puter-based systems for voice response. Much of the more recent work was carried out or was influenced by the co-editors, in their research at the Bell Laboratories.

About one-half of the papers are concerned with vocal-tract acoustics and with techniques for simulating this acoustic process, including analog and discrete-time techniques for modelling the sources of excitation and the transfer function of the acoustic tract. The theory and practice of these aspects of speech synthesis are well developed, and the treatment of these topics in the book is rather complete. Less well advanced is the theoretical and experimental basis for the control of these synthesizers from a discrete linguistic representation. The beginnings of such a theory are contained in several papers by linguists, psychologists, engineers and physicists, but with the exception of one or two papers, this volume cannot be considered as a source of material on the relations between the linguistic and acoustic representations of speech. Attempts to model the speech process with synthesizers have, however, led to a clear specification of the problems that need further research—particularly problems concerned with the acoustic representation of sentences.

The book can serve as a good reference source. It contains basic papers on linear predictive coding, on vocal-tract acoustics, on modelling of the vocal cords, and on speech synthesis by rule—papers that are scattered through a variety of journals. A few of the contributions have not previously been published, at least in the accessible literature. It represents, therefore, an excellent compilation of information for those concerned with the technology of speech synthesis, and for those who wish to use speech synthesis as a tool for gaining an understanding of the underlying speech production and perception processes.

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The Solar Chromosphere

R. J. Bray, R. E. Loughhead
384 pp. Halsted, New York, 1974. $30.00

Solar physicists have been studying the solar chromosphere for over a century, since it was first photographed at the total eclipse of 1860. In the years since 1962, added impetus has been given to chromospheric studies on two fronts. First, the announcement in 1962 of the discovery of the 300-second oscillations in the photosphere and low chromosphere has stimulated many detailed analyses of the hydrodynamics of the chromosphere. Second, the Orbiting Solar Observatories and Skylab have opened to observation the short-wavelength emissions of the chromosphere, which are inaccessible from the ground. The recent advances brought about by this impetus have produced a need for an up-to-date, in-depth review of the state of our understanding. *The Solar Chromosphere* by R. J. Bray and R. E. Loughhead has appeared on the scene at a propitious time.

Bray and Loughhead are both principal research scientists in the CSIRO Division of Physics, Sydney, Australia. Their well respected, scientific papers are devoted primarily to the observational study of the fine structure of the solar atmosphere. In addition they have written two other books on solar phenomena that have been published in the same International Astrophysics Series as the present book.

The Solar Chromosphere begins with a historical introduction, which is quite interesting but too brief for my taste. The remainder of the treatise can be logically divided into two parts: The first part consists of those chapters that describe the observational data on chromospheric fine structure, and the second part consists of chapters that describe theoretical studies of the chromosphere.

The observational side of the treatment consists of three chapters covering, respectively, fine structure observed at the limb, structure observed on the quiet disk, and fine structure observed in active regions. Except for the brief mention of fine structure in flares, these three chapters give detailed descriptions of the known types of fine structure. The authors have been very careful to present all the observational evidence, including that which is contrary to their own results, along with a balanced critical discussion. A student first approaching the subject will be overwhelmed by the incredible mass of detail. Therefore, I feel that these chapters will be of most use to advanced students and other solar physicists.

The theoretical side of the book also consists of three chapters, which discuss, respectively, physical conditions in the quite chromosphere, propagation and dissipation of waves, and chromospheric heating. By and large, this second part of the book does not measure up to the quality of the first part. For instance, I believe the authors are wrong to leave the subject of non-LTE to other sources. They recommend that the reader consult R. N. Thomas and R. G. Athay, *Physics of the Solar Chromosphere*, published in 1961, for details on non-LTE theory. However, that work is becoming dated, and, in

addition, it is very difficult reading for anyone not already familiar with the subject. Bray and Loughhead themselves point out in the preface to their book the vital interrelation between non-LTE theory and chromospheric physics. I feel that the result of their omission is an inadequate discussion of the contribution of the study of line spectra to our understanding of chromospheric structure.

Chapter 6 is a treatment of wave propagation in an arbitrary atmosphere. The authors assume the basic equations of hydrodynamics as well as Maxwell's equations, and then proceed from there to review the research on the topic. In reading through the discussion, I found several places where it could be improved. For instance, the only diagnostic diagram shown is a one-dimensional approximation to the usual diagram. It is not completely clear from the discussion that the frequency domains where wave propagation is possible are a function of wave number. The discussion of the propagation of gravity waves with radiative losses is weak.

