the purpose better than equations. Scattered through the book are a number of well chosen problems and exercises that allow the reader to test his understanding of the material or to explore interesting sidetracks. In this and other ways the book reflects the teaching experience of the authors, and I recommend it to those seeking a text for the opening of a senior or graduate course in microwave devices.

I also recommend it to all who work or would like to work in electron dynamics and desire a solid background in the field.

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J. Arol Simpson is chief of the electron physics section, NBS, and for some time has been struggling with the problems of low-voltage, high-current electron optics.

Shape of the earth

THEORY OF SATELLITE GEODESY: Applications of Satellites to Geodesy. By W. M. Kaula. 124 pp. Blaisdell, Waltham, Mass., 1966. $5.75

by Robert E. Street

Satellite geodesy is one of the very active fields of modern scientific research. It was born with the space age and has become the newest tool of the geodeticist in his continuing effort to determine the exact shape of our earth. Classical potential theory can be used to derive a series expansion for the gravitational potential of an irregularly shaped body of unknown density distribution with zonal and tesseral harmonic coefficients. Observations of close earth satellites can then be used to determine the numerical values of these coefficients.

The present brief monograph derives the mathematical expressions needed and this it does carefully and in sufficient detail. It discusses the effect of other phenomena such as radiation pressure, lunar-solar effects and atmospheric drag. The statistical problem of the reduction of observations is covered and finally there is a brief treatment of recent results. The difference in numerical values of the coefficients obtained by different observers points up the difficulties.

The advanced undergraduate with a good knowledge of calculus and the elements of celestial mechanics should find this book a very good, relatively easy introduction to the field. For more detail and numerical procedures he can then turn to the references given.

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The reviewer is professor of aeronautics and astronautics at the University of Washington.

For statistical experts

ADVANCES IN CHEMICAL PHYSICS, Vol. 11. I. Prigogine, ed. 406 pp. Interscience, New York, 1967. $17.75

by Kurt E. Shuler

Volume 11 of *Advances in Chemical Physics*, like its immediate predecessor, is again a topical volume, devoted to equilibrium and nonequilibrium statistical mechanics. The equilibrium part deals with point defects in solids, dense ionic systems and simple mixtures based on the average potential model. The nonequilibrium part treats relaxation and transport properties of electrolytes, nuclear paramagnetic relaxation in solids and generalized Boltzmann equations in the style of Bogoliubov, Choh and Uhlenbeck, Cohen and Prigogine.

As I wrote in my review of volume 10 of this series, a topical volume of reviews serves a useful purpose in bringing the reader almost up to date on the development and present status of some specialized field. To serve such a purpose, the articles must be authoritative and well written. This objective has certainly been met in this volume.

This book deals with a number of special topics in statistical mechanics and appears to be addressed primarily to active researchers in these fields and their graduate students. Four of the six articles are by members of the "Brussels school" and there is consequently a high density of diagrams and Fourier coefficients. Maybe the "Kirkwood school" will be stimulated to exercise its right of reply.

One unhappy note should be mentioned. The references in the various papers go only through 1964. The work of the last 2.5 years is not covered. Several important new develop-

ments, such as, for example, the recent work on singularities in virial expansions are therefore not discussed in the reviews. It is unfortunate that there is such a long gap between the completion of a manuscript and its appearance in print in this review series. I think, on the basis of personal experience, that this gap could be considerably shortened if authors, editor and publisher all would coöperate more closely on a stricter deadline basis.

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The reviewer is a senior research fellow at the National Bureau of Standards.

Do machines think?

GREAT IDEAS IN INFORMATION THEORY, LANGUAGE AND CYBERNETICS. By Jagjit Singh. 338 pp. Dover, New York, 1966. Paper $2.00

by Sanford E. Gerber

I find myself on that side of the fence where we believe that, if a machine exhibits some form of behavior that is also exhibited by human beings, this behavior should be called by the same name. That is to say, if an animal behaves in a certain way, such that I would conclude that he thinks, I would have to conclude that a machine that exhibits the same behavior also thinks. It seems to me unfair to say that, since a man can do more things than a machine, the machine does not think; whereas, if the machine can do some of the things which are within man's ability, it must perform some of the same processes. Furthermore, I find it clear that in order for a machine to do what a man does it is not necessary to do it the same way. I don't think Jagjit Singh would agree with my philosophy. He would prefer to consider such concepts as "will" and abstractions. I am tempted to agree that these concepts are uniquely human, but I am not willing to agree that a machine does not think. Anyway, this is a moot question that has been debated by people much brighter than me. I state it here only to indicate that Singh sits on the other side of the fence.

This is a most interesting book intended for the nonexpert, or even for the uninitiated. It contains chapters on such things as coding theory, information and entropy, neural networks, and artificial intelligence. What Singh knows about information theory and cybernetics is apparently greater than what he knows about language, for it is particularly in the area of natural language that the book exhibits its only true weakness. There is one chapter devoted to machine translation in which much of the recent meaningful work is not discussed. Other considerations of natural language processing, such as automatic speech recognition, are not even mentioned. With the exception of this sole weakness, the book does a very good job of describing, discussing and dissecting some very important research. I would recommend this book to the beginning student of information theory.

I have one bone to pick with the publisher. On the jacket of the book, the author is identified by name only. I have been unable to discover the identity of Jagjit Singh. Although he has written a worthwhile book, I cannot provide my reader with any information about his qualifications to have done so.

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Basic equations for the serious reader

X-RAY DETERMINATION OF ELECTRON DISTRIBUTIONS. By Richard J. Weiss. 196 pp. North-Holland, Amsterdam (Interscience, New York), 1966. $10.50

by Leonid V. Azároff

The development of the theory of x-ray diffraction by crystals was begun by C. G. Darwin concurrently with the discovery of the phenomenon by Max Laue. In 1914 it was expounded in two papers in the *Philosophical Magazine* and in 1922 a third paper by Darwin completed his contributions to this subject. About 50 years later, some of the leading present-day expositors met in Cambridge, Mass., to participate in a symposium commemorating B. E.