

placed" and "Will fusion energy from the D-T cycle prove the sovereign power? Or hydrogen from water?" The author, Roy Meador, is identified only as "Science Writer, Ann Arbor, Michigan." The writing is flamboyant, verbose and full of poetic quotes of doubtful relevance. The science is often missing or wrong: The constant reiterations of "inexhaustible energy sources" betrays a lack of insight into the First Law of Thermodynamics, and the bland assurances that fusion and other impending energy sources will not have any "waste heat" problems displays complete ignorance of the Second Law of Thermodynamics. Meador seems to confuse the amount of a resource with the time necessary to produce it; thus oil is presently in short supply apparently because "Nature needed over 40 million years to make a barrel of petroleum."

In our democracy every citizen should be aware of the dimensions of the current energy crisis, that is, national and international energy demands and the resources available to meet those demands. More importantly, in terms of societal decision making, the citizen should have some knowledge of reasonable projections of energy demand and anticipated energy resources so as to be able to estimate the present and future costs of alternative actions or lack of action. Many recent books, by individual authors and by committees and addressed to technical and lay audiences, have attempted to advise our citizenry on these matters. Meador's book commendably attempts to do the same; it is a survey of future energy resources in the context of today's energy crisis. It is, however, full of errors, misstatements and contradictions, betraying overly rapid and faulty writing and/or editing. Meador presents no quantitative comparisons between different approaches; the giving of a name, or quotation, or reference to another author, often substitutes for explanation or analysis. Meador constantly refers to economics and the role of high costs in presently denying us this or that energy resource, but does not attempt to explore the factors determining such costs. The book seems to be full of hopes (good hopes), but it keeps confusing hope and reality.

To his credit, Meador presents a series of questions important for our energy future. However, he neither answers them nor phrases them precisely enough to know how to answer them. But he does raise the questions! At the end, the book attacks the general public's complacency with regard to energy matters and its peculiar combination of hostile and complaisant attitudes toward technology. Meador correctly points out the shortsighted foolishness of those who don't believe in "the energy crisis" and who attribute fluctuations in the expected costs and supplies of energy solely to corporate greed or political desires. Unfortunately, his book is neither authori-

tative enough nor sufficiently concrete to persuade these doubters of the reality of the crisis. More importantly, it offers neither "doubter" nor "believer" any criteria upon which to base the necessary energy-policy decisions that our society constantly faces and that, almost as constantly, it seeks to avoid.

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Atom and Ion Sources

L. Valyi

429 pp. Wiley-Interscience, New York, 1977. \$41.00

For many scientists the understanding of atom- and ion-source operation is limited to the empirical art of producing a beam adequate for the purposes at hand. As such sources find increasing applications to technology, in ion implantation and other fields, it is necessary that the subject be placed on a firm scientific footing and removed from the realm of black magic. It is indeed an opportune moment for a comprehensive monograph such as *Atom and Ion Sources* by Laszlo Valyi. The stated aim, from the preface, is to provide both a textbook on the physical processes taking place in sources and a manual for guidance in the selection of a source appropriate to a given task.

Valyi opens his book with a useful review on the atomic and molecular processes that govern source operation. Three separate chapters follow on sources of atoms, sources of positive ions and so-called "special ion sources"; the latter category includes sources of negative ions, nuclear-spin polarised ions and methods of producing pulsed beams. The coverage is encyclopaedic in form with discussions of sources in practical use as well as those of only historic interest. Numerous excellent diagrams of source construction are given, along with voluminous references to the original papers. In each case Valyi provides a capsule description of the more important operating characteristics.

It is confusing to find discussions of such matters as output-beam energy spread, emittance and composition relegated to the final chapters and somewhat remote from the description of the sources to which the comments refer. Valyi does address very briefly the important question of how to monitor the output of a source; this discussion, however, is relegated to an appendix and is quite inadequate.

The format is that of an encyclopaedia of source designs rather than a textbook. Fully 80% of the references are dated before 1966 and predate modern techno-

logical applications; thus the encyclopaedia is largely out of date. The technologist concerned with source design will seek guidance as to the selection of a source for a problem at hand. He will seek in vain. Valyi provides little comparison between characteristics of different sources and no guidance as to choice for current technological applications. The technologist is far better served by a book such as *Ion Beams* (1973) by Robert G. Wilson and George R. Brewer (also published by Wiley), which, despite a concentration on ion implantation, does provide guidance as to source selection and optimisation. The research scientist will find Valyi's book to be a useful compendium of information, but he too will be conscious of shortcomings. For example, the excited-state composition of an ion or atom beam will substantially influence the atomic physics of its interaction with a target; nowhere in this book is the excited-state composition of sources discussed. Recent developments that permit production of excited-state selected beams are completely absent from this text.

