analysis, and statistics, and error measurement are competently presented and are most valuable. Being designed primarily for the analytical chemist, a brief section of notes on currently available, representative equipment is included, as well as a modest but adequate presentation of the necessary physics and electronics.

References cited date only through 1957; thus it is fortunate that three of the authors compile and publish a biennial review of recent advances in x-ray spectrochemical analysis (see *Analytical Chemistry*), which will aid in updating the book.

Hochbelastbare Wasserstoff-Diffusions-Elektroden für Betrieb bei Umgebungstemperatur und Niederdruck. (High-drain hydrogen-diffusion-electrodes operating at ambient temperature and low pressure.) By Eduard Justi, Manfred Pilkuhn, Wolfgang Scheibe, and August Winsel. 235 pp. Akademie der Wissenschaften und der Literatur, Mainz, Germany, 1959. Paperbound, DM 22.40. *Reviewed by H. A. Liebhafsky, General Electric Research Laboratory.*

PART of the large new research effort on old methods of energy conversion is directed toward the fuel cell, which differs from the other devices involved in that it converts chemical energy directly into electrical. (See an earlier book review in *Physics Today*, Dec. 1960, p. 58.) The present book is a welcome account of intensive fuel-cell research carried out under industrial sponsorship during the last decade by Professor Justi and his colleagues in West Germany. As its title shows, the book is concerned mainly with the hydrogen electrode. The completeness of the information released on this electrode betokens unusually enlightened sponsorship, and encourages one to anticipate early similar treatment for the oxygen electrode.

The most difficult of fuel-cell problems is to attain satisfactory electrode reactivity (hence, current density) under advantageous conditions. Justi and his collaborators have solved this problem for the hydrogen electrode by using two kinds of nickel (carbonyl and Raney) to give a microporous structure, in which the pores facing the electrolyte are smaller than those facing the gas. Others have used this structure, but no one in this reviewer's opinion has produced a better and more convenient hydrogen electrode for high current densities.

After a short and adequate introduction, the book proceeds to a theoretical treatment of the processes at a simple hydrogen gas-diffusion electrode, as the electrodes under discussion are called. The treatment is particularly noteworthy in that it strongly emphasizes the kinetic point of view over the thermodynamic; it is founded on the realization that the *rates* of physical, chemical, and electrochemical processes at the electrodes of a fuel cell determine whether or not electrons originally resident in the fuel can be made to flow *usefully* through an external circuit to be captured by oxygen. Such treatment cannot in the present state of our

