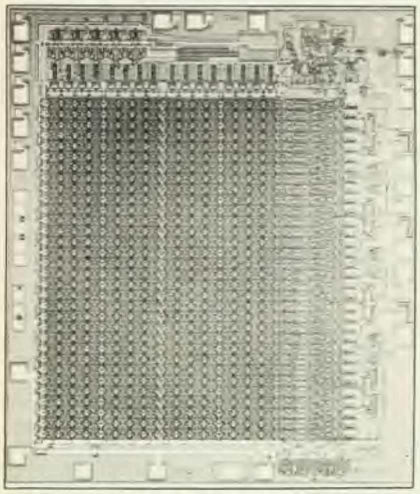
have matured under the drive of this commercial thrust. Solid-state physics, acoustics, magnetics, semiconductors and superconductivity, among other disciplines, have been extensively applied to the needs of assembling computers. More classical subjects, such as aerodynamics, optics, lubrication and fine particle dispersions, also have their place in the physics of computer memories.

Simon Middelhoek, Peter George and Peter Dekker have produced a thin volume entitled *Physics of Computer Memory Devices* from course notes that were produced for undergraduates at the Delft University of Technology. As an outline for a course in applied physics, the book would probably provide a starting



Random-access memory device. The AMS 7040 is a 256-word by 4-bit NMOS RAM produced by Advanced Memory Systems Inc, for microprocessing and memory systems.

point. The problem is the very wide range of interesting, practical physics that the title covers. Middelhoek, George and Dekker are each recognized workers in the physics of devices, especially magnetic devices, but their expertise overlaps too greatly for them to address the subject of this book effectively.

The book begins with a 12-page discussion of computer history and architecture. Since both the history and the architecture bear on requirements that the device must satisfy, and since the budding applied physicist must understand these requirements in detail to be effective in his work, this section is much too brief and too weak to be effective.

The rest of the volume is addressed to more specific technologies but does not give the flavor of the range of applications of physics to information storage. For example, the whole field of digital magnetic recording is treated in 30 pages, while the subject of delay lines gets 52 pages. Recurrent underlying themes are not emphasized, much to the confusion of any beginning student. In any text of this nature that attempts to characterize a rapidly moving field there is a temptation to be current and to project the future. This approach is doomed to failure, because the progress is so great that what was the leading approach two years ago is well behind now. Thus the discussion of semiconductor memories is dated in this text.

The references cited cover a very wide range of interesting subjects and would serve as a very good basic-reading guide for a course based on this text. At the price for this book, one would like either greater depth on a few general-physics topics or a much broader coverage of the general technology. On the whole, I feel that this volume misses the target and that if there is a need for a text on the physics of memory devices, then this volume does not meet it.

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Energy, Vol. 2: Non-nuclear Energy Technologies

S. S. Penner, L. Icerman
673 pp. Addison-Wesley, Reading, Mass., 1975. $19.50 clothbound, $13.50 paperbound

Energy: The Solar-Hydrogen Alternative

J. O'M. Bockris
365 pp. Halsted, New York, 1976. $27.50

Although governments and peoples act currently as if the "energy crisis" were over—as if the abatement of the oil boycott were permanent, as if Alaskan and North Sea oil and gas were infinite treasure troves whose only problems are distributive in nature—mature reflection convincingly indicates that the crisis's relaxation is only temporary. The energy problem remains with us—the conflict between finite, non-renewable energy resources and the continuing growth in world-wide energy demand, seen as reflecting the desired growth in general prosperity. There is thus a continuing need for public review and debate on the problem and its proposed solution paradigms, and hence a market exists for books to guide and inform these discussions.

In a democratic society the decision-making layman needs some insight into the basic scientific background to the supply and use of energy, as well as to the side-effects of such use. He must have some idea of the constraints imposed by science and nature, so as to know what to expect and what not to expect. It is obvious that there will be no perceived need for individual or societal change or sacrifice if it is generally believed that technology will be able to supply unlimited quantities of the desired energy at low cost. By "cost" I mean to include here the usual economic costs, as well as environmental and societal changes and the constraints placed upon the lives of future inhabitants of our finite planet.

