



A gaseous nebula in Gemini was observed by a 48-inch telescope at Hale Observatories.

mildly informative. Several laboratory spectroscopists discuss the techniques of "zero-Doppler-shift" spectroscopy and of bond-length prediction; their uniform message centers about the hazards of identifying an interstellar molecule on the basis of a single line. Notable among the papers in these sessions is M. Litvak's particularly lucid and well-illustrated presentation of masers and optical pumping. The least useful session concerns the short observational contributions which, with the exception of one or two papers, can be found in similar or greater detail in the *Astrophysical Journal*.

In a brief four-page introduction to a large session on astrochemistry, B. Donn summarizes quite well the current state of affairs of this burgeoning field of extraterrestrial investigation. Eight succeeding contributions consider several mechanisms proposed to account for the formation of primarily diatomic molecules: radiative association, charge exchange and neutral-atom exchange, and formation on grain surfaces. Oddly enough, though, it appears that no one has considered seriously the possibility that the molecular constituents now observed by radioastronomers may be mere fragments of much larger organic species distributed throughout space.

The implications for prebiotic organic chemistry and interstellar biology are discussed in four reasonably detailed and very entertaining articles by C. Ponnamperna, E. Anders, P. Morrison and C. Sagan. The well-known theme, namely that micromolecules of biological significance can be synthesized under laboratory conditions similar to those thought prevalent on primeval earth, is generally extended to suggest that condensation reactions of the micromolecules might have occurred to give rise to macromolecules

and polymers that may have been the forerunners of today's nucleic acids and proteins. However, these researchers hasten to add that, because of the high temperatures (several thousand Kelvins) characteristic of inner stellar nebulae prior to the formation of planetary systems, it is doubtful that any of the organic species now observed in the expansive clouds of interstellar space contribute directly to the origin of life.

The most useful and self-contained contributions are found in the first (review of the interstellar medium) and sixth (biological implications) sessions. Newcomers will find much of the central part of the proceedings either dated or difficult to comprehend. To learn much from it, one would have to work hand-in-hand with the research journals. In this regard, an adequate bibliography accompanies each article, and the editors have kindly provided a moderately sized index. The book is attractively printed with many illustrations.

Doctoral candidates and other young interstellar researchers who periodically experience morale crises that inevitably accompany fast-paced fields will find many aspects of the book motivating. Indeed, the real virtue of the book may lie in the inherent excitement that seems to flow through the proceedings that have helped to form the foundation of a pioneering, profitable and often controversial field of interdisciplinary investigation.

ERIC J. CHAISSON
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Cambridge, Massachusetts

Ion Implantation

G. Dearnaley, J. H. Freeman, R. S. Nelson, J. Stephen
802 pp. Elsevier, New York,
1973. \$79.00

The book is an ambitious and lengthy contribution to a rapidly advancing and highly diverse field. Refreshingly, it presents original writings by the four authors as compared to the many books issued as unedited conference proceedings. The field of ion implantation, having grown out of a marriage of nuclear and solid-state physics, has become technologically vital in the semiconductor fabrication industry, and in studies of corrosion and chemical alteration of metal and alloy surfaces. Ion implantation has also played a crucial role in the simulation of radiation damage in fission reactors, and, more recently, in fusion reactors. Researchers also use ion implantation to elucidate the fundamental aspects of defect physics. In view of these applications, it is not surprising to find a large number of groups, mainly at industrial and gov-

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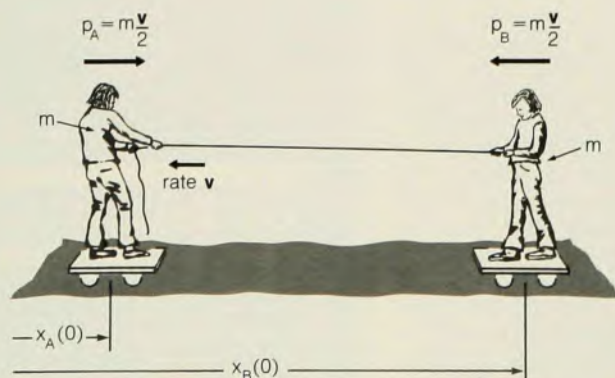
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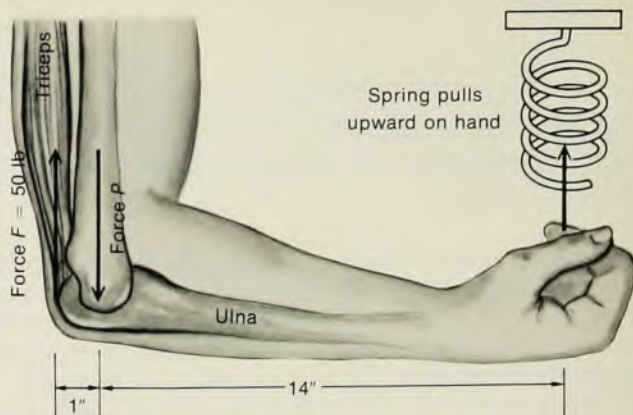
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ernment laboratories within the US and worldwide (principally Western Europe, Japan and Russia) actively contributing in journals and conferences. Historically, British laboratories have played an especially strong role in ion-implantation research, perhaps even out of proportion to the level of commercial exploitation of the associated technology. It is therefore quite appropriate to see in print this massive chronology of (British) contributions to ion implantation.