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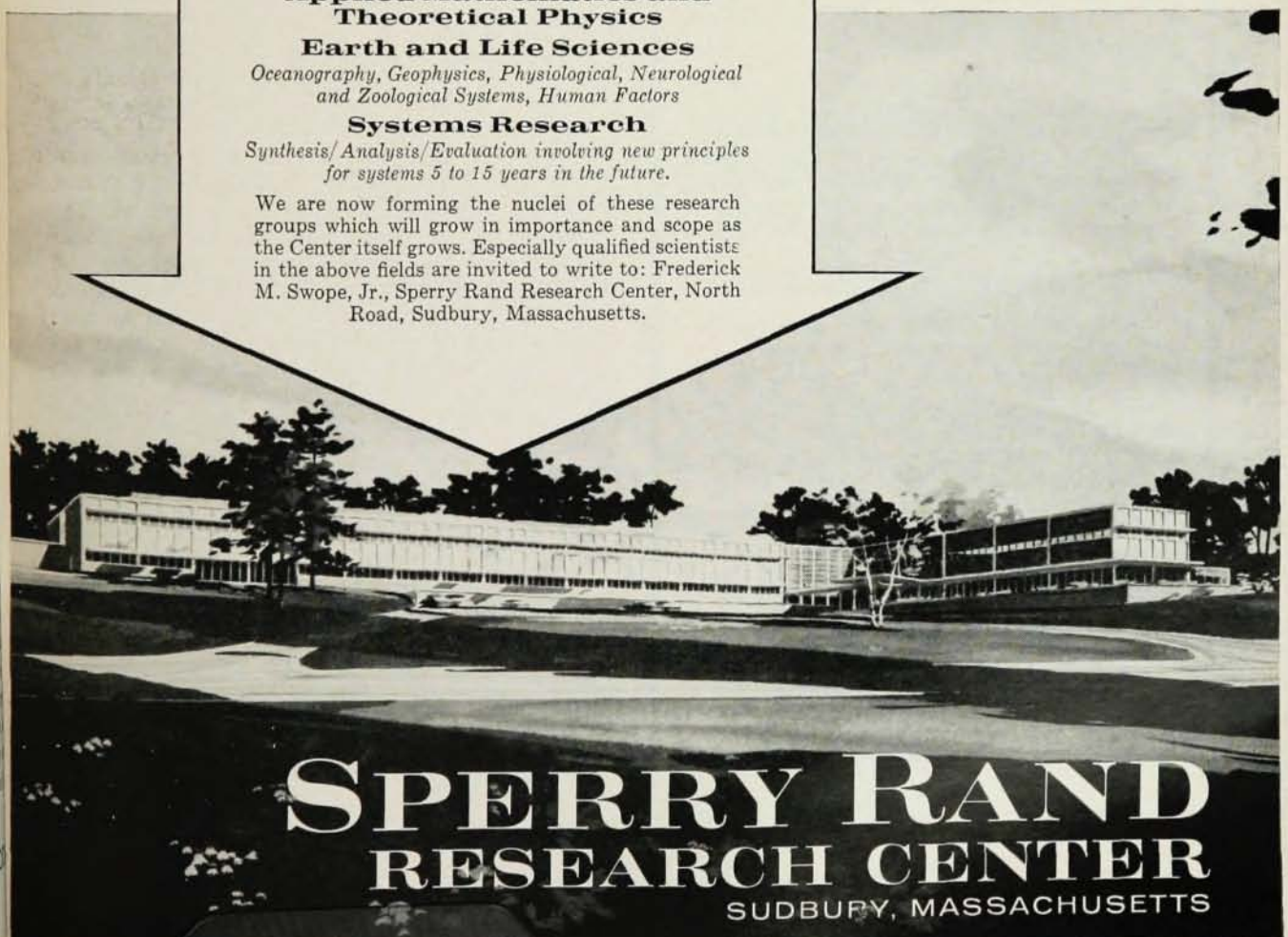

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knowledge be expected to give quantitative results for actual cells, but it serves as an invaluable guide to understanding and to further research.

The book is noteworthy also for the ingenious electrode designs it describes, for the fuel-cell applications it lists, and for the information it contains on fuel-cell developments by others—information fully up to date at the time of publication. An English table of contents and comprehensive chapter summaries in English will prove useful aids to many. The casual reader may find some of the book excessively detailed in the tradition of doctoral dissertations. Be that as it may, this reviewer looks forward to a companion volume on the oxygen electrode, which should help fuel cells along the hard road to widespread practical use.

Tables of Higher Functions (6th ed.). By Jahnke-Emde-Lösch. Revised by Friedrich Lösch. 318 pp. (B. G. Teubner, Stuttgart) McGraw-Hill Book Co., Inc., New York, 1960. $14.00. *Reviewed by A. A. Maradudin, Westinghouse Research Laboratories.*

IN common, I suspect, with many of my contemporaries, I had as a constant companion during my undergraduate and graduate school days a paperback edition of Jahnke and Emde. The innumerable references to this compilation of tables of higher functions in the scientific literature past and present amply attest to its status as the standard reference work of its kind. It was with considerable pleasure that I found the new, completely revised edition, prepared by Professor Friedrich Lösch of the Stuttgart Technical College, to be almost all that its predecessors were, and in many ways more besides. The changes in this edition are of two kinds: changes in the format and changes in the contents. The former are readily apparent on opening the book. The tables and text are set in clean, easy-to-read type. Most tables are now provided with first or second differences to facilitate interpolation. The discussions of the various functions, their definitions and properties have been expanded in every case, and the bibliography has been enlarged and brought up to date. The printing of the explanatory text in both German and English has been retained, as have the many graphs and relief maps of the special functions. An attempt has been made to bring the notations for the various special functions into line with current usage.

New tables have been added, while others have been expanded or revised. For example, to the tables of the Legendre functions found in earlier editions have been added tables of the Tschebyscheff, Laguerre, and Hermite polynomials in a section on orthogonal polynomials, while the Fresnel integrals are now tabulated for small increments of their arguments. Tables of the Einstein and Debye functions have also been included. These and other additions to the present edition were, however, not achieved without some sacrifices. For example, the Lommel-Weber and Struve functions in the new edition are tabulated at coarser