The final chapter is a discussion of the heating of the chromosphere and the formation of spicules. The discussion of heating is already out of date. Since this material was written, new evidence has been published that suggests high-frequency waves with periods of 100 seconds or less cannot, as was originally suspected, heat the low chromosphere. The new evidence suggests that the 300-sec oscillation must be re-examined as a source of the heating.

In summary the observational half of this book is a good review of the state of our knowledge of chromospheric fine structure that will be of use to the specialist. The theoretical half, on the other hand is not as good. *The Solar Chromosphere* belongs in the professional library of the working solar physicist, but considering the high price of the book, I cannot recommend that it be added to every astronomer's bookshelf.

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Understanding Technology

C. Susskind
163 pp. Johns Hopkins U. P., Baltimore, 1973. $6.95

It is generally acknowledged that human history is coterminous with the history of our technology. As *homo faber* we have, from whenever we could legitimately be called "human," lived by altering the environment by our tools. Of late, there has been a growing perception that something about our technological existence is problematical. Charles Susskind's book attempts to discuss what to do about the problem. The basic difficulty with the book stems from its antitheoretical character—no attempt is made to identify what exactly the problem might be.

But suppose, for the sake of argument, we go along and assume that there is some sort of a problem. Before we go any further, there is a methodological difficulty. How shall we talk about it? In contemporary society, communication that is not of the garden variety tends to occur in distinct sublanguages. Within the same society we have different sublanguages whose speakers do not comprehend each other. An engineer talking about linear-induction motors, say, makes about as much sense to an anthropologist, as the anthropologist talking about ethnomethodology does to the engineer. Susskind tries to confront this problem in terms of the oversimplistic dichotomy popularized by C. P. Snow. He assumes that there are two kinds of people, those who have simply a "liberal" education as against the others who know about technology. He wants to present in rough outline, something of what is said in one group of such sublanguages—called "technological"—to those who do not understand it. Since form and content are inseparable in such sublanguages, this brings about a discussion of contemporary machines and their performance and—his real concern—what social impact the use of such machines may have.

From the point of view of natural-science students the book fails because of the author's attempt to treat "technology" in isolation from "science." Connections are alluded to, but the development of technology becomes an incomprehensible sequence of mechanical inventions tumbling out of some mysterious horn of plenty. (Thus in a discussion of heat engines, the contributions of Watt, Newcomen, Smeaton, Rankine, even Daimler and Benz, are referred to, but not Sadi Carnot). Historians of science may perhaps often be faulted for ignoring technical practice and the basis of science on such practice, but Susskind's approach is at least equally unpardonable from the other side.

From the standpoint of students of philosophy and sociology the attempt fails for two reasons. First, it fails for any "nontechnological" reader because of the problem of translation between different sublanguages. Susskind cannot of course be blamed for not solving it, but one wishes he were somewhat more aware of the problem. The second reason is a naive reification of "technology" into something that exists almost autonomously, that we have to react to and cope with while tending the machinery and enjoying the commodities churned out by it. Here again, a vague gesture of acknowledgment is made in passing to social conditions that may somehow be involved in developing or sustaining a level of technological production. But it is no more than that. "Technology" advances, and society must adapt to its changes. His prognosis-cum-recommendation is that "we may come to look to the engineer for moral guidance." How society can ask the engineer for what on earth to do is unclear in view of the further admission that "no real basis exists on which anyone could compute what constitutes the public interest." But logical inconsistency does not appear bothersome to the author in his hit-and-run method of discourse.

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Comets, Meteorites & Men

P. L. Brown
255 pp. Taplinger, New York, 1973. $12.50

"Nowadays, in the West, neither the visual nor the photographic discovery of a new comet stirs much interest outside the close, intimate world of the initiates." Clearly this book antedates the coming of Comet Kohoutek! Certainly Kohoutek the media happening and Kohoutek the target of many scientific investigations will deserve a work of its own.

As a popular presentation of cometary science Before Kohoutek, *Comets, Meteorites and Men* is of modest interest. As a summary of astronomers' anecdotes and legends, the stuff known collectively as "comet tales," it does much better. If we are disappointed to find no mention of the controlling role of water ice on the evaporation of other substances and are sorry to see that the discarded gravel-bank model for the nucleus is treated as a serious current rival of the icy-conglomerate theory, we can revive our spirits by leafing through the generous selection of comet lore. Especially interesting is the lengthy excerpt from the *San Francisco Examiner* hoax of 8 March 1891. Therein is described the fabulous electrified and automated comet-discovery apparatus of noted astronomer Edward Emerson Barnard (famous for "Barnard's Star"). Since the press had been warned to expect ritual disavowals of this secret project, the infuriated Barnard could not prevail on them to publish his denial until 1893. It should be noted that such an apparatus is still lacking, although it must be