sary in order to produce an enzyme that (i) has a higher specific activity for xylitol and (ii) has enough activity to allow strains carrying it to outcompete the wild-type strain. These experiments are an illustration of the difficulties in the way of tailoring enzymes to order by harnessing selection. While mutants are easily produced, the small refinements that result in an efficient enzyme are likely to be selected for very slowly, especially if the refinements give a very slight advantage. To give an example calculated from the formulas of Kubitschek: in a chemostat with a total population of 10^{10} cells in which 25 percent of the medium is replaced each hour, it will take a mutant with a 10 percent growth advantage almost 40 days to reach the point where it makes up half the population (the changeover time). A mutant with only a 1 percent advantage, which is in the range often dealt with by population geneticists, will take well over a year.

This informative symposium is disappointing primarily in not having more on the manipulation of the microbial genotype by the remarkably precise bacterial restriction enzymes and other tools of the molecular biologist. These allow one virtually to stitch and sew a chromosome to order. In view of the recent concern on the part of many molecular biologists about the consequences of such manipulations, such a discussion would have been timely and suitable.

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Natural History of Islands

Island Biology. SHERWIN CARLQUIST. Illustrated by Sherwin Carlquist and Michael J. Cole. Columbia University Press, New York, 1974. xii, 660 pp. $25.

Remote islands fascinate us, whether we are romanticists or scientists or some combination of the two. Indeed, the peculiarities of terrestrial island life pose many puzzling problems for the biogeographer, the ecologist, the systematist, and the evolutionist. In particular, biological conditions on remote oceanic archipelagoes like Hawaii deviate sharply from most of those on the continents.

A founding propagule must somehow make its way across vast ocean distances; accordingly, chance strongly affects both arrival and establishment. The latter process, furthermore, requires genetic integration of the newcomer into a unique and often discordant ecosystem. Response to this new situation may take the form of an extraordinary multiplication of species and the evolution of adaptations that are new for the group. *Island Biology* deals with all these topics in a great variety of plants and animals on islands around the world.

Sherwin Carlquist is the author of two other books on the upland biology of islands, *Island Life* and *Hawaii: A Natural History* (Natural History Press, 1965 and 1970). Accordingly, some burden rests on the reviewer to relate the present book to these others. All three books center on the same phenomena. The first two are successful popularizations, with little documentation in the text. In *Hawaii*, the author produced a lavishly illustrated guide to the islands he knows best. The general principles advanced in *Island Life* are skillfully invested with Hawaiian examples.

The newest book is the most ambitious; it attempts to be a technical treatise of encyclopedic breadth. There is no accompanying major change from the other books in concept or content. Again, the author deals with plants, animals, anatomy, systematics, ecology, genetics, geography, and adaptations. Beyond all this, most of the islands of the world are at least mentioned, and he deals with islandlike areas on the Australian, African, and South American continents as well. The result this time around leaves something to be desired. The earlier books succeeded because of the need for communication of these scattered facts and concepts to a large audience, but the breadth of the material is so great that the author's attempts to deal with it in documented technical detail are only partly successful.

The book tries to do many difficult things. For example, 24 "principles" of island biology are announced in the first chapter. This is a bold attempt at integration of widely dispersed and somewhat disparate knowledge. The statements are challenging, provocative and in many cases speculative. Discussion of each principle is brief, however, and one is left with the feeling of unsatisfactory coverage of both the origins of the ideas and their present status.

Considerable attention is given to the important topic of long-distance dispersal of organisms. Here the author comes closest to a satisfactory treatment in depth. These chapters are elaborations of a series of five previously published technical papers. The author guides us through this material with a sure hand, but I was annoyed by some detailed repetitions of material. For example, eight of the photographs in *Island Biology* were also used both in *Hawaii* and in a technical article in the *Bulletin* of the Torrey Botanical Club, 1967. Indeed, the chapters tend to be almost separate articles, and repetition plagues the reader in other ways. Each chapter has its own reference list and many references are repeated within the book. *Island Life*, for example, is cited in 13 out of 15 of these lists.

The bulk of the book is given over to a description of "adaptive radiation" in various insular biotas. In these chapters, the author simply describes adaptive differences between related species within islands or island groups. He emphasizes his favorite material, the higher plants. Much of this discussion is little more than clever guesswork, the fascinating game that all observant naturalists play. Carlquist is very good at this game, but the reader longs for hard evidence among the hypotheses. The author is surely aware of this and indeed points out how little is known about insular biotas beyond the floristic and faunistic level. Perhaps it will be an important function of this book to stimulate interest in obtaining the evidence that is so badly needed.

Neither modern ecological theory nor genetical patterns of evolution are given much place in this book. The author frequently refers to the classical work of MacArthur and Wilson, but the discussions do not go very far. He falls into the old trap of wondering if something is due to drift or to selection. Of course it is the interaction of these processes that is important. He declares that "weedy immigrants would be expected to have the advantage of high mutability." There are no data which suggest that such variations in mutability occur. Vague phrases are often used, such as "evolutionarily upgrade" and "genetic momentum."

In his preface, the author suggests that he does not have to apologize for presenting materials that could be called "natural history." I heartily agree. While the book falls short of being a definitive treatise, large amounts of widely dispersed and valuable materials are compiled in it and future litera-

ture searches into the depths of the subject are thereby made easier. The fascinating questions outlined in this book will someday be answered at a more sophisticated level of integration. No one who attempts to do this can afford to ignore this bold and significant first step at synthesis.

