alone all that crazy stuff about $E = MC^2$. (I am being slightly unfair, but only slightly, because Weinberg is primarily concerned with Big Science.) Weinberg applies his principle to some contemporary fields; it causes him to smile on molecular biology and to frown on high-energy physics. Nuclear energy gets an A+, space exploration a *D*. He would like to give the behavioral sciences much greater support, but he is worried about whether they are ready for it.

There is lots more in this excellent book. There are essays on scientific communication, national laboratories, universities and disciplines, biomedical science, scientific choice and human values as well as other topics. They are generally stimulating and even delightful when the ox being gored belongs to a neighbor. I will not be surprised if the book is widely used in the various seminars and courses that are developing in the area of Science and Society. Somebody should try his hand at writing a rebuttal as soon as possible.

* * *

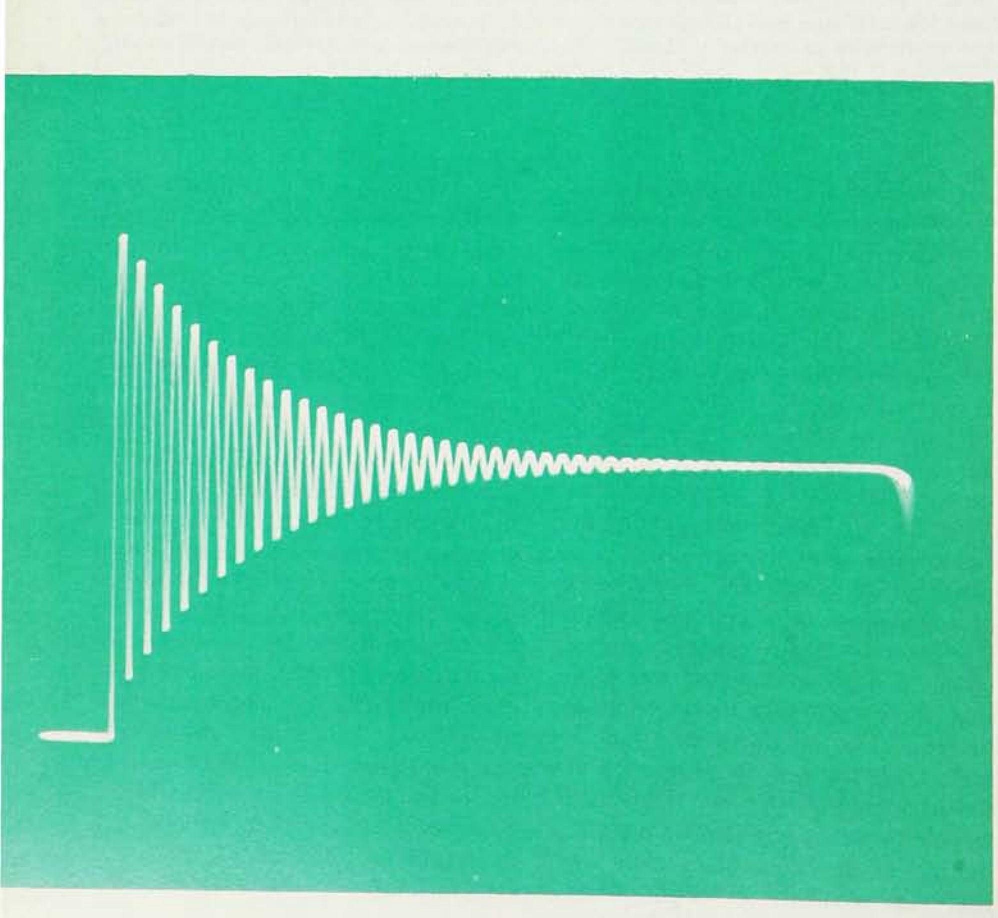
Raymond Bowers is a professor of physics at Cornell University. He has recently returned to Cornell after spending 15 months in the Office of Science and Technology.

Mod look in teaching laboratories

LABORATORY PHYSICS, BERKELEY PHYSICS LABORATORY: Part A, 115 pp.; Part B, 117 pp.; Parts C & D, 119 pp. McGraw-Hill, New York, 1964, 65, 66. Paper $2.25 each

by Eugenie V. Mielczarek

For a long time the weekly pattern of freshman and sophomore physics laboratories has been the demonstration of a concept discussed the previous week in lecture. The equipment used was simple, and emphasis was directed at the concept of a measurement and its associated errors. After World War II this emphasis and the nature of the equipment changed very little even though experimental physics was moving rapidly into development and use of sophisticated electronic equipment. Besides short changing physics majors, thousands of engineers, chemists and biologists were being graduated after never having used an oscilloscope, "except maybe once." The Berkeley Lab is an attempt to remedy this situation. It is successful.



The author of the laboratory, Alan Portis, and his associates have created a coherent set of experiments through the investigation of a series of topics germane to modern research problems. In these experiments they have chosen to emphasize electrical skills common to most scientific research. Typical topics covered are electron dynamics, coupled oscillators, electromagnetic wave phenomena and statistical phenomena. Thus the Berkeley Physics Laboratory is a definite break with the traditional freshman and sophomore physics laboratories.

