personal opportunity, distribution of wealth and income, education, knowledge, foreign policy, esthetics, and recreation—must all be made on broad judgmental grounds relating to the ultimate values and meanings of human life. Few specific criteria or objective standards are available. Where quantitative standards can be applied, as in the case of costs and prices within the private economy or tests within the educational system, these quantitative standards often tend to dominate decision-making to the exclusion of nonmeasurable and usually more important considerations. The allocation of resources to scientific investigation is partly an economic matter in which there are some quasi-objective standards, but it is largely an esthetic and educational matter relating to fundamental values and meanings of human life. As the seminar so clearly showed, the allocation of resources to science, including the determination of the role of universities in scientific investigation, is one of those important matters that call upon human beings to use their broad judgment (expressed in part through the political process) and not merely to resort to simple and automatic quantitative analysis.

The importance of the book is not lessened by the paucity of clear-cut answers and formulas. It is the best available discussion of a subject vital to our society and should be read and pondered by all those concerned with science policy.

HOWARD R. BOWEN
University of Iowa, Iowa City

Colloque Ampère

Magnetic Resonance and Relaxation. Proceedings of the 14th Colloque Ampère, Ljubljana, Yugoslavia, Sept. 1966. R. BLINC, D. HADŽI, and M. OSREDKAR, Eds. North-Holland, Amsterdam, 1967. xvi + 1241 pp., illus. $50.

The advent of magnetic resonance methods, in the early 1950's, has been recognized by some as the latest major contribution to the study of physical chemistry, where "physical chemistry" can be defined in the words of the late G. N. Lewis as "all those things in which I am interested." Certainly, the interest has grown from a physicist's laboratory curiosity (albeit, a Nobel-prizewinning observation) through a period of exciting, almost romantic, discovery of the inner secrets of molecules and on to its present stages as an essentially routine exploratory or analytical tool.

This rapid maturation of a technique which was in many ways mechanically complex and even awesome to the chemist can to no small extent be attributed to the efficient, rapid communication systems developed by the early practitioners. Publications in the conventional literature serve their useful purpose, but are too slow and too restricted for the serious student. The solution was found in the formation of specialized colloquia, of which the Colloque Ampère is a prime example. This continuing series of colloquia has provided the international latticework for the interchange of results and ideas at the current state-of-the-art.

This compendium of the 14th session is illustrative of the range and intensity of activities of a cross section of the world's contributors. The emphasis of the conference was on the basic physics of magnetic resonance and on its applications in physics, chemistry, and biology. The almost 200 papers can be, somewhat artificially, sorted into about 60 on the fundamentals of the magnetic resonance phenomenon, 60 on applications to solid state physics including metals and semiconductors, 40 on the physical chemistry of molecules and aggregate systems, and the remainder on a variety of topics in dielectrics, radiation damage studies, deuteron resonance, and the computerization of magnetic resonance experiments. The rigor of the condensations printed here is highly varied, ranging from a few excellent general review articles of 30 pages or so down to abbreviated abstracts of less than 50 words. It is an admittedly arbitrary reflection of one's own interests to select individual articles for comment, but the several which I found particularly informative included R. L. Mössbauer's general discussion of recoil absorption of gamma rays and nuclear hyperfine interactions, the historical survey of the impact of NMR on the knowledge of hydrogen bonding by G. L. Hofacker and A. H. Hofacker, three descriptive articles on nuclear dynamic polarization by A. Abragam, E. L. Hahn, and K. H. Hauser, and the entire session on new techniques, which includes a particularly good survey on the superconducting magnet by F. A. Nelson and H. E. Weaver. Other readers would undoubtedly select a differing list.

In general, however, this compendium should not be viewed as a source book or even as a general review. The coverage is too extensive and, in consequence, too abbreviated—even considering the 1241 pages. Unfortunately, it becomes a moot question even as to justification for hard-cover publication of a volume of such a relatively high price and predictable short-term utility.

CHARLES M. HUGGINS
Research and Development Center, General Electric Company, Schenectady, New York

Successful Theorists

The Atomists (1805–1933). BASIL SCHONLAND. Oxford University Press, New York, 1968. x + 198 pp., illus. $5.60.

Sir Basil Schonland has written an engaging semipopular account of an extremely interesting and complex aspect of the history of modern science. *The Atomists (1805–1933)* discusses the major post-1800 antecedents of the quantum mechanical atom, what Sir Basil calls "the final mathematical model of the atom." The story begins with Dalton and reviews very briefly the development of the ideas of the ion, electromagnetic waves, the electron, the early atomic models of the atom of Rutherford and of Bohr, and finally the changes wrought by quantum mechanics. The ideas and the relevant experiments pertaining to each are described clearly and economically; the illustrations are skillfully selected and helpful.

This account of historical landmarks in science raises some interesting questions. Without a doubt, Sir Basil's story of atomism is an example of "Whig" history; that is, the author has sought to illuminate only those aspects of history which have contributed positively to the development of present-day "textbook" versions of atomic structure. Consequently, armed with hindsight, the book systematically slights the concerns of the past. There is no discussion, for instance, of the vortex atom of William Thomson, which played so interesting and important a role in Victorian physics. There is bare mention of the influential Boscovichean atom and scarcely a reference to the opponents of atomism, the ranks of which included a fair number of distinguished scientists.

