times, simply because the growing complexity of the world has made suboptimization increasingly more dangerous and optimization less plausible. One has a constant nightmare in which the next generation of Sporns succeeds in destroying us, while the next generation of Novicks prophesies doom into the careless wind. It is not criticism of these authors that they have not solved this problem; it is a problem, however, which the human race must keep on its agenda, or it may perish.

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Inside the Human Brain

Subcortical Correlates of Human Behavior. A Psychological Study of Thalamic and Basal Ganglia Surgery. MANUEL RIKLAN and ERIC LEVITA. Williams and Wilkins, Baltimore, 1969. xii + 340 pp., illus. $17.

The acceptance of neurosurgical methods of treating parkinsonism is due in no small measure to Irving Cooper at New York's St. Barnabas Hospital; he has performed several thousand of the subcortical operations that can relieve patients of the abnormal movement symptomatic of that progressive disease. As a result, an elderly human population has been available for behaviorial studies of subcortical function, the study of which has otherwise been confined largely to work on monkeys, cats, and rats. During the last decade the two senior psychologists at St. Barnabas have published useful statistics on IQ, inkblot, and other clinical results. In this book they survey their research and provide a "unified bidimensional rationale" to explain psychological defects that are at least temporarily accentuated by the surgery.

The introductory chapters cover the mind-brain issue, methodology, and the relevant subcortical physiology and anatomy. The next four chapters—on cognition, language, perception, and personality—contain critical comment on contemporary psychology and cover Riklan and Levita's own varied research (often on groups containing more than 50 cases and in one instance 256 cases). Their selected research patients were not very alert after their operations, but the impairment was minimal months later, provided the surgery had to be done on only one side of the brain. The changes after the surgery were therefore rather general, and in another chapter the authors compare them with the known changes following (larger) lesions at the surface of the brain. The latter effects are usually found in younger patients and are more specific in that they often can be related diversely to size, side, and locus of surgery or neuropathology.

Riklan and Levita's research enables them to emphasize that subcortical physiology is a persuasive factor affecting all that the human brain does, and before neatly summarizing the book they offer a theoretical chapter based on a concept of "directed-activation" or "activated-direction," about which the reader has been amply forewarned. Several other general theoretical positions are given short shrift even when allowed to contribute to the grand formulation. The new concept is intended to be both a physiological and a behavioral one and is as acceptable as any designed to comprehend so much. A part of one sentence probably does as well as any other short passage to indicate the character of the theory: ". . . the matrix of directed-activation can range from a preponderance of quasiautomatic organizational responses to arduous directive reactions requiring much greater catalysis from activation associated with physiological arousal" (p. 306). The authors have worked hard to synthesize ideas of activation and direction in behavior, to get at the complexities of clinical reality, and to avoid the simplifications which biologists commonly use. Their concern for highest integrative functions, interaction, patterning, interweaving relationships, and so on seems to go along with the selection of the word "correlates" for the title rather than some stronger term like "mechanisms" or "functions." Early in the book they request that they not be interpreted as assuming that "the human brain could think without man."

The conventional jargon of clinical psychology is used sparingly, but the writing style is often cumbersome and the variety of terms needed to cover such diverse fields as neuropathology, factor analysis, and existentialism slows the reader. Every chapter but the last ends with a comprehensive list of references, but the text has its share of excess and missing citations, as well as of typographical errors. Most of the schematic drawings that are meant to illuminate theoretical issues get an isolated "see figure" at the end of their corresponding sections, and the reader is invited to go back again to review the problem visually. Many section headings promise more organization than is actually found.

Two reports on the variation in site and size of the lesions (in 20 and 22 cases) indicate that the consistency of the surgery, and some of the nonspecificity in the results, is more debatable than is implied elsewhere in the book. Physicians will also wonder if some general psychological benefit from the therapeutic surgery could be quantified as well as the deficit. The next 1000 patients will yield more explicit information with the new methods Riklan and Levita are using, and their future work will serve to test their approach to the most complicated organism and its most complicated organ.

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Guidelines to Invention

The Design of Design. GORDON L. GLEGG. Cambridge University Press, New York, 1969. viii + 96 pp., illus. $4.95. Cambridge Engineering Series.

Gordon Glegg is obviously an engineer of wide experience and great originality, and his purpose in this small and very charming book is "to suggest some guiding principles that are behind most designs and so help the young engineer on his way." The book outlines three basic elements in design—the invention, the art, and the final, cold-blooded analysis. The many examples offered in it of conventional and unconventional thinking in the solution of engineering problems are beautifully described.

With most of Glegg's presentation this reviewer agrees wholeheartedly. There is no doubt that almost always the basic ideas come first and not too rationally, and that cold, incisive logic, which separates the wheat from the chaff, has to follow. Perhaps this is just as well. If the reverse were true, computers could replace us who make a living by producing original designs.

The question in my mind is whether any small book, or any large one for that matter, can really help an engineer or inventor to develop his designing skill. How can one learn even to appreciate the art of design—that is, the concept of overall beauty or elegance in a mechanism or a system? It can only be learned as one learns to appreciate good painting, good music—

by long association with others who have good taste. That does not mean, of course, that good books have not been written on the appreciation of painting and music. This book is certainly recommended reading for anyone who has a taste for that sort of thing, and while it may not make a good designer out of a poor one, it certainly will help a good designer to teach good design to others.