This book is unusual in that it is a joint production between John Wiley and the Hungarian publishing house Akadémiai Kiadó of Budapest. This perhaps explains the numerous editorial inadequacies such as misspelled names in the bibliography and clumsy use of colloquial scientific terminology in the English language. Other errors, such as incorrect references to figures, also serve to annoy the reader. Despite the shortcomings the book will find much use as a reference simply because no other comprehensive treatise is available. The reader will be disappointed by the lack of up-to-date information, and the absence of any clear fundamental explanation of why sources give their observed performance. Valyi has failed to raise the subject of atom and ion "sourcery" from a black art to a science.

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Scientists under Hitler: Politics and the Physics Community in the Third Reich

A. D. Beyerchen

287 pp. Yale U. P., New Haven, 1977. \$18.50

This is an important book; it is also a very timely book. The title instantly evokes the "German science" movement and especially "Aryan physics"—that all-too-well known example of political

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Philipp Lenard receives the congratulations of Paul Schmittner, rector of Heidelberg University for his honorary degree. Alan D. Beyerchen discusses Lenard's advocacy of "Aryan physics" in his *Scientists under Hitler*, reviewed here. (Photograph courtesy of Heidelberg University)

choices and pressures overriding the traditional values of scientific research. The episode appears, indeed, to be well known in its broad outline: Nearly every work on science or scientists in the 1920's and 1930's refers to the ostracism of Einstein and relativity or to emigration forced on German scientists of Jewish origin as the only alternative to persecution by the Nazi régime. References to the proponents of "German physics"—Philipp Lenard and Johannes Stark—have become popular also among sociologists of science, perhaps partly because the spectacular absurdity of the phenomenon makes it easy to remember as an illustration of the ultimate imperviousness of science to political influences. With the exception of David Irving's pioneering study *The Virus House: Germany's Atomic Research and Allied Countermeasures* (W. Kimber, London, 1967), scholarly attention has focused primarily on the functioning of the scientific and academic system within a political environment, and the response of individual scientists—*qua* scientists—to it, with a tendency to neglect the intricacies of the relationship between the scientists—*qua* citizens—and that particular political situation. As a result, the story of science under Hitler tends to be gradually isolated from its specific political context, that is, its historical reality, and to transform itself into a sociological cliché.

Alan Beyerchen is a historian. He is far from ignoring the concerns and the analytical framework of sociology of science, and he discusses clearly the scientific substance involved. But he firmly delineates the relative position of the

German physicists on the political checkerboard of the 1930's and early 1940's, in explicit opposition to that widespread tendency to project the political role of the scientific community as it is perceived today on a situation prior to World War II. He addresses himself essentially to three broad questions: the extent of the quantitative and qualitative loss inflicted upon German physics by the national-socialist legislation of dismissal and expulsion; the particular intellectual tendencies within the German community of physicists, especially the movement of "Aryan physics"; and the moral and political reaction of those physicists who neither emigrated nor chose to bring their science into line with the political ideology in power.

These questions are of course familiar—they are the very questions that have been raised over and over again the last forty years—but no previous commentator has given the answers with comparable thoroughness and cautious precision. Although the chapter on the content and mechanics of the dismissal policy and its consequences is fundamental to the study, the part on "Aryan physics," its proponents, and their motives and politics is the most illuminating. Beyerchen demonstrates how little Lenard's and Stark's line of thought had to do with science proper, and to what considerable extent it was, for both of them, an attempt to redress earlier personal grievances. Their professional isolation and frustration predated their commitment to *voelkische* ideology and national socialism. Their determination to impose their canon of "German science"—as opposed to "Jewish science"—as a binding principle in mat-

ters of recruitment, promotion and funding policies, reflected their desire to get even with the majority of their fellow physicists, including the theoretical physicists in particular, whose ideas they had failed to follow and by whom they had felt consistently ostracised.