Those who will mold and carry out the decisions of the citizenry—technologists, both presently working and students—have need of a comprehensive picture of the problem so as to be able to guide the discussions of their fellow citizens and to insert their own skills most productively for themselves and their society. They will have to know more than technology and its foundations in physical science; historical, societal, political and resource limits may place more severe constraints upon their advice and actions than are placed by the laws of the physical universe.

For all concerned, there are two ways to look at "the energy problem," in the short term and in the long term. The short-term view of the problem—of which Project Independence is characteristic—seeks solutions in the form of changes from one type of existing resource to another. For example, one may seek to replace Mid-Eastern oil by Alaskan oil, by oil from coal liquifaction, or by oil from tar sands and oil shales. Primarily, this approach requires a narrow engineering view—how to build new energy-extraction equipment cheaply and reliably. It is taken for granted that there are vast quantities of these "new" resources (enough to warrant the capital investments required); all that is needed is the means to tap them and convert them into close approximations to the usual fuels.

The long-term view looks to the running out of all non-renewable (fossil) fuels and is concerned with the overall picture, including global pollutional problems as we burn off all of the Earth's carbonaceous fossil fuels. From this perspective, one asks questions such as: What will be the impact on the presently perceived long resource lifetime of coal if we proceed to derive all of our increasing petroleum demands from liquified coal? Will the vast amounts of energy required to develop new, post-fossil-fuel energy sources be available to us when we get around to seriously attempting to create and deploy such resources?

The two books under review here illustrate this short-term, long-term dichotomy. The book by Stanford S. Penner and Larry Icerman embodies the short-term, engineering point of view (though to be fair, it is part of a three-volume set, the other two of which, *Demands, Resources, Impact, Technology and Policy* (1974) and *Nuclear Energy and Energy Policies* (1976)—not under review or seen by this reviewer—may contain contributions to the long-term discussion). It is a textbook, apparently directed toward engineering students and practicing engineers. Certainly scientific, engineering, and economic concepts and terminology are often used without prior definition or explanation, and little explanation is devoted to the scientific underpinnings of the problems or solutions offered. The authors' contributions to combustion science and thermodynamics, and their professional involvement with *in situ* use of fossil fuels, the "hydrogen economy," the solar sea-power plant and hydrothermal energy generation is reflected in the book's comprehensive coverage of current engineering developments in these felds. They also discuss other aspects of solar and terrestrial energy sources, energy storage and transportation. The book contains a tremendous amount of numerical information about these subjects, though specific facts are often hard to find via the index.

The ordering of topics in the Penner—Icerman volume is somewhat peculiar, from a fundamental point of view. For example, the discussions on the transportation of energy appear in several widely separated parts of the book, with little attempt to link them; the same is true for the storage of energy. A number of current topics are, surprisingly, omitted: There is no discussion of the storage of hydrogen as an automotive fuel via metallic hydrides; almost no effort is spent on probing discussions of overall efficiency and comparisons of different approaches; when estimates of resource availability are given, there is usually no critical discussion of the methodology behind these availability or cost estimates. In sum, the book is a well-written, descriptive, short-range approach, with no attempt at policy prescription or criticism.

In contrast, John O'M. Bockris's book attempts the long-term view. The volume's central core is an obsession with the possibility that fossil fuels will run out before the successful development of acceptable replacement resources. As a consequence, the book is full of long-range forecasts—such as those of the Club of Rome—, comparisons of various approaches, and policy prescriptions. In spite of the author's productive career as a research electrochemist, the book is not limited to such subjects as hydrogen production, batteries, fuel cells and solar cells; in fact, Bockris is more complete in his coverage than are Penner and Icerman.

The audience for this book is not obvious—the policy prescriptions and comparisons of approach might be directed toward laymen, but this group would find the discussions of science and technology incomprehensible. It is doubtful that uninformed technologists will find the book much more suitable, because explanations are often too short or taken from other references without the necessary introductory or bridging logical statements. Too often, Bockris substitutes repetition for explanation; the book is poorly written, full of obscure sentence and paragraph structure. The overall impression is that of a complete set of notes and references on the subject for someone who is about to write a suitable book. As such, this work will probably be very useful to someone already very knowledgeable about the entire subject area. Certainly Bockris raises the right questions; he points out how past and present policies often result from blindness to scientific and economic realities. He links facts to policy to action.

