book is not, nor was it intended to be, a reactor-physics text. For the most part it is restricted to the one-speed problem. The whole question of suitable methods for treating the energy variable, which in reactor analysis is just as important as the spatial and angular variables, is ignored. For this the interested party must refer to the standard reactor-physics texts of Alvin Weinberg and Eugene Wigner, Meghreblian and Holmes, and others, or the recent book by M. M. R. Williams, *The Slowing Down and Thermalization of Neutrons*, which treats the energy variable almost exclusively.

For its fine discussion of the application of the singular-eigenfunction method to linear-transport problems, this book can be recommended without reservation. Although most of the problems solvable exactly in transport theory can be handled by other methods (Fourier transforms, Weiner–Hopf techniques) the singular-eigenfunction method is a single technique that handles most, if not all, such problems. With the critical-slab problem, it is the only known method that yields a solution. Because of its relatively wide utility and elegance, all physicists interested in transport phenomena should become familiar with this technique. This book is an excellent means to gain this familiarity, and it will be a valuable reference to have in one's personal library.

* * *

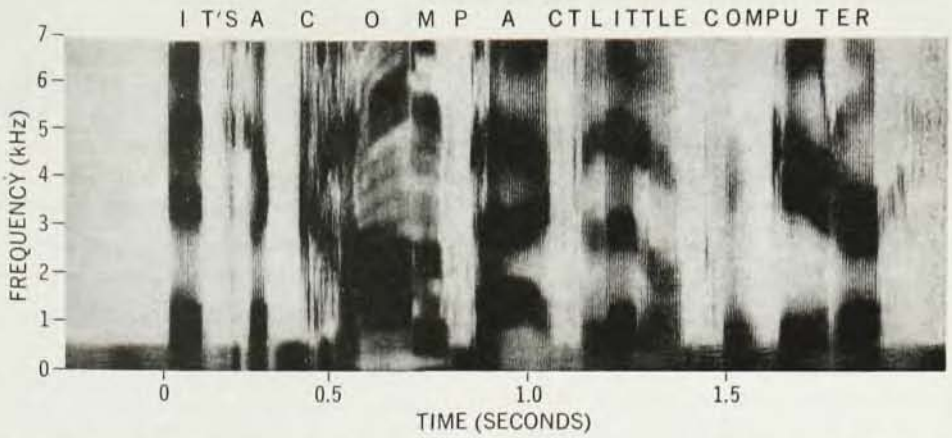
The reviewer, a physicist with Gulf General Atomic Incorporated, does work in reactor physics and transport theory.

Acoustics of speech

READINGS IN ACOUSTIC PHONETICS. (Reprint collection) Ilse Lehiste, ed. 358 pp. MIT Press, Cambridge, Mass., 1967. $10.00

by Sanford E. Gerber

To assemble a collection of readings that is more than just an odd assortment of reprints requires that the assembler apply some unifying criterion beyond a commonality of subject matter. The outstanding unifying criterion in this volume was, ". . . to present articles in which an original idea was formulated for the first time." For one to determine the extent to which this criterion was satisfied would demand the same labor that Ilse Lehiste has done; I am confident that she has satisfied it. I am not confident, however, that the criterion of originality is the best one. I would wonder if some of these first articles were altered, modified or refuted by later studies, perhaps by the same authors. I would wonder, then, if the book's historical value might exceed its scientific value in some places. For example, the volume contains some papers that deal (at least in part) with the theory of distinctive features of Jakobson, Fant and Halle. This is a most important theory; but there is nothing in this book that indicates the theory is also a controversial one.



FREQUENCY SPECTRUM as a function of time for the sounds in the sentence "It's a compact little computer" as recorded by a Bell Telephone Laboratories spectrograph.

All told there are 32 papers reproduced (not reprinted) in this volume. Lehiste seems to have done a satisfactory job of meeting an additional criterion of completeness in terms of subject matter. There are seven papers on acoustic theory and speech analysis; 15 on acoustic structure; and 10 on the synthesis and perception of speech. Her other criterion, ". . . whether the article was difficult to obtain" did not seem to be a very rigid one. There were only five papers that I had not previously read. Her concept of difficulty was based on linguists' habits of not visiting physics or engineering libraries. I doubt that this is a good criterion, and it caused her to omit articles "of linguistic or phonetic journals." This probably led to some serious omissions. Actually, she used nine different journals and one Festschrift; but 20 of the reproduced papers appeared in the *Journal of the Acoustical Society of America*.

While one may take issue with Lehiste's choice of selection criteria, her competence to do so is not an issue. She was educated in Estonia, in Germany, and at the University of Michigan where she was associated with the late Gordon Peterson. She is currently professor of linguistics and chairman of the division of linguistics at the Ohio State University.

I continue to find this a useful book. It contains a number of papers to which I often wish to refer, and I can now go to this one source instead of digging through my journals and files. It would also be a valuable adjunct text for a graduate-level course in phonetics or in communication science. Its text value would be greater if it were an anthology rather than just a compilation, that is, if the author had commented on each paper.

In summary, while the book is not all that I would like it to be, I like what it is. It would be a useful addition to the library of anyone active in speech research, communication science or language engineering.

* * *

The reviewer is at the Speech and Hearing Center of the University of California, at Santa Barbara.

