Throughout there is a strong emphasis on the principles of operation of laboratory equipment. A chapter is devoted to the description and explanation of various common electronic devices: transistors, oscilloscopes, strain gauges and FET's. A short but wide-ranging discussion of optics and optical microscopy is illustrated with photographs of flagellated microorganisms, clearly the authors' favorite subject. There is also a chapter on electron microscopes, including a careful discussion of the operation of magnetic lenses. The sections on microscopy are probably the strongest sections of the book.

It is difficult for us to think of the American equivalent of the students for whom this book is intended (who are stated to be "a mixed group of first-year undergraduates"). The chapter on mechanics, for example, 30 pages long, would serve as a review for a student already quite familiar with the concepts, but would not be a satisfactory introduction to the material. In fact, our general impression of the book is that it would serve as a review volume or a useful elementary reference for a biologist, but would be quite difficult to use in a course where students could be expected to be unfamiliar with most of the material. The book is not sufficiently deep or detailed to serve as a text for an advanced course. Perhaps this book could serve a useful function as supplementary reading for an elementary class that wanted to go into certain areas in greater detail.

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Molecules in the Galactic Environment

M. A. Gordon, L. E. Snyder, eds.
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1973. $18.95

Optical spectroscopy long ago established the presence of diatomic molecules such as CN, CH and CH^+ in reasonably dense interstellar clouds that absorb the radiation of young, hot stars. The discovery of more complex species (like H_2O, H_2CO, CH_3OH, HC_3N and others) awaited the development of molecular radio astronomy which, after a slow beginning with the initial observation of OH about ten years ago, has produced a near-exponential growth in the number of interstellar molecules detected during the past five years. Modern techniques of radiofrequency spectroscopy allow radio astronomers to listen to the characteristic (generally rotational) frequencies of polyatomic molecules that, because of their fragility to the harsh interstellar radiation field, reside in shielded, dark and very dense clouds generally inaccessible to study by optical or ultraviolet means.

However, the past year or so has seen a sharp diminution in the detection of new species, probably because the cream of the interstellar crop has been skimmed to the present level of observational sensitivity. Currently, there is a total of about 100 radio-frequency spectral lines attributable to some 30 compounds and a few as yet unidentified species. Recent advances in millimeter-wave signal detection and cryogenic technology nevertheless insure that the current lull is only temporary; it is likely that another rapid rise in number and variety of interstellar species will again occur in the near future as new equipment becomes operational.

The large number of organic molecules, non-terrestrial isotope abundances, non-equilibrium thermodynamic processes, several unidentified spectral features and possibilities for prebiotic synthesis have emphasized the need for an interdisciplinary approach to understand and appreciate fully the extreme diversity of the observations. To this end, *Molecules in the Galactic Environment* describes the proceedings of a symposium that brought together astronomers, biologists, chemists and physicists to discuss the observations and their implications and to provide suggestions for future observational and theoretical work. Because the symposium was held at the end of 1971, these proceedings may be conveniently taken as a partial record of the initial phase of interstellar molecular research.

The first session sets the pace by reviewing selected aspects of the interstellar medium: I. Iben superbly considers stellar synthesis and possible ejection mechanisms of the reasonably heavy elements C, N and O that bind together and with H to form interstellar molecules; G. Field thoroughly reviews the heating and cooling mechanisms and current evolutionary models of interstellar clouds in what may be the most comprehensive article of the symposium; B. Bok and C. Cordwell summarize optical studies of nearby dark clouds and globules, providing the reader with a very useful guide to the techniques of star counting and to the available catalogs and atlases of obscure regions; M. Greenberg provides insight into the hodgepodge of galactic dust that almost certainly plays a surface-catalytic role in the formation of interstellar molecules.

The middle three sessions are only

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. Ponnamperuma, 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.

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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-