exception, entirely phenomenological, i.e., related to the interpretation of experiment in terms of parameters rather than with the prediction of the properties of systems in terms of the presumed known properties of the constituent molecules and ions. The remaining seven chapters deal with a survey of available data. No reference is made to Fuoss' work on bolaform electrolytes, to Wall's measurements of ion association to polyelectrolytes, of Scatchard's or Klotz's studies of protein-ion interactions, etc. In keeping with the phenomenological approach adopted, no mention is made of the Kirkwood-Westheimer theory of secondary dissociation, and Gilkerson's theory of ion-pairing is glossed over with a single reference.

To sum up, the author has compiled an immense amount of data concerned with electrolyte dissociation in very simple systems, but he has not made any attempt at consistent interpretation of the data in molecular terms. For a very few specialists this text will probably have value as a reference. However, the lack of any over-all theoretical interpretation and the abbreviated nature of the phenomenological theory presented will severely limit its utility to the student.

**Free-Will and Determinism.** By Allan M. Munn. 218 pp. U. of Toronto Press, Toronto, 1960. $6.00. *Reviewed by R. Bruce Lindsay, Brown University.*

SOME current schools of thought hold the view that modern physics, through quantum mechanics with its indeterminacy principle, provides a bias in favor of freedom of the will of man as against rigid determinism. This is in spite of the fact that competent physicists have been unable to see any relevant connection. Professor Munn, in the present volume, takes another crack at the problem. It must straightway be confessed that his conclusion at the end of the book reduces essentially to the conviction that indeterminism in physics merely admits the possibility of free will. It is unlikely that most physicists will be impressed with this result. What the philosophers will make of it, the reviewer does not presume to predict.

In the course of his argument, the author devotes about half of the book to a review of determinism in classical and modern physics. The treatment is marred by a failure to distinguish between the concepts of causality and determinism. But a more important difficulty is that purely pedagogical one that the discussion of quantum mechanics in particular is encumbered by a mathematical analysis which is not sufficiently rigorous and detailed to be of any value to the student competent in physics and mathematics, and which, at the same time, will be more or less unintelligible to the intelligent layman for whom the book is presumably intended, but who will almost certainly get lost long before he reaches the end of the trail. The volume also contains numerous stylistic blemishes, such as, for example, *cognito* in place of *cogito* in Descartes' famous dictum, *homesostatis* in place of *homeostasis*, etc., together with many misspellings of proper names. These will unfortunately distract the attention of the careful reader who would like to understand what the author is trying to say. The use of the book for any reference purpose is rendered difficult by the absence of an index.

**The Impact of Atomic Energy.** By Erwin N. Hiebert. 302 pp. Faith and Life Press, Newton, Kansas, 1961. $4.00. *Reviewed by Alice K. Smith.*

WRITTEN for the Peace and Social Concerns Committee of the Mennonite Church, this book offers the thoughtful nonscientist a survey of the milestones in the military and peaceful applications of atomic energy and an account of how politicians, scientists, and church groups have responded to the practical and moral problems of control over the past fifteen years. Since no such comprehensive study has hitherto been attempted, scientists and others familiar with the field should also find this catalogue of events and points of view extremely useful, although they will need to check on the accuracy of minor points and to look elsewhere for profound and thorough analyses of scientists' reactions. Religious groups, it seems, have been scarcely less generous in making pronouncements about the dangers of atomic energy than the scientists themselves, and with about as much effect in curbing the nuclear arms race. In fact, the only case where the influence of a religious point of view upon official policy is clearly evident was when Thomas E. Murray, as a member of the Atomic Energy Commission from 1950 to 1957, explicitly used the argument of a "just" war in support of a limited nuclear arsenal to maintain the struggle against communism. Professor Hiebert himself espouses the position of nonviolence and believes that Christians should try to convince others of the validity of this stand, while encouraging scientists to work out the technical requirements of methods of control. "The Christian," he concludes, "may well believe that science without religion cannot see what needs to be done. But religion without science has not the power to do it." That this would be an alliance of men of good will, few would deny, but it still leaves unanswered the vital question of how scientists and Christians, as citizens and as policy makers, are to translate their yearning for peace into political reality.

**Automat und Mensch.** Über menschliche und maschinelle Intelligenz. By Karl Steinbuch. 253 pp. Springer-Verlag, Berlin, 1961. DM 28.50. *Reviewed by Walter G. Mayer, Michigan State University.*

THIS book states the personal convictions of the author concerning the relationship between the "intelligence" of programmed mechanical devices and that of the human mind. Thought processes are to be explained by ordinary physics. "I believe that we are able to analyze the functions of the mind as rationally as we can our metabolism or the motion of our muscles," is a statement found early in the book.