A particle gold mine

CURRENT ALGEBRAS AND APPLICATION TO PARTICLE PHYSICS. By Stephen L. Adler, Roger F. Dashen. 394 pp. W. A. Benjamin, New York, 1968. Cloth $12.50, paper $5.95

CURRENT ALGEBRAS AND THEIR APPLICATIONS. By Bruno Renner. 177 pp. Pergamon Press, Oxford, 1968. $9.00

by Jeremy Bernstein

As early as 1960 Murray Gell-Mann realized that the currents through which leptons interact weakly with each other commute, as he then put it, like "angular momenta." It occurred

to him that, if one demanded that the full weak currents, including the strongly interacting particles, obeyed, or were made to obey, the same algebraic relations as the leptonic currents, then this could constitute a new interpretation, or definition, of the universality of the weak interactions. Moreover since these commutation relations are nonlinear—the commutator of two currents is proportional to a third—they might be used to set the scale of the effective coupling constants in the various weak processes relative to the constant that governs muon decay, the only decay that involves leptons alone. From these fundamental and elegant ideas has come the whole explosive development of current algebras that is the subject of two books discussed in this review: *Current Algebras and Their Applications* by Bruno Renner, who was at Cambridge University in 1966 when he gave the lectures on which his book is based, and *Current Algebras and Applications to Particle Physics* by Stephen Adler and Roger Dashen of the Institute for Advanced Study, Princeton, N. J. All three authors have been active workers in this field, and Adler and Dashen are responsible for several interesting recent developments. The most notable developments are the Adler–Weisberger sum rule, which is the quantitative expression of Gell-Mann's idea of using the commutation relations to set the scale of the coupling constants, and the Dashen–Gell-Mann attempt to find a complete phenomenological model of hadrons by studying matrix elements of current commutators between states with infinite momenta.

Both books cover about the same material. Neither one is, strictly speaking, useful for what Renner refers to as the "uninitiated reader." Renner provides, however, a brief introductory chapter in which he sketches the highlights of such basic notions as SU(3) and the quark model. This chapter is probably not enough of an introduction to be really useful to someone coming to these notions for the first time. Renner also gives a bibliography that covers the relevant papers up to approximately the spring of 1967. Renner's list includes no less than 516 papers and is a testimony to the sort of gold mine that this field has been to otherwise unemployed theoretical physicists.

Adler and Dashen are more selective and give a bibliography of about 60 papers. In addition 22 papers—the *crème de la crème*—are reproduced in the book. Many of them, like the Gell-Mann–Levy paper of 1960 on PCAC, appear, like good wine, to have improved with age. In some cases the authors of these papers have added footnotes and corrections to the originals. Such an opportunity for second thoughts on one's physics papers is rarely available in this life. Adler's and Dashen's text—about 200 pages worth—is a model of critical exposition in theoretical physics. A reader who works through it carefully will have a relatively complete grasp of the status of current algebras, at least as it was a year ago.

Both books suffer, as do all books in physics that deal with current events—no pun intended—from the inevitable time lapse between the time the book is written and the time it is published. With these books much has happened in this dynamic field in a year. There have been the Weinberg sum rules, the phenomenological Lagrangians, and the algebra of fields, all of which will, no doubt, be included in the next edition. Even so, when one is able to obtain the sort of synoptic view of this field that these books give, one is led to wonder what it all means. Are the currents really the fundamental objects (a view that has been taken to its logical limit by Hirotaka Sugawara and others who attempt to construct the stress tensor of the world out of products of weak currents), or are the currents really a superficial manifestation of an underlying stratum of vector mesons (a view taken by T. D. Lee and others), many of which have not yet been found? In these matters theorists may well be in the somewhat passive position of the secretaries in William Wotton's description of Sir Francis Bacon: "My Lord Bacon was the first Great Man who took much pains to convince the World that they had hitherto been in a wrong Path, and that Nature herself, rather than her Secretaries, was to be addressed to by those who were desirous to know much of her Mind."

* * *

Jeremy Bernstein is professor of physics at Stevens Institute of Technology. He is a frequent contributor to The New Yorker Magazine *and is the author of the recently published* Elementary Particles and Their Currents *(W. H. Freeman & Co., New York, 1968).*

Fields, forces and material media

ELECTRODYNAMICS OF MOVING MEDIA. By Paul Penfield Jr, Hermann A. Haus. 276 pp. MIT Press, Cambridge, Mass., 1967. $12.50

by James B. Kelley

At the very outset, it should be noted that Paul Penfield and Hermann Haus do something almost no authors ever take the trouble to do; in an excellent preface, precise introduction and fine concluding chapter, they tell why the book is being written, what questions are involved and at whom the book is aimed, and give a general review of the literature followed by a first-rate list of references. As the authors point out, no really complete survey of literature in electrodynamics could ever be given in a book of this size or scope. But if such books as this served no other purpose than to bring up to date work in a field of speciality, particularly one so fundamental as this one, they would be worthwhile contributions. Of course this book does more.

For one thing, it concerns itself with the dispute between Lan Jen Chu at MIT and others concerning his formulation of electrodynamics of moving media. It also develops new material in several areas, notably in connection with Hamilton's principle and a new "principle of virtual power." The development of the material in the first few chapters is not much different from other developments of similar material. As the authors point out, however, this must be done as part of the necessary background.

In chapter 3, after giving us the usual basic Maxwell equations and the principles of conservation of momentum and energy, the authors discuss the so-called "Minkowski" (1908) and "Chu" (1960) formulations. The conclusions they reach on these two formulations is that they are essentially equivalent to their field predictions for **E** and **H** fields outside a polarized body even though they predict different fields inside the polarized body. Since these fields cannot be subjected to direct experimental verification, the differences are of lesser