Both books contain great quantities of information of use to people already knowledgeable in the subject, but I suspect they will be of little use to laymen or to scientific outsiders. Neither volume provides the needed overall view, careful writing and comparisons of approach found in some of the older, distinguished books on the subject. Examples include *Energy Sources: The Wealth of the World,* by E. Ayres and C. A. Scarlott; *Energy and the Future,* by A. L. Hammond, W. D. Metz and T. H. Maugh; P. C. Putman's *Energy in the Future;* "Energy and Power" by C. Starr, published in *Scientific American* (September, 1971), and H. Thirring's *Power Production:*

The Practical Application of World Energy. Such books, though perhaps not as numerically complete as the books under review, were not only suitable for laymen but offered comprehensive insights that enabled them to help engineers overcome their occasional professional narrowness and short-term views. We still await such definitive books of this generation. With their aid, we—layman and technologist together—may plan both the tactics and strategy for our future life in a world of diminishing fossil energy sources but (one hopes) increasing renewable possibilities.

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Microwave Circuits and Amplifiers: The Physics of Transmission Lines at High and Very High Frequencies, Vol. 2

P. Grivet
749 pp. Academic, London, 1976. $79.50

The increasing spectrum congestion at conventional frequencies impels the modern communications engineer to shift his projects into the microwave range. Also, the current trend to replace analog equipment by digital devices calls for the development of circuitry at frequencies that lie several orders of magnitude above the original working range of the analog system. As the author points out in his preface, beyond about 500 MHz even the long-familiar idea of "connection" loses all its simplicity, giving way to the "connection quadrupole" formed by a transmission line or a waveguide.

As a consequence, a marked revival of interest in specialized applications of microwave techniques has recently become evident. To find effective solutions to the multifaceted problems encountered, a thorough knowledge of the theory and practice of transmission lines is obviously required. Although extensive literature has accumulated on this subject over the course of years, one can observe that relatively few authors add new points to the basic approach outlined in a few classic works. Especially in modern applications the designer is often forced to synthesize his approach from a tedious study of a large number of different sources. The book by Pierre Grivet constitutes a rare exception in this respect. Based on the most advanced theory, it reviews in a clear and concise manner the subject of transmission lines as applied to the microwave circuits and amplifiers of today's practice.

After an introductory discussion of line parameters, the circle diagram and the physics of pure and partial standing-wave operation, the author examines available methods for calculating the properties of various quadrupoles. Grivet then analyzes problems associated with power transfer, amplification and matching. He concludes by treating multipoles, line coupling and directional couplers, with the help of extended matrix techniques.

The text offers the reader a clear insight into problems associated with the design of transmission lines and with their application in power transfer, amplification and measuring techniques. By outlining a problem and showing its analytical solution, the author finds in many instances an optimal coupling between theory and practice. Here is a book distinguished not only by a new approach to conventional subject matter in the application of the latest tools of mathematical physics, but which in many cases thoroughly discusses problems hardly touched by other authors. The scientist and the experienced engineer, as well as the interested student, will certainly find it a very useful reference.

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book notes

Principles of Laser Plasmas. B. Bekefi, ed. 695 pp. Wiley, New York, 1976. $35.00

Electrical discharges of the lasing medium are the central concern of this volume. After an introductory survey section the book's eleven contributors get down to business with four chapters on particle collisions, two on distribution functions and instabilities, three on laser systems (including excimer lasers and the electrically- and e-beam-pumped molecular lasers), two on laser interactions with gases and one on plasma diagnostics. The presentation is largely nonmathematical, and the book is intended as a reference tool for research physicists, chemists and electrical engineers.

Cosmology Now. L. John, ed. 168 pp. Taplinger, New York, 1976. $10.95

Ten prominent astronomers, all but one of them theoreticians, contributed to this book, which seeks to explain at a nontechnical and nonmathematical level what is known and conjectured in the field of cosmology; the ten are Hermann Bondi, Donald Lynden-Bell, William H. McCrea, Jayant V. Narlikar, John Peach, Roger Penrose, Martin Rees, Martin Ryle, Dennis Sciama and John Taylor. One