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Nerve Tissue Culture

Tissue Culture of the Nervous System. GORDON SATO, Ed. Plenum, New York, 1974. xiv, 288 pp., illus. $19.50. Current Topics in Neurobiology, vol. 1.

"The impetus for compiling this book," writes the editor, "was the recent development of culture strains of neuroblastoma and glial cells and the immediate and enthusiastic way they have been taken up as model systems." This is a fair indication of its contents. The book consists of 11 chapters contributed mainly by recent recruits to the venerable field of nerve tissue culture who, in the '70's and late '60's, have been exploring the theoretical possibilities offered by cultures of dissociated cells, to which they have applied a variety of quantitative interdisciplinary techniques. Little attention is given in this compendium to other methods and fields of inquiry with which "tissue culture of the nervous system" has heretofore been identified, except for an informative chapter by Levi-Montalcini on her recent work with insect nervous and neuroendocrine systems. The book does not, moreover, include more than passing mention of the considerable current work by other investigators making use of cloned or dissociated nervous tissue in culture.

Tissue culture, like other experimental approaches, has its advantages and limitations. Paramount among the advantages is that it enables the experimenter to isolate a living microcosm from the organism as a whole and maintain it in generally normal form and function for considerable periods while observing its behavior directly at the cellular level. With primary explants, especially organotypic cultures, possibilities for quantitation are limited, the more so since the normal nerve cell cannot be propagated once it has developed beyond its early (neuroblast) stage. Concomitantly, mature glial cells divide sluggishly, if at all. Furthermore, in situ, differentiated neurons appear in a great variety of forms whose functions differ, and they exist in intricate relationships with glial cells and with each other that hamper attempts to deal separately with single factors.

On the chance of unraveling this tangled skein, the dedicated experimentalist will grasp at whatever appears to be a dangling thread. The availability of a transplantable mouse neuroblastoma (Jackson C1300) that can undergo even a limited degree of differentiation in culture and is not contaminated with supporting cells sparked this current onslaught. These neoplastic neurons were cloned in 1969 by Augusti-Tocco and Sato, who adapted methods introduced earlier by Sanford and by Puck for somatic cells. Clonal lines of neoplastic glial cells (for example, the C6 astrocytoma, which is here shown to elaborate the specific S-100 protein) were already available and under study in 1968. In its brief history this type of material has been extensively and intensively examined by these authors along biochemical and physiological lines; in addition, clonal lines of muscle cells have been presented to the neuroblastoma cells for their interaction. A neurotrophic effect is indicated, though synapses are not engendered. Genetic analysis of clonal lines has been attempted, in which hybridization has been performed between L-cells and C1300 cells. A substantial degree of aneuploidy and karyotypic instability is shown even by the cloned descendants of single neuroblastoma cells, a finding that is in keeping with the results of earlier exhaustive studies by others on HeLa and other neoplastic cell lines. Even though Sato has an enviable history of success in producing "minimally deviating" somatic cell lines, the hoped-for analysis of development has not materialized in these strains. There are indications here, especially in chapters by Seeds, Rosenberg, and Nelson, of a retreat from the cell lines to prepared positions involving primary cultures from normal brain. In these cultures the whole range of cell forms is present, and reaggregation takes place.

The data gathered together in this tour de force, though somewhat repetitiously presented, are interesting in themselves, as is the ingenuity that has gone into designing the experiments that permit a rigorous application of interdisciplinary methods to cultured nervous tissues. The ultimate value of this work in illuminating present concepts of nervous system function is still open to question because of the stubborn aberrancy, or inadequacy, of the biological material. Perhaps ways may be found to overcome this. In any case, it is evident that these research workers have been having a lot of fun, which their readers may share.

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Excited States

Organic Molecular Photophysics. Vol. 1. JOHN B. BIRKS, Ed. Wiley-Interscience, New York, 1973. xviii, 600 pp. illus. $37.50. Wiley Monographs in Chemical Physics.

The subjects covered in this volume include some of the most exciting and significant fields of current investigation in photophysics and photophysical chemistry. These include both theoretical and experimental studies of the nature of electronic excitation and of the decay of electronic excited states and some related topics concerned with the chemical and physical properties of excited states. The volume to some extent updates Birks's *Photophysics of Aromatic Molecules*, and in any event it fills a definite gap in the literature in this rapidly expanding field. The balance between theory and experiment is nicely maintained within chapters as well as in the book as a whole. The subjects treated include absorption and emission spectroscopy of organic compounds, radiationless transitions, lasers, excimers, diffusion-controlled rate processes, and exciton interaction in solids. The authors have generally achieved a high scientific as well as stylistic level in their contributions. The literature of each subject has been critically examined, and many tables and figures from the original papers are included in the book. Most chapters include citations of 1972 papers, which is as up to date as seems possible these days.

The book is aimed primarily at scientists with an active interest in photophysics, whether they are theoreticians or experimentalists, and a good background in spectroscopy and photochemistry is assumed. Such scientists will probably want to have this book in their personal libraries and will undoubtedly return to it again and again. Photochemists with a physical bent will be interested in much of the