Beyerchen explains why, in spite of a political *conjoncture* that at first sight was extremely favorable to the rise of "Aryan physics," the movement did not succeed in establishing control over German physics and declined before the collapse of the Nazi régime itself. Lenard and Stark, founders and principal proponents of the movement, had been isolated for years when Hitler came to power, and although political opportunism and constraints helped "Aryan physics" to gather some following, it never rallied more than a minority of academics. More articulate about the kind of ideas it opposed rather than those it promoted, "Aryan physics" remained vague, intellectually inconsistent and dominated by personal animosities—"a set of fundamentally incompatible concepts" (page 140). This made it relatively easy, intellectually, for other physicists to defeat the "Aryan physicists" in scientific discussion, although, given the political distribution of power, it remained politically dangerous and required personal courage.

It was fortunate for the physicists who wanted to maintain the scientific standards of their discipline that the politics of Lenard, Stark and their followers was, as Beyerchen puts it, as bad as their physics. Although Stark rose to leading positions in the hierarchy of organized science, the movement did not succeed in obtaining reliable political backing. The higher echelons of the German government were relatively unconcerned with the internal problems of the physics community, notwithstanding Hitler's distrust of academics and some platitudes he had expressed about science as a social endeavour. Success therefore depended on skillful mobilization of competing second-echelon agencies. A succession of bad choices—not only of allies, but also of enemies (such as the Prussian Ministry of Education)—weakened the position of the Aryan physicists.

When government leaders finally showed interest in scientific activities, they were less concerned with ideological purity than with practical results. The fact that physics was recognized as relevant to the war effort strengthened the position of the "professional" physicists, as Beyerchen calls them, and gave credit to their request for the application of scientific, rather than ideological, criteria in the policies of research and higher education. Theoretical physicists, especially Heisenberg and his group, gained influence through the German Atomic Program. Beyerchen discusses the various reasons for the failure of that pro-

gram. He does not omit the alleged desire of the physicists to keep an atomic weapon from being placed into the hands of Hitler, but he avoids carefully any definite statement on the issue.

One of the major qualities of the book lies in Beyerchen's discussion of the moral problem. Beyerchen avoids relying exclusively on the usual references to the traditions of the German professoriate and the traumatism of 1918-19. Instead of wondering—with the benefit of hindsight and from a safe distance—why German scientists did not react more rapidly and more thoroughly to the dismissal policy in particular and to the Nazi dictatorship in general, Beyerchen tries to grasp the political challenge in its perplexing day-to-day reality and fragmentation. Without political leverage as a group, with a strong, albeit illusory, ideal of scholarly pursuit quite remote from political entanglements, and confused in the beginning by the superficial legality of the dismissal policy, the German physicists were hardly prepared to recognize the extent of the growing danger and to take appropriate action. In the course of his book, and looking far beyond the well-known circle of the famous, Beyerchen cites interesting examples of reaction against political pressures and initiatives that, although far from being the great gesture of resistance, required personal courage. He rightly observes that such reactions were generated by the desire to preserve professional values and, consequently, a possibility of retreat from political involvement, rather than by fundamental opposition to the régime. But he adds immediately that this should not be interpreted as cowardice: "The truth was not that the scientists were political cowards, but that they did not know how to be political heroes." It would be foolish indeed to expect that scholarship could lead to the answers to these ethical questions.

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Fiber Optics in Communications Systems

G. R. Elion, H. A. Elion

245 pp. Marcel Dekker, New York, 1978.
\$19.50

The use of glass fibers as a telecommunications medium has excited the interest of scientists, engineers and businessmen throughout the world. Since 1970, when the first low-loss (20 dB/km) fiber was announced, more than an order-of-magnitude further reduction in attenuation has been achieved. Also in 1970, the first semiconductor-injection laser to radiate

continuously at room temperature was reported, and now lasers are being made with an extrapolated mean-time-before-failure at room temperature in excess of 10^6 hours. Similar rapid advances have been made in all other aspects of fiber-optic communications technology; and within the last few years, a large number of experimental and actual service-carrying systems have been installed throughout the world.

The father and son team of Herbert and Glenn Elion have provided one of the first books that cover all aspects of this new field: Their book includes chapters

on fibers and cables; couplers, connectors and splices; light sources and modulators; photodetectors and repeaters; system design, and economics and applications. The book appears to be addressed more towards potential users of the technology rather than to workers in the field. (An appendix provides a listing of company addresses and products.) The Elions state results without derivation, and their sparse discussion provides little background or insight. Although they follow each chapter with a long bibliography arranged as to subject matter, they do not cite the entries in the text.

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