7.95; paper, $4.95. Foundations of Developmental Biology Series.

Two central problems facing experimental gerontologists are the diverse nature of the field and the distinguishing of causes from effects. The first difficulty, as well as the apparent lack of conceptual framework, discourages many capable investigators from selecting this research area at an early stage in their careers. *Principles of Mammalian Aging*, organized primarily for such individuals, outlines ample representative studies on topics ranging from the aging of isolated macromolecules to aging and mortality in the intact organism. Pretense of encyclopedic coverage is avoided and interested readers, acquainted with essentials through this exposure, are referred to reviews and the more detailed works of Comfort and Strehler.

On the more problematical questions concerning proposed mechanisms and distinction between cause and effect relationships the author frequently is at variance with a sizable segment of the scientific community involved in this research area. In essence he argues that there is no substantial evidence to support theories suggesting that intrinsic cellular alterations lead to aging in the whole animal. Instead he believes that cross-linking theories, especially applied to collagen and other extracellular pro-

teins, are "best able to explain aging . . . and . . . should receive the highest priority for future investigations." This controversial viewpoint is defended on the grounds that collagen represents 25 to 30 percent of total body protein and has an exceedingly low turnover rate. Progressive cross-linking might inhibit tissue flexibility and capillary-to-tissue cell mobility. Furthermore, cross-linking could satisfy a proposed requirement, often mentioned in this volume, that a true aging process affecting the intact mammal must begin or accelerate after maturity.

This latter proposition is also used to discriminate against the notion that intrinsic cellular aging processes exist. Studies indicating decreased rates of protein synthesis or decline in rates of DNA synthesis and cell proliferation and studies measuring rates of cell loss with animal age are judged to be of less gerontological significance because the major changes occur during growth and prior to maturation. One could challenge this central argument, however, since there is as yet no reason to exclude the possibility that age-associated functional decline may result from a continuation of the progressive drop in rates of protein synthesis and cell proliferation observed between birth and maturity. This general hypothesis dates back to the work of Minot in 1908, and its acceptance underlies many of the studies Kohn cites. His argument that there is no substantial supportive evidence is rendered less effective when one considers that the same objection might be directed against cross-linking theories. Thus, for example, although cross-linking of collagen molecules is well established, evidence that this impairs permeability and function is equivocal or contradictory.

Several other hypotheses and model systems are also judged to be of lesser significance, at least with regard to aging of the whole animal. For example, the limited survival of human diploid cells in culture, proposed as a model for studies on intrinsic cellular aging, is considered to be more relevant to questions of growth cessation and neoplasia. This conviction apparently is based on the fact that intermitotic cell types in vivo exhibit declining growth rates mainly in correlation with animal growth. Much less change is observed following maturity. Furthermore, at the time of publication no relationship between potential survival of cells in vitro and age of adult donor had been established. The former point, however, need not be considered an effective argument against the model for reasons outlined in the paragraph above. Concerning the latter point, the recent works of Goldstein and of Martin have shown a definite relationship between postnatal donor age and survival of human fibroblasts in culture. Kohn regards as improbable hypotheses that implicate somatic mutations, the immune system, or cell damage due to free radicals as major factors effecting aging in the animal. This conclusion is also based, at least in part, on arguments against involvement of inherent cellular change in the aging syndrome.

Both novices and more experienced investigators in the field of gerontology may gain perspective through examination of this volume. The controversial issues discussed and the stand taken by its author should stimulate both thought and experimentation.

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Drug Action

Essentials of Molecular Pharmacology. Background for Drug Design. ANDREJUS KOROLKOVAS. Wiley-Interscience, New York, 1970. xviii, 340 pp., illus. $16.50.

The major purpose of this monograph is to illustrate fundamental principles of drug actions at the molecular level, as far as they can be explained in terms of modern chemistry and biochemistry. To this end, the first half of the text develops logically from consideration of the physicochemical properties of small molecules, through the pharmacological effects of specific moieties, to an analysis of drug-receptor interactions. This development is handled with reasonable balance between chemistry and its relationship to drug action by the use of frequent and, on the whole, clear examples.

By way of illustration, the steric, electronic, and obstructive effects of halogenation are documented effectively by reference to changes in the pharmacological activity of many drugs including steroids, thyroid hormones, antimetabolites, and central nervous system depressants. Similarly, stereochemical considerations are presented with clarity and relative simplicity. I admire, particularly, the facility of the author in summarizing results obtained by sundry advanced chemical and physical techniques to illustrate the relationship between electronic distribution and configuration and also the concept of preferred conformation in terms of neurotransmitter agents. Drug-receptor interactions are introduced from the standpoint of the types of bonding possible between small drug molecules and macromolecules. Since numerous examples are given, I was a little surprised to find no mention of the interaction between inert-gas anesthetics and myoglobin or hemoglobin, perhaps the best-documented example of a drug-macromolecule interaction based on Van der Waals forces.

If this section of the text has a limitation it resides in a tendency to "show you the cookies but to take the plate away before you can accept one." For example, although the author acknowledges the usefulness of mathematical derivations based on polarizability (Hansch) and molar attraction constants (Ostrenga), these models are treated cursorily and exceptions are not discussed.

The second half of the monograph includes a lengthy discussion of receptor topography and more succinct appraisals of theories and mechanisms of drug action. The first topic is handled well, and quite recent interpretations of the nature of receptors for drugs from analgetics to steroids are covered. A brief and useful review of membrane excitability and autonomic pharmacology precedes discussion of cholinergic and adrenergic receptors.

In this reasonably short monograph, chemistry is favored over biology, but this is not a serious limitation since descriptive pharmacological information is readily available in other texts. There is little mention of the attempted isolation and characterization of receptors, presumably because the first real success in this area has occurred so recently. The book is well illustrated and referenced and is easy to read if one is not "chemophobic." It is quite different from previous monographs on molecular pharmacology, which, in my opinion, either have been simplistic or have suffered from an inordinate preoccupation with receptor theory. It is recommended to anyone with an interest in the *precise* nature of drug action.

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