examples of control fit the more general and heuristic idea that control is directed at restoring the independence of media.

The stimulation produced by Barker's theorizing is matched by that of his data and procedures. The data about Midwest's environments have the same unsettling effect on traditional ideas in psychology as do some of the papers in Willems and Raush. Affect, thinking, and instrumental talk are prominent in a relatively small portion of the environments occupied by people in Midwest, yet many theorists argue that these mechanisms are crucial to understanding motivation, attitude formation, social perception, and so on. By comparing the availability of settings with their occupancy in man-hours, Barker is able to pinpoint those settings that overgenerate and undergenerate behavior. It is tempting to equate a setting that undergenerates behavior with one that is undermanned, but it is not clear whether this is warranted and Barker says nothing to inform us one way or the other. This reflects the major disappointment a reader of the book may feel. With all the information and insight Barker presents, there is no attempt to illustrate the theory by means of data presented in the preceding chapters. One can only guess at how the theoretical concepts would be operationalized in terms of the data that were gathered. But there is enough stimulation in this book to insure that other investigators will push these ideas ahead. There is no question—Barker has more to say about behavioral environments than any other person currently writing in psychology.

It is not apparent that many realize this, however. His other major book—*Midwest and Its Children*—is now out of print. Surely a scientist of Barker's stature deserves better than that. Thus it is small wonder that naturalistic researchers feel compelled to argue their case to excess. The *Zeitgeist* in psychology has so far been downright rude toward naturalistic research. Perhaps these two books will induce a long overdue change.

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The Fundamental Concepts of Pharmacology

Principles of Drug Action. The Basis of Pharmacology. AVRAM GOLDSTEIN, LEWIS ARONOW, and SUMNER M. KALMAN. Harper and Row, New York, 1968. xii + 884 pp., illus. $18.50.

Twenty-eight years ago the teaching and practice of pharmacology were given renaissance (perhaps more properly *naissance*) by the appearance of Louis Goodman and Alfred Gilman's *The Pharmacological Basis of Therapeutics.* That book of classic title and content, now in its third edition, has also made possible the definition of this subtle science, a blend of chemistry, magic, molecular and organ physiology, and the life-or-death practice of medicine.

Goodman and Gilman's book is constructed along lines of organ or drug systems, making it possible for the student or physician to find for any subject the essential bridge between basic and applied knowledge. The formula has been successful enough to spawn copies and competitors, none quite matching the original.

But until *Principles of Drug Action* no general text has existed on the fundamental concepts of pharmacology, which cut across all organ systems and therapeutic applications: binding forces of drugs; structure-activity relations and their biochemical basis; principles of drug absorption, distribution, and elimination; drug metabolism; general theories of drug resistance; principles of toxic reactions. These are main topics in medical and graduate school teaching of pharmacology, and now for the first time we have a book for the purpose. And for good measure, the book is literate, critical, and abundantly documented.

Somewhat surprising and most important is the suitability of this book to the medical student. Not that he should or will consume it all, but that the fundamental matter of pharmacology is now available in clear and thoughtful exposition. Perhaps one key to this great success lies in the "476 illustrations" noted on the title page. Thus we are taken, on almost every page, back to original data, which are analyzed and put into context, in a manner eminently suitable for both teaching and research.

There are, certainly, small and large omissions, and some small errors. Most are not worth documenting, but it may be asked if a book that reflects "the breadth of modern pharmacology" can exclude the autonomic and cardiovascular and renal systems. It is not a systems book; yet, there are "principles of drug action" that derive from chemical interactions at the physiological level. Perhaps the next edition. . . .

Then there are some surprising features: chapters on carcinogenesis, teratogenesis, drug development including clinical trials, and (yes!) principles of prescribing. What does it mean when three reasonably avant-garde pharmacologists, who know all about how to misread an RNA codon, devote at least 100 pages to such matters? Are they intimidated by beards talking relevance? Probably not. The truth of the matter is that in pharmacology there is a long but coherent line between the most basic and the most applied; relevance is built into the science, back to Marshall, Abel, and Schmiedeberg.

Are the student and teacher then left with a dilemma sounding like a line out of Beowulf? Goodman and Gilman vs. Goldstein *et al.*? Certainly not! Both are essential; they are complementary. The total cost—0.5 percent of a year's expenses to the medical or graduate student, or about the cost of one football weekend.

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Damage-Induced Growth

Tissue Repair. R. M. H. MCMINN. With a chapter by J. J. Pritchard. Academic Press, New York, 1969. xii + 432 pp., illus. $23.50.

This book is concerned largely with the response of adult mammalian tissues and organs to damage. There is also some discussion of compensatory hypertrophy and hormone-induced growth. Unlike most books on tissue repair, which limit themselves to particular organs such as the skin, this one covers all the principal organs. There is a good author and subject index. The chapter on bone repair is written by J. J. Pritchard.

Tissue Repair is not only the most comprehensive book in recent times on the subject of damage-induced growth, but it also brings order to the data it summarizes, and it tells the reader what is known as well as what is not known. As might be expected in a book of such breadth, the depth

of coverage is uneven. However, this is probably due more to the imbalance in available material than superficiality on the part of the author.