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Professor Steinbuch says in the preface that "a superficial critic" might voice the objection that the book is split into two sections (technical part and non-professional philosophy). It does indeed have two parts although there is no reason to object to this arrangement. The first few chapters give a review of the technological aspects of information theory, signal processing, memory and learning devices, and data-control systems. The author presents these topics in a simplified manner by practically eliminating mathematical formulas. Instead, he gives a great number of descriptive pictures. There is, however, a tendency to include too much information per illustration, which does not always keep the message clear and effective.

Most of the information presented in these chapters is not new. They constitute a long introduction to the second and seemingly more important part of the book. In this second section, the author uses a mixture of philosophy and technical analysis to relate manifestations of mental activities directly to various functions of mechanical devices. Discussions of such qualities as learning, motives, and intelligence are centered around repeated statements to the effect that "under no circumstances does it appear to me to be probable or, even less, proven that any superphysical influences have to be assumed for the explanation of mental functions." The author does not ignore the fact that there exist processes of the mind for which a purely physical analogy cannot be given now. This he does not accept as an argument against his approach but interprets it as a probably temporary lack of sufficient insight into information theory.

This book is not a text; it is a thought provoking technical and philosophical essay, sometimes emotional and potentially controversial. The conservative reader may even become angry—it is probably accidental that the very attractive semi-hard plastic binding is fire-engine red.

**Biography of Physics.** By George Gamow. 338 pp. Harper & Brothers, New York, 1961. $5.95. *Reviewed by William F. Meggers, National Bureau of Standards.*

WHEN this reviewer began to study science, he read *A History of Physics* written in 1898 by Florian Cajori. That book discussed some 700 natural philosophers and physicists (Abney to Zeeman) and their works between 384 B.C. and 1898 A.D., but it was written too soon to mention quanta, relativity, atomic and nuclear physics, or such names as Planck, Einstein, or Bohr. During the past four decades at least ten histories of physics, including modern developments, have been published but none is quite like George Gamow's *Biography of Physics* written with the primary aim to "give young readers (and maybe some older readers too) the impulse to study physics". An attempt is made "to give the reader the feeling of what physics is, and what kinds of people physicists are, thus getting him interested enough to pursue his studies by seeking out more systematically written books on the subject".

A biography is a written account of a person's life, but this "Biography of Physics" contains more physics than biography. In each of the eight chapters, the history of an era or subject centers about one or a few leading individuals (with brief biographies and usually recognizable pen sketches by the author), and other physicists are mentioned to fill in the background. Altogether, about 200 physicists are indexed, from Aristotle to Yukawa (Zeeman is not mentioned). There are copious quotes from the works of Archimedes, Galileo (including his recantation extracted by the Holy Inquisition), Newton, and Faraday, but none from later physicists. This might suggest to some readers that modern physicists (excepting Gamow) do not write interestingly about their subject. More than half of this book is devoted to three chapters: Relativistic Revolution, The Law of Quantum, and The Atomic Nucleus and Elementary Particles, which belong entirely to this century.

It is regrettable that the biographies of physicists are often too brief (to show "what kinds of people physicists are"), and sometimes in error. For example, Rydberg is described as a "German spectroscopist" and Balmer as a "German schoolteacher", but in truth Rydberg was a Swede and Balmer a Swiss. Also Rutherford is said to have discovered alpha, beta, and gamma rays in 1899, whereas, the last is usually credited to Villard. In this first edition, there are also a number of misspelled or misused words; perhaps the best example is found in a statement "about Otto von Guericke's invention of the air plumb". These minor defects are compensated by delightful descriptions of physical experiments, by clever cartoons illustrating the principal physical principles, and by several anonymous, amusing poems, including a limerick! We sincerely hope that this book will attract more people to physics, inspire talented young students to major in it, and alleviate the general public's abysmal ignorance of this vital subject.

**Modern Physics Buildings: Design and Function.** By R. Ronald Palmer and William Maxwell Rice. 324 pp. Reinhold Publishing Corp., New York, 1961. $13.50. *Reviewed by J. L. Olsen, Swiss Federal Institute of Technology.*

MANY physicists must at some point in their career help design a new laboratory. For this, a mixture of good ideas and solid facts is needed and just such a mixture is provided by this book. Plans of thirty-three recently completed or designed physics buildings are given which incorporate many admirable ideas and provide a goldmine of stimulation and information. Brilliant, boringly efficient, and perhaps plain boring designs are included. This is all to the good and this section alone would make the book worthwhile.

The text also includes chapters on space requirements, floor plans, lecture rooms, research laboratories,


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