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generation are covered; the former, which offers promise of more practical use, is greatly emphasized.

Beginning with an introduction to the basic thermoelectric effects, equations are developed for the coefficient of performance of a thermoelectric refrigerator, with single and cascaded couples, as well as relations between current and temperature difference. The Seebeck coefficient, and thermal and electrical conduction, in semiconductors are discussed in detail, and criteria are considered for the selection of materials. Considerable improvement can be obtained by alloying semiconductors, and the trend of research in this area is indicated.

A chapter is devoted to preparation and evaluation of materials, particularly methods for measuring thermal and electrical conductivity, with only brief mention of such aspects as proper junction preparation. This again illustrates the book's emphasis on fundamentals of thermoelectric behavior, rather than practical applications. Applications of thermoelectric cooling are briefly discussed (refrigeration, air conditioning, dew-point hygrometry, a thermostat, and zone melting), as are applications of thermoelectric generation (oil-burning generator, solar energy converter, and the radiation thermopile). This book does not attempt to chart the future practical possibilities of thermoelectricity. It should be of value to scientists and engineers interested in the principles on which such applications will be built.

The Dynamic Behavior of Thermoelectric Devices.

By Paul E. Gray. 136 pp. The Technology Press of MIT and John Wiley & Sons, Inc., New York, 1960. \$3.50. Reviewed by Peter L. Balise, University of Washington.

LIKE the book discussed in the preceding review, this monograph was inspired by the promise of useful thermoelectric heat pumps and generators. However, it is not concerned with materials, but is the first book to anticipate the need, not now dominant, for solving thermoelectric control problems through analysis of dynamic behavior.

This is difficult, since the partial differential equations are nonlinear in current and only approximately linear in temperature, and are governed by boundary conditions with product-type temperature-current nonlinearities. For control purposes, it is useful to know the small-signal behavior; this approach is followed here, even though it has limited application to large inputs such as occur in process start-up.

The system equations are developed for a somewhat idealized thermoelectric heat pump, and then separated into large-signal static and small-signal dynamic equations, with the assumption that thermal and electrical conductivities, specific heats, and Thomson coefficients are independent of temperature. Fourier transformation is applied to obtain ordinary differential equations

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which yield the frequency-domain small-signal transfer functions. A procedure is presented for inverse transformation to obtain the time-domain transients for Fourier-transformable inputs. A similar analysis is also given for a thermoelectric generator.

For the heat pump, an experimental investigation was made of time behavior and frequency response, showing good agreement with the mathematical model for small signals, especially at low frequencies. When the model was modified to include the temperature dependence of electrical resistivity, significant improvement was obtained. This analysis may be applied to the effects of the materials and device parameters on dynamic behavior.

Nuclear Reactions at Medium Energies. Lectures given at Fourth Summer Meeting of Nuclear Physicists (Hercegnovi, Yugoslavia, Sept. 1959). Edited by R. V. Popić. 304 pp. Federal Nuclear Energy Commission of FPR, Yugoslavia, 1960. Paperbound. Reviewed by H. H. Barschall, University of Wisconsin.

EVERY summer the Nuclear Energy Commission of Yugoslavia organizes a meeting of nuclear physicists. The second meeting held in 1957 was described by C. E. Porter in *Physics Today* of February 1958. Since that time these meetings have been moved from Lošinj Island to Hercegnovi which is reported to be an even more attractive resort on the Adriatic Coast.

The present volume contains a transcript of the lectures given at the 1959 summer meeting on the subject "Nuclear Reactions at Medium Energies". It is ably edited by R. V. Popić of the Boris Kidrič Institute in Belgrade. The theory of nuclear reactions is discussed by F. Beck, C. Bloch, B. H. Flowers, and L. Rosenfeld. These lectures deal with resonance theory, direct interactions, and the nuclear many-body problem. Lectures on experimental nuclear physics were given by U. Facchini, L. Rosen, and J. Thirion and cover both neutron and charged-particle interactions, including experiments with polarized beams and targets.

It is not clear whether copies of this book are available at book stores. In order not to disappoint prospective buyers who are unable to obtain the book it might be inadvisable to recommend it too highly.

Policies for Science Education. Edited by Frederick L. Fitzpatrick. 219 pp. Bureau of Publications, Teachers College, Columbia U., New York, 1960. \$3.95. Reviewed by Norman Feather, University of Edinburgh.

THE Science Manpower Project of Teachers College at Columbia University is just four years old. The volume under review is the seventh, and so far the most ambitious, of a series of monographs through which the Project is reporting to the nation

on the results of its labors—and, it is to be hoped, justifying itself to its supporters, "a group of leading American industries and foundations".

Previous monographs have dealt with well-defined topics—*Modern High School Physics* (or *Chemistry*, or *Biology*)—even with quite specific matters of pedagogy (as, for example, *Dimensions, Units and Numbers in the Teaching of Physical Sciences*). The present monograph is "concerned with matters of general policy". There had been so many requests for advice, from such diverse quarters, that "the preparation of this policy report became a virtual necessity". The quotations are from the editor's Preface.

Twelve experts collaborated with Dr. Fitzpatrick in writing the report. Possibly some of the repetitiveness which remains in the final version is intended to impress the reader with their unanimity where fundamental criticisms or essential reforms are in question; possibly it is merely symptomatic of the difficulties which any editor must experience with a large team and a small compass only for their offerings. But it must be said that the writing is rather repetitious—even disregarding the 23-point summary which brings the report to a close.

In the preface, the need for definitions of "science", "technology", "technician" is identified and met. A foreign reviewer, whose on-the-spot acquaintance with the recent American scene is not very extensive, feels the need for further definition which the home reader may not require—precise definition of such terms as "workshop course", "trade book", "talent search", "resource person", "guidance"—and he feels somewhat uneasy with certain plurals, "advices", "provisions", "experiences", which would be singular in his own idiom; but he does the best he can in terms of the context. He recognizes certain acute criticisms which he is prepared to accept as valid, some constructive suggestions which he applauds; then, occasionally, he detects an attitude of mind which he does not share—and he wonders whether he or the writer is wrong-headed, or whether each has reason on his side within his own society. He can do no better than that.

The present reviewer is prepared to accept as valid the criticism that anti-intellectualism is still a common national trait and that public pressure is frequently brought to bear in order to establish "easier" programs for students at high school, though he would not have dared to make this criticism on the basis of his own limited experience. On that experience, however, he would have doubted, with the report, whether the increased use of visual aids will do more than bring partial relief: "whether such alternative means will supply the important components of an education is far from clear". He applauds the statement "we take our departure from the principle that science has assumed such stature that it constitutes a fourth R in the early program of general or liberal education", and the recommendations relating to science teaching in the elementary school which derive from it.