The principal conclusions that emerge from this book are: (i) All organs are capable of repair. Repair is achieved through cell proliferation, enlargement, differentiation, movement, recognition, and death, as well as through the synthesis of intercellular materials. The extent to which each of these tools is used, if at all, is determined largely by the organ in question. Since these tools are also the ones used in development, the study of tissue repair may shed light on the mechanisms bringing about embryogenesis. (ii) Except for a few organs such as the skin, we have a very poor description of tissue repair. (iii) Modern molecular biology has still to make its impact on the problems of damage-induced growth. It is time for such investigation to begin.

This book also allows us to evaluate the impact of two other experimental approaches to the problem of tissue repair which have been used to a considerable extent. The first is histochemistry and the second electron microscopy. In the reviewer's opinion it is clear that histochemistry has contributed very little of fundamental importance to our understanding of damage-induced growth. Electron microscopy has been valuable in filling in important details, for example, in cell identification.

The author presents ideas and interpretations that I disagree with, and I suspect that other readers may find themselves disagreeing with him on specific points, or points of view. I would have preferred a more balanced discussion of the role of stimulators and inhibitors in the control of damage-induced growth. I think there should have been a summary at the end of the book attempting a synthesis of the problem of tissue repair in the various organs studied and its relationship to the problem of growth control. But no matter what one finds to disagree with, it will be secondary to the overall feeling of gratefulness to the author for bringing together and organizing such a vast array of facts.

This book is not only useful for the developmental and cell biologist, surgeon, or pathologist, but it is of value for anyone who wishes to get a good overall understanding of the current status of the biological bases of tissue repair.

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Cybernetic Biology

Neurological Control Systems. Studies in Bioengineering. LAWRENCE STARK. Plenum, New York, 1968. xx + 428 pp., illus. $17.50.

Stark has thought considerably and deeply about the topics of his book, yet I find it less stimulating than I expected. Part of the problem undoubtedly arises because the book is fundamentally a collection of edited reprints, arranged in a sort of phylogenetic order of subject. This leads to redundancy and some obscurity in the text, where much is taken for granted. There are few biologists who can read about "Wiener kernels" with any insight, and the others would find Stark's explanation of the relevant techniques for signal analysis inadequate. To an engineer, perhaps, the profusion of Bode plots means more and is even possibly exciting.

I find it hard to understand the exact rationale for some of the experiments described, although I am sympathetic to the applications of systems theory to problems of biological organization. For example, in the first section of the book the light responses of photoreceptor neurons in the crayfish are described in some detail. In particular the impulse patterns from the two photoreceptors in the sixth abdominal segment were recorded and compared under conditions of *constant illumination*. No, or in some cases small, correlations were found between the two pulse trains. I cannot understand, however, why correlation should be expected except under conditions of changing illumination—which, indeed, are the conditions that evoke a behavioral response from the animal. The data are then used to restrict the description of the neural code used by the crayfish—an extrapolation which must be invalid.

Autobiography has a new vogue in scientific literature. Stark's book is often autobiographical and therefore idiosyncratic, so that it unfortunately invites comparison with others of the genre, for example, K. S. Cole's brilliant and exciting *Membranes, Ions and Impulses.* The strongly autobiographical approach is probably successful only when the author can look back at continuous work in a field that has already shown enduring achievements, such as the description of the action potential by the Hodgkin-Huxley equations. I do not think that that stage has been reached by work on the human operator, to whom most of the book is devoted; he has been described, inevitably in limited, essentially linear regions. So although there is much that is interesting and useful to be found in the details of the human operator that Stark presents, there is nothing that is new in the book and little that is novel in the synthesis.

The book is full of data which are undoubtedly needed by theorists of muscular control systems but which by themselves are unsatisfactory for less committed students. The conclusions drawn and the discursive sections themselves are often redundant although individually interesting. This is not so much a book as a compendium, not a closed account but a progress report. In other words, all the details, but not the essence, are readily available. This is not to decry the worth of the book: the details and not the essence are often overwhelmingly important. Interpretations of news are better avoided; the living is more interesting, though less explicable, than the dead.

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Enzymology

Flavins and Flavoproteins. Proceedings of the second conference, Nagoya, Japan, 1967. KUNIO YAGI, Ed. University of Tokyo Press, Tokyo; University Park Press, Baltimore, 1969. xii + 286 pp., illus. $17.50.

Immediately preceding the 1967 International Congress of Biochemistry in Tokyo, a group of experts working with flavin nucleotides and flavoproteins assembled in Nagoya to assess the current status of their field. Their experimental findings (up to date as of that moment), their conclusions and speculations, and even their disagreements are all faithfully recorded in this volume, which will serve as a standard work on this specialized subject.

Although such books as this one reach limited audiences, their importance as part of the foundation for a larger discipline (enzymology, in this case) cannot be overemphasized. The continuity of the symposia upon which these reference works are based is now in jeopardy owing to the travel restrictions being imposed by granting agencies, and this should be a matter of concern for all scientists.

The formal papers (23 in number) in this symposium fall into three groups, and, indeed, it might have been preferable if they had been published in this