The report (186 pages) is mainly intended to provide those engaged in the solar-energy industry, as well as other users, with information and components that are encountered in the production of cost-effective solar-energy systems for heating and cooling, which involves to a great extent, components such as heat pumps, air-conditioner machines, controls, etc., that are used in conventional heating, ventilating and air-conditioning (HVAC) systems.

The report is divided into three parts: Plan, Paths and Tasks. Part 1 of the report (the Executive Summary and Sections I and II) gives the overall view of the program plan.

The second part is focussed on several approaches, called paths, (a path is simply the linking of a method of energy collection or rejection with a particular application), to the application of solar energy. This part of the report is divided into two sections: Section III for the solar energy heating and cooling buildings, and Section V for agricultural and industrial process applications. Section III describes ten such paths: (a) service hot water (2 paths); flat-plate liquid-heating collectors and flat-plate air-heating collectors; (b) space heating (4 paths), direct solar heating, solar-assisted heat pump, flat-plate air-heating collectors, and flat-plate liquid-heating collectors; and (c) space cooling (4 paths), evaporative cooling, night sky radiation, or cool night air without energy conditioning equipment; concentrating collectors with absorption or vapor compression chiller (operating at moderate temperatures); and flat-plate collectors with dessiccant machines for air-conditioning or dehumidification. These ten paths differ in character; some require an emphasis on materials development, some on system analysis and some on component development and testing. In Section IV, there is just a list and very brief discussion of eleven paths for agricultural and industrial process applications, but without describing them in detail.

The third part of the report (4 appendices) present detailed information on the specific tasks that should be undertaken to move along any of the paths, whether in series or in parallel. Appendix A gives flow diagrams for the heating and cooling tasks. Appendix B includes brief descriptions of these tasks and of the non-engineering tasks. Approximately 275 tasks are identified and divided into five categories: solar collectors, thermal storage and heat exchange, solar air-conditioning and heat pumps, systems and controls, and non-engineering aspects. The importance of each task to a given path is indicated by a number, and the tasks for each path are placed in functional categories and arranged in sequence, giving each path a logical development. Appendix C lists the importance number for all of the solar heating and cooling engineering, while Appendix D indicates the importance and priority of each non-engineering task to the overall R & D program. The report emphasizes that the solar heating and cooling 10 paths for buildings applications are to be cost effective if key problems can be solved. However, the report is calling for both information dissemination and component development.

A-M. R. REZK

STANLEY F. GILMAN (Coordinator and Editor), **Solar Energy Heat Pump Systems for Heating and Cooling Buildings.** ERDA Doc. COO-2560-1, Con. 7506130. The Pennsylvania State University (June 1975).

THIS document (248 pages) is the proceedings of a workshop on solar-energy heat-pump systems for heating and cooling of buildings, conducted by the Pennsylvania State University College of Engineering, June 1975, and financed by U.S. Energy Research and Development Administration (ERDA). The theme of the workshop is mainly exchange of information and ideas on solar heat-pump systems, designs, applications, equipment and performance characteristics. The document also shows public-utility view points on the potential of heat-pump systems, federal programs and future research and development needs.

The proceedings contain 32 papers complete with their discussions and working group session reports, grouped in 6 parts. Part 1 has 5 papers on the descriptions and discussions of recent solar energy heat-pump systems. Part II (7 papers) concerns evaluation of a solar building, design philosophy of a residential system, closed-loop system for moderate size commercial building, a turbo-compressor air-conditioning system and a Rankine-cycle vapour-compression (RC-VC) heat pump, featuring pivoting-tip vanes.

In part III, 4 papers deal with compound systems: solar boosted and cascaded heat pumps, solar augmented air-to-air systems, and systems utilizing combined solar-energy and internal heat sources. Another 3 papers present a comparison of systems for a proposed building, installations in cold climates, and energy use analysis and residential construction techniques.

