

Physics with a biological flavor

Introduction to Biological Physics

M. E. Holwill, N. R. Silvester

359 pp. Wiley, New York,
1973. \$16.50 hardcover, \$7.95 paperback

Physics for the Life Sciences

A. H. Cromer

497 pp. McGraw-Hill, New York,
1974. \$11.95

Reviewed by J. A. Anderson and M. M. Nass

Whenever a book is presented as "Physics for Someone" it is important to determine who that someone might be. Two such books, *Physics for the Life Sciences* and *Introduction to Biological Physics* are intended to serve as "first" texts in college physics for biologists. Yet even a glance at the two indicates that they would be suitable for entirely different audiences.

Physics for the Life Sciences is by Alan H. Cromer, professor of physics at Northeastern. In 497 pages it covers briefly a standard one-year course in introductory physics with all the familiar topics—mechanics, thermodynamics, waves, electricity and magnetism, optics and a smattering of modern physics. Calculus is not used anywhere, although algebra is extensively employed.

As one might hope, there has been an effort to choose biological examples of simple physical principles. Many of the examples and many homework problems in the mechanics section are direct applications of mechanics to the human skeleton and musculature, often involving fairly detailed calculations of forces on joints and bones. Other sections usually do not provide such a direct connection between the physics and the biology, although there are interesting short sections on simple fluid flow applied to the circulation of the blood, the acoustics of the human vocal tract, the use of polarized light for direction finding in the bee, electrically excitable cells and nuclear medicine. Worth mentioning is an excellent discussion of the laws of scaling as applied to living systems. This section should dispel forever from the reader's mind any concern about the giant insects found in horror movies.

The writing is clear, and numerous



problems are worked out numerically; there is also a large selection of homework problems. As in many modern elementary textbooks, the wide margins of the pages contain tables and small figures that complement the written material. Diagrams and figures are clear and generally make their point. However, because both physics and biology abound with spectacular pictures, it seems a shame that more was not done with visual material.

This text appears to be designed as a first and last course in physics for students who require a brief introduction to some of the concepts and jargon of physics, but who never really plan to make more than rudimentary use of physics in the future. We doubt, however, if this book would be at a high enough level for premedical students or for future academic biologists. It would be eminently suitable for a one-year physics course for many students in medically related areas such as pharmacy, physical therapy, nursing and for other biologically-related professional programs.

The potential audience for the second

book, *Introduction to Biological Physics* by M. E. Holwill and N. R. Silvester of the University of London is less obvious. Unlike the first book, this one is organized less as a textbook than as a selection of biophysical essays. In 359 pages, it provides discussions of such topics as the mechanics of solids, thermodynamics with application to the control of internal temperature in living organisms, properties of fluids, and electricity and magnetism.

The authors often formulate laws and relations with expressions from the calculus (in one case, diffusion, with partial derivatives) but they generally do not work out derivations and specific examples. Some of the topics discussed in this context seem to be present simply because of their standard nature. For example, an extensive discussion of surface tension leads to only limited biological application.

There are only a few homework problems per chapter. For the most part these problems are of the "grind" type, designed more for the development of analytical skills than for the clarification of ideas.

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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.
475 pp. Wiley, New York,
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 H₂O, H₂CO, CH₃OH, HC₃N 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