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Lectures in Physics

Nuclear and Particle Physics. Proceedings of an institute, Montreal, 1967. B. MARGOLIS and C. S. LAM, Eds. Benjamin, New York, 1968. viii + 552 pp., illus. $12.50.

Summer institutes (and spring, fall, and, more rarely, even winter institutes), seldom lasting beyond a month or two, have frequently had a lasting impact on the development of theoretical physics. These schools, some of which have become annual events (the subject matter shifting from year to year) are organized ostensibly to provide pedagogically accessible lectures on recent developments to (a relatively small number of) advanced graduate and fresh postgraduate students. Their most cogent justification, however, resides in the written proceedings, which often develop into the *loci classici* of their subjects, much more used and useful than the original literature. Though it is notorious that the audience may have heard only a fraction of the material that ultimately appears as proceedings, the fact that these papers were prepared, in principle, to be delivered orally often results in an attractive informality and freshness of style absent from more formally commissioned or intended review articles.

The proceedings under discussion, issuing from a one-shot affair organized with the Montreal Exposition as backdrop, have several uncommon features. Nuclear and particle physics have parted company for over two decades, though important bridges (such as nuclear forces and weak interactions) remain connecting them and at least one major bridge is being extended (in the use of high energy beams to study nuclear structure). Tempting as it is to ascribe the juxtaposition of subjects in this volume to the modest size of the institute, it is nevertheless true that four of the nine articles contain some bridge material: "Collision and decay phenomena" by K. Gottfried, "Radiative corrections to weak interactions" by G. Källén, "Muon-capture in nuclei and Migdal theory" by M. Rho, and "High energy scattering from nuclei" by C. Wilkin. Of the remaining articles, those by B. W. Lee on "Chiral algebra and dynamics" and by J. Schwinger on "Theory of sources" belong exclusively to the second part of the title, whereas those by S. Kahana on "Effective interactions in finite nuclei," by D. Kurath on "Nuclear deformations in the shell model," and by B. Margolis on "Selected topics in nuclear reactions" will be of interest to nuclear physicists only.

The range of subjects covered is thus so broad as to be beyond the gamut of practice of most physicists. The reviewer, currently a nuclear theorist, feels no disloyalty in nominating the articles on particle theory by Källén, Lee, and Schwinger as prime (and outstanding) candidates for tenure of interest. Except for the long article by Rho, which is still not long enough to be self-contained throughout, the contributions are all of exceptional clarity and can be utilized as entrées into the topics covered. From the standpoint of today's specialization, however, one must view these proceedings as almost frivolous and light-hearted (not that any of the specific contents of the volume are) compared to the monolithic volumes resulting more characteristically from such institutes.

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Radiation Biology

Radioisotopes in the Human Body. Physical and Biological Aspects. F. W. SPIERS. Academic Press, New York, 1968. xiv + 346 pp., illus. $15. American Institute of Biological Sciences and U.S. Atomic Energy Commission Monograph Series on Radiation Biology.

Radioisotopes in the Human Body is a treatise for scientists working in radiation research and protection. It describes dose calculations for ionizing radiations in the human body and succeeds in providing a unified treatment of the physical calculations, biological factors, and radiobiological effects.

Although its scope is not as wide as its title would indicate, this carefully prepared work deserves great praise. It is clearly written and well edited and provides the first comprehensive treatment of its subject by a single author. Spiers discusses the details of radioactive decay and isotope metabolism, and the mathematical models are described and applied with skill to biological events. There is an excellent review of the dosimetry of radionuclides in soft tissues. The nonuniform distribution of radiation dose in soft tissues is explored, but not as thoroughly as the distribution in bone. This reflects the state of the field. For example, the development of lung cancers in uranium miners in the western United States calls attention to the need for better information with respect to alpha particles in the lung. Chapter 4 is a most valuable and unique chapter which describes the macroscopic and microscopic structure of bone in a manner suitable for a physicist whose aim is to make radiation dose calculations. The next two subjects relate to dose calculations and measurements in bone; it is in this area that the author is most at home.

Insufficient credit seems to have been given to the pioneering work of Robley Evans in establishing the biophysical basis of radium poisoning in watch-dial painters. With this exception the book seems to be accurate in its historical account of the development of internal dose calculations.

It will be difficult for biologists without facility in calculus and some familiarity with the mathematical basis of radiation dose calculations to follow these chapters, for intermediate steps between the formulation and the solution of the problems are omitted. However, for physicists these formulations are distinctly and clearly illustrated and constitute one of the strong points of the work. In the last three chapters the author treats the effects of internal doses of radiation, natural and man-made radioisotopes in the human body, and the manner in which maximum permissible burdens of radionuclides in the body are determined. His presentations are precise and in some cases clearer than the reports of the International Commission on Radiological Protection, upon which a chapter of the book is based.

This book is suitable and valuable for the libraries of researchers. For students, it is unfortunate that the book does not contain problems. However, the suggested reading material at the