Part IV contains 7 papers about various heat-pump systems, e.g. solar systems in a commercial building, water-source and air-to-air systems, heating and cooling systems, large built-up systems, and engine-driven heat pumps. Part V is a group of 6 papers, half of them are studies of residential solar heat-pump design, solar steam-turbine driven heat pump, and analytical comparison of systems. The other 3 papers are about analytical evaluation of the impact of electric heating loads on utility operation, energy availability and the electric utility view point, and probable future researches and development.

The last part presents brief reports of the working-group sessions; Group A reporting on heat-pump fluids and machine interactions, Group B on heat pump and collector interaction, Group C on heat and storage system interaction, and Group D on system modelling.

It will be apparent that these 32 papers with their discussions and the enormous lists of references gathered in this document will be of use to researchers, consulting engineers, manufacturers and public utility representatives when concerned with design, equipment selection and optimum models of operation of a solar heat-pump system for heating and cooling of a building.

A-M. A. REZK

A. A. M. SAYIGH (Editor), **Solar Energy Engineering.** Academic Press, New York (1977), 506 pp.

THIS book by a panel of 18 international contributors from eight different countries, is concerned with research and development into utilizing solar energy. As the editor has recognised the insufficiency of texts for scientists and engineers on solar energy, he based his selection of contributors and topics so as to provide ample information on all forms and topics of solar energy, thus making the book in the general form to serve as an international text book as well as a work of reference.

The wide range of topics, scope and authority of this book can be sufficiently indicated by the following list of contents: the sun and celestial vault by Enrico Coffari; solar irradiance, total and spectral by Thekaekara; solar energy availability prediction from climatological data by Sayigh; heat transfer for solar-energy utilization by Sabbagh; liquid-flat-plate collectors, and convective heat-transfer effects within honeycomb structures for collectors by Charters; solar air-heaters and their applications by Kudret; concentrating collectors by Meinel; solar pond by Savage; solar furnaces by Takemaro; photovoltaic conversion and application of solar energy in space by Backus;

conversion of solar energy into electricity and storage of solar energy by Kattani; refrigeration and air-conditioning by Brinkworth, solar heating and cooling of homes by Yellott; solar production of hydrogen by Veziroglu and Kakac; solar energy measuring equipment by Wood; fundamentals of water desalination by Howe and Tleimat; economics of solar energy by Sayigh.

This book can be divided into four parts, apart from the first and last chapters written by the editor: chapter 1 dealing with the scope and advantages of solar energy and serving as a short introduction to this book, and chapter 21 at the end of the book, discussing costings of solar appliances. The first part, containing chapters 2 and 5, discusses the nature of the sun, solar radiation spectrum, estimation of total, direct and diffuse radiation, and heat-transfer fundamentals for solar energy utilization. The second part composed of chapters 6, 7 and 8, outlines fundamentals, fabrication, and uses of water and air heaters. The third part having chapters 9 and 11, deals with optics, concentrating collectors and solar furnaces. The fourth part, represented by chapters 10 and 12 to 20, discusses various applications of solar energy, e.g. solar pond, solar distillation, photovoltaic conversion of solar energy, solar refrigeration, solar hydrogen production space applications and solar measuring equipment.

Apart from the few errors and repetitions which are bound to occur in such a book of wide scope, the reviewer considers the contents of each chapter to be well rounded; but detail is sacrificed to clarity of the concept, particularly in chapter 16 (refrigeration and air-conditioning) which is rather elementary and lacking details and diagrams of actual systems or projects, and chapter 17 (solar heating and cooling of homes) which is a general and brief presentation of some applications in U.S.A. The editor has laid special emphasis on the engineering aspects of the topics, so the book is best suited as an engineers reference book, but each subject covered is more exhaustively discussed in other books and documents, particularly those of the U.S. Energy Research and Development Administration (ERDA) which are not on the list of references at end of the book.