Yet there are uses even of Whig history, and Sir Basil's book amply illustrates them. As a concise source for clear discussions of important and well-known scientific events, *The Atomists (1805–1933)* succeeds admirably. More-

over, the author's method casts into bold relief a very important theme: what Sir Basil calls "[t]he process of mathematization of the laws of nature, the replacement of physical concepts by mathematical symbols." To quote Synge, "The robust body of the Cheshire cat was gone, leaving in its place only a sort of mathematical grin." The atrophying of physical concepts, the "aphasia of mathematics" as Kelvin put it, was indeed a source of concern to many British physicists of the last century, and emphasizes the gulf between their day and ours.

ROBERT KARGON
Department of the History of Science, Johns Hopkins University, Baltimore, Maryland

Survey of Genetics

Genetics. MONROE W. STRICKBERGER. Macmillan, New York; Collier-Macmillan, London, 1968. x + 868 pp., illus. $12.95.

The opinions offered here of Strickberger's book were formed from two vantage points: doing genetics and teaching genetics. In general the book should prove useful to the gifted beginning student, to intermediate undergraduate and beginning graduate students, and to teachers of genetics whose background and time prohibit continuous updating.

In explaining this general conclusion let me say first that like most general textbooks this book suffers from the author's attempt to be both comprehensive and broad in scope; the good chapters display his interests and competence, and the weak chapters his lacks thereof.

Strickberger's treatment of "classical" genetics is thorough, and most likely the best treatment of the subject to be found in a general textbook, but some of the interspersed, "nonclassical" chapters are correspondingly weak. For example, the chapter on cytoplasmic (maternal) inheritance is superficial, out of date, and misleading in that it strives for solutions to non-Mendelian problems via the Mendelian approach. Most of the examples used to illustrate cytoplasmic inheritance can be found in older, less comprehensive textbooks; only brief mention is made of the fact that mitochrondria, chloroplasts, and other organelles possess DNA and RNA (that is, their own hereditary information); and no mention is made of the presence in these organelles of unique ribosomes, amino acyl synthetases, transfer RNA's, and so on (unique protein-synthesizing machinery). As a consequence of this omission the author bypasses the opportunity to explore the interesting and profound means for assaying cytoplasmic inheritance, and the equally exciting relationships between organelle and bacterial heredity. Other examples of this kind of weakness (in the chapter on nucleic acids, RNA is mentioned only in passing) will be apparent to specialists in the various areas of nonclassical genetics. For this reason the book will be of limited usefulness to the professional geneticist.

For the teacher who is not a professional geneticist the book will be of value as a means of fortifying his background beyond the depth of the more usual textbook, but I question its usefulness for his beginning students. The book demands a prior interest in genetics; it is too professional for the general student. Gifted students headed toward a career in biology will find the chapters on Mendelian, quantitative, population, and evolution genetics a gold mine of information, but in other chapters the students will need to go to the original sources (as one example, the descriptions of *Neurospora,* in the chapter describing life cycles, were taken from another textbook, not from Beadle or Dodge; in such cases, and there are many, the book merely translates errors from one textbook to another). In short, some chapters seem too difficult for beginners and others too superficial for the serious student.

In a day when textbooks are yielding to the monograph and *"Scientific American* offprints," when new information is a daily experience, and when teachers are shying from methods involving memorization-regurgitation and canned questions, a textbook must be expected to convey excitement and generalizations, as a minimum requirement, and at the same time it must leave a platform from which the teacher can function effectively. Strickberger's book is not first-rate judged by these criteria.

The author has made himself familiar, in a detailed way, with many important areas of genetics and has presented these in a readable way for the initiated, but to capitalize on these admirable efforts for maximum usefulness to students I would suggest an organization along the lines of Hayes's *The Genetics of Bacteria and Their Viruses,* such that the beginner might see the big picture before getting into deep water.

I think the science of "genetics" has grown too large for detailed treatment in a beginning textbook, and probably too large for detailed treatment by one author. Much of my criticism of Strickberger's book may stem from the fact that he would not agree with me on these points. Apart from my criticisms, this book is not just another textbook of genetics but rather a pandect of Mendelian, quantitative, population, and evolutionary genetics.

VAL WOODWARD
Department of Genetics and Cell Biology, University of Minnesota, St. Paul

Developmental Botany

Morphogenesis in Plants. A Contemporary Study. C. W. WARDLAW. Second edition. Methuen, London, 1968 (distributed in the U.S. by Barnes and Noble, New York). 451 pp., illus. $14.50.

The scarcity of published books on plant morphogenesis is not surprising considering the often ill-defined and all-encompassing nature of the field. An author attempting to discuss the origin of form in plants and its experimental control not only sets an extremely high goal for himself but also must proceed towards that goal without benefit of any generally accepted outline of formalized and structured subject matter. Wardlaw emphasizes that for a satisfying account of morphogenetic phenomena "we must draw upon the whole corpus of botanical knowledge and of the physical sciences; and, not withstanding the difficulties, which are admittedly great, we must attempt to unify and to integrate our information." As a consequence of the extensive scope of plant morphogenesis, the approach taken and the material included in most available books concerned with organization and development in plants are highly individualistic. The book reviewed here is no exception. The reader is exposed to a very personal and somewhat restricted account of plant morphogenesis. Like its predecessor (published in 1952), this edition contains accumulated results of observations and experimentation from Wardlaw's laboratory and does not lack adequate discussion of the author's concepts of apical organi-