The laboratory is divided into three parts, A, B, C and D. It is published in three volumes, C and D sharing the same volume. Part A is an introduction to the mechanics of free and nearly free electrons. In all of the experiments either a cathode-ray tube or an oscilloscope is used. Typical experiments are time of flight of electrons, damped oscillators and nonlinearity. Four of the experiments involve semiconducting circuit elements. Oscilloscope functions that the student learns are presentation of Lissajous figures, beam-intensity modulation and sweep synchronization. Part B continues the introduction to semiconducting devices and simple associated circuits, with a natural progression from oscillation to coupled oscillators to propogation of electromagnetic waves using simple microwave plumbing. Parts C and D provide an introduction to some of the experimental problems and techniques of atomic and nuclear physics. An introduction to statistical physics includes Geiger counting, thermionic vacuum diodes, photoemission, and finally a set of experiments on photon polarization and interference. Part D is a collection of 14 reprints of some of the classical experiments in modern physics: electron diffraction, atomic spectroscopy, the Franck–Hertz experiment, magnetic resonance and optical pumping.

One of the best features of the laboratory is the cost. Presently it is marketed by two firms, Hickok Teaching Systems, Inc., and Heath Company. The cost of all three semesters excluding Part D is about $38.00 per station per experiment. The second feature is the challenge it presents to the student. The material is an extension of lecture material, and in each experiment the theoretical material is presented very completely and clearly. Minimal directions are given, and it is virtually impossible for the student to make the measurement unless he has read and understood the material. Because of this, the student finds the laboratory hard, and some resent its demands on their time. The laboratory, which is designed for three hours per week, requires about the same preparation a student would give to two lecture hours. Throughout the text, Portis has used figures lavishly, and they are excellent. The presentations are clear but sophisticated; the format is attractive, and wide margins are available for scribbling.

The laboratory, however, has many pitfalls for the unwary instructor. One of the greatest disadvantages is the lack of an adequate instructor's manual. An instructor's manual is published separately by Hickok, but one published by McGraw-Hill and distributed with the laboratory manual would thwart many a case of professorial apoplexy. Those attempting Part C should be adequately forewarned before purchasing equipment; for example, an oscilloscope better than the one marketed with the laboratory is needed for experiments C1 to C4. Another disadvantage is the lack of any experiment giving a precise measurement. The student gets no feeling for the satisfaction of precision. This reviewer has found it imperative to include an introduction to experimental measurement and errors in the beginning of Part A.

The laboratory is very flexible, and the instructor will easily discover variations and extensions of the experiments. Portis has included some interesting appendix experiments; for example A1, electrostatic focusing, A9, the varactor diode and B4, operational amplifiers. The experiments, or groups of them, can be presented in different order than that in the manual. However, the cost of each manual is $2.25. The laboratory would gain wider acceptance if certain groups of experiments could be sold separately, A, numbers 1 to 4, and C, numbers 5 to 8, for example. Those considering teaching the laboratories would be advised to consult two articles by Portis, *Am. J. Phys.* **34**, 1087 (1966) and **32**, 458 (1964).

The main advance of the laboratory that outweighs all other advantages and disadvantages is that in both its selection of topics and equipment it bears some relation to experiments that one performs as a research scientist. The student suffers the same frustration that a neophyte experimentalist experiences. He learns to check contacts, continuity and the scope sync function. Professors who use the laboratory or substantial parts of it in the freshman and sophomore year will find that the junior and senior physics laboratories can be considerably upgraded. Portis has deliberately created a sharp break with traditional laboratory assignments. Certainly time is needed for it to gain acceptance. For this reviewer, however, having taught parts of the laboratory for three years, the cry is HURRAH !!!

* * *

The reviewer is associate professor of physics at the George Mason College of the University of Virginia. Her research interests are in solid-state physics.

Macro and micro evolution

RED GIANTS AND WHITE DWARFS: THE EVOLUTION OF STARS, PLANETS AND LIFE. By Robert Jastrow. 188 pp. Harper & Row, New York, 1967. $5.95

by R. Hobart Ellis Jr

Through a curious development, science appears to be closing a circle on itself. A few decades ago the subject became respectable and was labeled "natural science" in university curricula. Then it broke up into fragments like chemistry, physics, biology, geology, archeology. Now the gaps between fragments are filling in; boundaries are growing too vague to be recognized, and the renaissance man—the scholar who sees all knowledge as his province and responsibility —is coming back to the lecture platform.

This book, which started as a series of television lectures, is by and for the renaissance man. "The path of evolution," says its concluding sentence, "stretches back into time—from man . . . into the parent cloud of hydrogen." In his text the author has traced this path for us, proceeding in the other direction: origin of stars and planets, development of amino acids and DNA, biological evolution and the ascent of man. Would you expect the size of the task to compel in a short book either shallowness or ponderosity? In my opinion Robert Jastrow, a master of the concise sentence, the appropriate metaphor, the order that commands attention, has fallen into neither trap.

Jastrow is perhaps uniquely qualified to accomplish the mission he set out on. The road that took him to his present position as director of the Goddard Institute for Space Studies in New York City was varied and scenic. At an unusually early age he took a Columbia PhD degree and went off to Washington to work at the Naval Research Laboratory on nuclear theory. Then Sputnik I went flying, and Jastrow made calculations on its orbit that revealed unknown properties of the upper atmosphere. Next came a more general interest in atmospheric

Reviewed in This Issue