Although the editor intended to make the book a truly international textbook, yet being himself Arabian, he concentrated more on information and data concerning the Arab countries; thus in chapter 4, sunshine hours and ambient conditions curves, iso-radiation maps and tables of total solar radiation and comparison between the estimated and measured values, are only for Arab locations and territories.

Finally, the reviewer finds this book unique in covering nearly all topics of solar energy, and feels that the clarity and neatness of presentation is a classic and a help for everyone interested in solar energy, and in the design and operation of solar equipment.

A-M. A. REZK

D. R. PITTS and L. E. SISSOM, **Theory and Problems of Heat Transfer, (Schaum's Outline Series).** McGraw-Hill, New York (1978).

IN THEIR books Professors Pitts and Sissom have attempted to achieve a number of ambitious objectives. Firstly and perhaps most importantly they have attempted to write a text book that will be suitable for use by lecturers and students in tutorials and for self-study. The number of worked examples (296) and problems means that the book is worth buying for this fact alone. Secondly they have covered a number of areas; and major topics (Conduction, Convection, Radiation, Boiling and Condensation and Heat Exchangers) are covered in sufficient detail to ensure that the appropriate chapters could form the basis of several undergraduate courses. Thirdly, in their attempt at striking a balance between a mathematical approach based upon rate equations and an empirical approach, they have in the main been successful. In particular the chapters on conduction give a balanced approach to the analytical and numerical methods available for the solution of the underlying equations. The examples illustrate the usefulness of these techniques and underpin the theory. A number of flow charts and Computer programs are given. (These chapters provide an excellent background for any Engineering Mathematics Lecturer; much of the mathematical detail would however need much expansion.) Finally, due importance is given to a precise definition of the particular problem being considered and all important relationships are clearly highlighted.

The authors are to be complimented on their work and I am sure that the book will find its way on to many bookshelves where it will be a valuable supplementary text book and source of exercises and problems.

R. D. GIBSON
Department of Mathematics, Statistics and Computing
Newcastle upon Tyne Polytechnic
Newcastle upon Tyne
U.K.

D. B. SPALDING (Editor), **Physicochemical Hydrodynamics, V.G. Levich Festschrift.** Advance Publications, London (1977), pp. X/V 1076.

THESE two substantial volumes contain the contributions to the conference held in Oxford in July 1977 to mark the sixtieth birthday of Benjamin Levich. The title is that used by Levich for his famous book first published in 1952. One of the outstanding features of this collection is an article by Levich himself describing the subject he invented and the problems which face it in its present state of development. Reading this article (which of course could not be presented by Levich personally at the conference) one is forcefully reminded that the Soviet Government has yet again impeded the progress of science by its shortsighted policy of preventing one of its ablest citizens from exercizing his remarkable talent to the full.

It is impossible in a brief review to do justice to the extraordinary range of topics covered by the seventy or more papers, but the headings of the sections may give some idea: Physical Transport, Interface Mechanics, Interspersed Phases, Chemical Hydrodynamics, Electrophysics, Electrochemistry. It is abundantly clear that this is no formal tribute to a great man but, what is far more important, part of active scientific progress, a lively cross-fertilization process in which scientists from different disciplines can learn what their colleagues are doing. In this way the lines which have diverged from the origin in 1952 can be linked and again new directions discovered. Thus it is a tribute of which the recipient and the donors can justly be proud. Professor Spalding and his colleagues who undertook the large amount of work involved in organizing the conference and the publication deserve our grateful thanks.

ROGER PARSONS
Directeur du Laboratoire
d'Electrochimie Interfaciale
du C.N.R.S.
Meudon
France

M. P. MURGAI, **Natural Convection from Combustion Sources.** Oxford and IBH (1976). pp. 377. **Similarity Analysis in Fire Research.** Mohan Primlani (1976). pp. 132.

THESE volumes are closely related as to substive physical phenomena treated, and still more so as to underlying philosophy. The author attempts comprehensive treatment