Valuable features not present in the original edition include an enlarged section of photographs, a "synoptic calendar" of events, and an index. But the bibliography of Hahn's papers and the section of biographical sketches of other scientists are defective. The former omits many papers published prior to the 1930's and leaves the reader uninformed of its incompleteness, and the latter contains far too many errors of fact and of omission. Additionally, one senses a lack of care in assembling the book: some "Germanisms" appear in the translation; there are several misprints; and some of the numerous references which Hahn placed in footnotes have been raised into the text in an incomplete form, while others have been omitted.

Nevertheless, we are indeed fortunate to have such an account of Hahn's work from his own pen. Its publication is particularly timely, for Hahn shared the 1966 Fermi Award with his two eminent colleagues Lise Meitner and Fritz Strassmann.

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Signals and Receivers

Information Theory and Esthetic Perception. ABRAHAM MOLES. Translated from the French edition (1958) by Joel E. Cohen. University of Illinois Press, Urbana, 1966. 227 pp., illus. $7.50.

It is an old idea to suppose that each department of sense—vision, hearing, touch, smell, and taste—is analogous to a telegraph line over which electrical signals can be sent and messages thereby transmitted. It is obvious to compare the sensory nerves (or their fibers) with wires, and there is a vague similarity between the impulses in neurones and the electrical pulses of the Morse code. The sense organ is analogous to the transmitting apparatus and the brain to the receiving apparatus. Sense-perception, then, is supposed to be a matter of decoding the nerve signals. Since the message comes from the environment, the *sender* of the message is comparable to an object in the world. What is comparable to the *receiver* of the message? In human communication there is always an operator who has learned the code or (with a teletypewriter) a person who reads the telegram. In sensory communication it would seem that a little man in the brain, a homunculus, is required by the logic of the analogy, but this is an unwelcome implication. Some psychologists believe that this difficulty destroys the whole analogy.

This way of thinking about perception was given a new impetus, however, when Shannon published his mathematical theory of communication some 20 years ago. He could define a channel in general terms and show how coded information could be treated as a quantity. It seemed that the analogy between a human channel of communication and a sensory channel could be tested. There were other applications of the theory of information transmission, but this was one.

Information Theory and Esthetic Perception is primarily a book about sense perception, as indeed it has to be if the author is going to discuss music and art, which he does in the second half. It was written in the full flush of enthusiasm for Shannon's mathematics by a man who had studied electrical engineering, physics, psychology, philosophy, and music. The author is an academic at the University of Strasbourg but, like the other standard-bearers of information theory, he wanted to cut across the academic disciplines and found a new branch of knowledge. There is boldness and imagination in this book but also much oversimplification and looseness of thought. The author was impatient with the existing theories of language, music, painting, and esthetics generally. He sat down to write a book, trusting to insight, intuition, and his explorations into "concrete music." This consists of experiments with recordings, electronic "clipping" of waves, tape-splicing, running a tape backwards, and the like.

The translation appears to have been carefully done, and there is an excellent translator's preface. This English edition is useful mostly in showing what a certain intellectual movement was like nine years ago, not what it is like today. Although communications engineering has made orderly progress, general information theory has not. Many of its pioneers have turned to other methods, and there is no assurance that Moles himself would subscribe now to what he wrote then.

The chapters on esthetic perception are plagued by the same obscurity that characterizes other writings on esthetics. Information theory has not made the subject any easier to understand.

The chapters on visual and auditory perception represent one form of the theory of the sense organs as transmitters of elementary sensations and the brain as a receiver of these signals. Moles thinks of the brain as storing memories, creating symbols, and having a priori knowledge. These concepts of what the brain does are not new. The newest way to think of the brain is as a computer, and this conception is not found in Moles's book. Computer models of perception are now proliferating.

So long, however, as the brain is likened to any instrument that simply receives coded signals the theorist is faced with a paradox. Optic or acoustic signals must be seen or heard. If what the brain gets is signals from its eyes and ears it must have internal eyes to see them with and internal ears to hear them with. So the theorist is right back where he started.

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Unifying Theory for Solids

Pseudopotentials in the Theory of Metals. WALTER A. HARRISON. Benjamin, New York, 1966. 352 pp., illus. Paper, $7.95; cloth, $13.

The general reader may well be surprised by the title of this book. In nuclear physics constructed potentials (pseudopotentials) are often used to describe the results of scattering experiments, because of our inability to calculate nucleon-nucleon forces. In metals, however, all the forces of interest are of Coulombic origin, and there appears to be no need for an artificial potential. Nevertheless a large technical literature concerning pseudopotentials in solids has grown up.

Pseudopotentials have proved useful in solids because they represent, as indicated by the author in his preface, "a single point of view from which virtually all the properties of simple metals [and, one may add, semiconductors also] may be studied." The pseudopotential represents an abstraction of the actual atomic potential which describes scattering of valence electrons near the Fermi energy. The pseudopotential is weak, so that it can be treated by perturbation theory, and the complicated behavior of the real

wave functions in the atomic cores has been projected out of the model wave functions. The result is a theory which has proved to be well suited to treating, in a unified manner, the very wide range of quantum problems that arise in solids and in liquids as well.