Their "magnum opus" represents effectively four relatively independent "books" in one. According to the authors, the main reasons for publication are to provide a summary for technologists interested in exploiting scientific ideas, and also to provide a text for student—who unfortunately cannot afford it—so as to increase academic involvement in a field dominated by government and industrial laboratories.

The first "book" by Geoffrey Dearnaley is a 150-page treatise on ion-solid interactions. He begins with a very readable and detailed discussion of energy-loss mechanisms. The role of interatomic potentials is blended informatively with experimental range data, which gives the reader the capability of estimating range and straggling distributions. Emphasis on the historical aspects from the days of H. A. Bethe and F. Bloch in the 1930's, the era of J. Lindhard and colleagues in the 1960's to the more recent work on the oscillations in the electronic-energy loss is quite refreshing. He discusses some channeling phenomena with currently important application of lattice location of impurity atoms.

The second "book" on the physical state of the ion-implanted solids by R. Stuart Nelson primarily deals with those aspects of radiation damage deemed important to ion implantation. A large portion considers high dose effects in metals with emphasis on electron microscopy. Although the author is eminently qualified to write in this field (he has made many significant contributions), this section lacks coherence. A very nice discussion on radiation-enhanced diffusion and precipitation during implantation, which overlaps somewhat with a similar section in the first book, rounds out Nelson's contribution.

The third "book" by J. Harry Freeman deals with the production and manipulation of ion beams for implantation. This section with its many excellent illustrations is a delight to read. It displays a thorough working knowledge of accelerator systems and heavy-ion sources. Certainly, this is a must for anyone concerned with the experimental aspects of ion implantation between the ion source and implantation target.

The fourth "book," by J. Stephen, is

on the applications of ion implantation to semiconductors. This book was written to complement an earlier book *Ion Implantation in Semiconductors*, by J. W. Mayer, L. Eriksson and J. A. Davies (Academic, 1970), by placing emphasis on present-day semiconductor fabrication methods. The emphasis was placed on motivating semiconductor-device designers to evaluate the technique of ion implantation for incorporation into the device design.

A last section, with no author credit, is a summary of applications outside of semiconductors. It deals with many interesting applications such as low friction and wear resistance in metal surfaces, but reflects neither the rigor nor coherence of some of the earlier sections.

This book would serve the ion-implantation community better by being issued as three separate books: the first consisting of a combination of the first two sections by Dearnaley and Nelson on "Ion Penetration and Implanted Solids," the second by Freeman on "Ion Beams," and the third by Stephen on "Semiconductors." This would, it is hoped, bring the price within range of individuals and students. The technical quality of the printing and illustrations is excellent. On the whole, this book represents a highly readable and thorough review of the most important aspects of ion implantation.

WALTER BAUER
Sandia Laboratories
Livermore, California

Structure-Borne Sound

L. Cremer, M. Heckl, E. E. Ungar
528 pp. Springer-Verlag, New York
1973. \$36.10

Over many years Lothar Cremer has been a major contributor to architectural acoustics. In particular he has been the authority on all aspects of sound transmission in and through building structures, and he has published many papers on the subject, mostly in German but a few in English and at least one in Swedish. Much of this material was collected in an English-language monograph published by the British Council for Scientific and Industrial Research in 1949. The monograph was a sort of rough manuscript rather than a book, and it had limited circulation, but those of us who were fortunate enough to acquire a copy guarded it jealously as the one infallible guide in any problem involving the interaction of sound waves and structures. Here, for example, we found the definitive exposition of sound transmission through a wall, complete with both theoretical analysis and a detailed discussion of how to

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