This monograph represents a detailed account of the author's work on metals using this method during the period 1958–1965, and it contains also adequate references to the work of others using the same method. As such, it should prove quite useful to students entering the field, because the approach is straightforward. The growing accomplishments of modern physics present the beginner with a barrier of ever-increasing height as well as width. A simple, unifying language reduces the problem of digesting information on a wide scale, and a monograph such as this can contribute significantly toward overcoming the initial psychological barrier.

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Reproductive Endocrinology

Marshall's Physiology of Reproduction. Vol. 3. A. S. PARKES, Ed. Little, Brown, Boston, 3rd ed., 1966. 1184 pp., illus. $70.

Volume 3 of A. S. Parkes's revised version of F. H. A. Marshall's *Physiology of Reproduction* is devoted to endocrinology. It contains ten chapters written by the editor and seven outstanding British experts, I. W. Rowlands, M. Allanson, B. T. Donovan, G. W. Harris, J. O. R. Morris, R. Deanesly, and A. E. Kellie.

The first four chapters are concerned with the hypothalamo-pituitary-gonad axis and all of its ramifications. In addition to discussing functional relationships these chapters include careful descriptions of the anatomy of the hypothalamus and the hypophysis, an examination of comparative morphology among different species, and a careful consideration of hypothalamic and hypophyseal cytology in normal and experimental states. A much-needed discussion of antigonadotrophic activity is presented by Rowlands and Parkes. Although the relationships between the hypothalamus and the hypophysis are elucidated in detail, the possible role of other components of the central nervous system in the regulation of the axis is examined only cursorily, possibly because of the lack of any very detailed data.

Morris presents a detailed description of the chemistry of the various gonadotrophins in a careful review which describes assay methods as well as methods of purification of three trophic hormones from the pituitary, two chorionic gonadotrophins, and human menopausal gonadotrophins. Advances in the chemical identification of these compounds which have occurred in the past three years are not included.

There follow three chapters concerned with the gonadal hormones and their biochemical activities. In addition to discussions of the chemistry and physiology of androgens, progestogens, and estrogens, there is a brief discussion of nonsteroidal estrogens and a rather abbreviated account of relaxin as an ovarian hormone. Kellie's account of the biogenesis of gonadal steroids is thorough, particularly as it relates to the biosynthesis of cholesterol as the major steroid hormone precursor. Here again, some recent work on the enzymatic reactions involved is not included.

A long and thorough discussion by Deanesly on pregnancy and fetal life inquires further into the role of relaxin and includes the role of ovarian and pituitary hormones as well as placental hormones in implantation and pregnancy maintenance. She reviews admirably the problem of pregnancy termination and the mechanism of parturition. A rather brief discussion of mammary gland function in pregnancy precedes an even briefer one concerned with adrenocortical, thyroid, and liver function. An excellent review of fetal endocrinology is contained in this chapter. The chronology of the development of endocrine dependence is clearly set forth, and interactions between the fetus and the maternal organism are described.

In the final chapter, on relationships between gonads and adrenal glands, Parkes and Deanesly present in good detail the evidence for adrenal participation in various reproductive phenomena and discuss the effects of gonadal steroids upon adrenocortical activity. The fact that steroids having sexual effects are produced both by gonads and the adrenal cortex is well documented, and the possibility of gonadal function as an adrenal cortical substitute is also indicated. It is clear from this chapter that our knowledge of the nature of the control of sex hormone production by the adrenals and perhaps of adrenocortical hormone production by the gonads is still quite rudimentary.

This volume brings to a conclusion the opus begun many years ago and subject to a number of delays. With the ever-increasing production of experimental and clinical data relating to reproductive physiology, it is unfair to expect a book like this to be up to date. The editor's hope that "it will not get out of date" is, I believe, well justified by the superior quality of the presentations, the excellent illustrations, and the citation of outstanding and relevant publications. It is clear that the authors have not attempted an exhaustive bibliography of reproductive physiology, but they certainly have attained a fairly representative one. In a volume containing contributions from an assemblage of authors there often occurs quite diverse performance. Here Parkes has succeeded in maintaining a remarkably uniform standard of excellence. This volume alone should be invaluable to students of reproductive physiology, of special interest to the experimentalist, and informative of basic concepts and processes to clinical and public health workers. Although its prediction of truly exciting developments in the field of reproduction is rather limited and conservative, the discerning mind may easily construe from the data presented what should be, and in fact have often become, new directions for research. With the publication of this final volume of the work a most substantial treatise on the whole field is now available. In undertaking this revision and limiting the revisers to experts from Marshall's beloved England, the editor assumed a monumental task. It is most laudably fulfilled, and the world biomedical community is indeed in his debt.

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For Physics Students

Mathematical Methods in the Physical Sciences. MARY L. BOAS. Wiley, New York, 1966. 790 pp., illus. $11.95.

Boas has adopted one of a number of possible views as to how undergraduates majoring in the physical sciences should learn mathematics. This viewpoint is that such students need a utilitarian knowledge of a va-