ing patterns. (Democrats ought to be pleased, for men are significantly and systematically less inclined than women to vote Republican.) Some of my colleagues would argue that society would adjust "automatically" by increasing the value of women until a new demographic balance was found. In my judgment, there is little evidence that such an easy solution will be possible. Even after considerable costs, I expect, the adaptation would probably be as inadequate and confused as, to cite a present instance, our adjustment to the proliferation of the automobile.

This recurring problem of the interaction between society and technology is the subject of Elting Morison's **Men, Machines, and Modern Times** (M.I.T. Press, Cambridge, Mass., 1966. 245 pp. $5.95). Morison, a fine historian and M.I.T. professor of management, first tells us a set of stories about the introduction of certain 19th-century inventions, including naval guns capable of continuous-aim firing, indexing procedures for office filing, and the Bessemer process for making steel rails. He examines the personalities of the innovators (usually eccentric trouble-makers of the sort few government agencies or large corporations would hire today), their first allies and devoted disciples, and the resistance they met from the organizations and societies to which they offered their discoveries. In each case the new machines or methods were vastly superior to the old (the improved naval gun was 3000 percent more effective), and in ways which were easily demonstrable. This on the one hand makes the resistances to the innovations stand out sharply in their absurdity, and adds much to Morison's narrative; but the demonstrable superiority also explains, in my judgment, why these new technologies did not face still more opposition.

Discussing the difficulties posed by society to the inventors and their inventions provides Morison with an opportunity to present an informal but highly sensitive and insightful study of the way society and its organizational arms function. He shows, for instance, what a tightly knit community the United States Navy is, with its own culture, institutional fears, and worked-out mechanisms to repel those suggestions that force change, as the newly improved gun threatened to do. It took outside intervention, in the form of a different "big gun" and former naval person turned President—Theodore Roosevelt—to scuttle the opposition.

Morison is very much aware that the innovations he reviews do have harmful side effects. He correctly warns that the bureaucrat who comes upon new ways of collating information (once index card systems, today computers) may gain disproportional and otherwise unjustifiable control over the activities of his organization. Morison sees in computers the danger that they may deepen the tendency toward a fragmented and unduly quantified view of life and in so doing strengthen the illusion that what cannot be measured is insignificant. He does not deal with innovations whose *main* effects are harmful.

More than the details of the inventions or the resistances they faced, which he outlines masterfully, Morison is concerned with Thomas Huxley's deceptively simple question: "What are you going to do with all these things?" He stresses that we cannot reverse the process and return to a pretechnological age, any more than we can arrest the march of new technologies—nor should we try. He suggests rather the creation of a new culture (I think he means morality) to guide us. He hopes that new technologies, rather than be allowed to restructure society to their own demands, will be adapted to the varying human and societal requirements. Urbanely he presents these general views as modest afterthoughts, although they vibrate through the case studies which are the core of the book.

Morison's one weakness is his implicit acceptance of the prevailing liberal approach to his subject. New cultures do not spring up because modern times demand them: a more deliberate, rational, and in this case political expression of societal will is necessary. If technologies are to be adapted to societies and not the other way around, some specific institutional arrangements will have to be made. Morison can be readily exempted from having to provide details of the nature of these institutions, but he must realize that a societal guidance of technology is required similar in scope to that now provided to the economy. Surprisingly, many liberals who have fully accepted Keynesian economic controls take a laissez-faire view of technology. Theirs are the arguments once used to defend laissez-faire economics: that any attempt to control technology would stifle innovation and initiative. Morison does sense a vague need for societal guidance to accelerate beneficial technologies, to curb harmful side effects, and to block destructive technologies. But his studies do not as yet include anything like the marketing of thalidomide, the proliferation of nuclear weaponry, and LSD-triggered psychoses—and they do not lead him to fully face three key questions: Are the unlimited freedom of research and unlimited implementation of findings not outweighed by the sufferings they inflict upon millions? Is technology really a neutral tool, or is some of it manifestly dangerous? And how—politically—will society express itself to regain control of technology?

AMITAI ETZIONI
Department of Sociology, Columbia University, New York 10027

Aid to Education Abroad

Papers, speeches, and discussion remarks which were timely at conferences held in 1961 and 1962 frustrate and irritate the reader of a book carrying a 1966 publishing date. As I read into **Education and Training in the Developing Countries: The Role of U.S. Foreign Aid** (Praeger, New York, 1966. 415 pp., $7.50), edited by William Y. Elliott, the sensation was like that when one inadvertently launches into an old newsmagazine in a doctor's waiting room.

The trouble is that most of the contributions are on very specific problems, with recommendations for organizational steps and tactics that have decreased in relevance now that the context has changed. For example, the editor speculates on how the then new organization Education and World Affairs might develop; but meanwhile it has developed through several years of experience. A piece on "The Peace Corps: problems and potentialities" conveys the information that, "As of March, 1962, we had about 919 people in training or overseas," whereas now there are about ten times that many overseas, thousands of returnees, and very extensive experience on which penetrating studies already exist, such as Robert Textor's *Cultural Frontiers of the Peace Corps.*

Some of the papers do offer analysis

of a relatively timeless quality or suggest ideas that are still stimulating, for example, John A. Hannah on "Motives for the participation of American universities in international education," Robert M. Macy on "The need for guidelines to political development," and Jerome Bruner on "Educational assistance for developing nations: techniques and technology." But in general one is impressed that the pace of change in this field, as in others, is so rapid that mimeographed documents prepared for conferences and committees should be put into print quickly or not at all.

EUGENE STALEY
School of Education, Stanford University, Stanford, California

Techniques in Chemistry

High Resolution Nuclear Magnetic Resonance Spectroscopy, by J. W. Emsley, J. Feeney, and L. H. Sutcliffe (Pergamon, New York, 1965. vol. 1, 733 pp., illus.; vol. 2, 542 pp., illus. $17.50 each), is a bold attempt "to provide a detailed account of the basic theory underlying high resolution nuclear magnetic resonance (nmr) spectroscopy and also to present a survey of the major applications in physics and chemistry." That it succeeds in its purpose to a remarkable degree is testimony to the abilities and thoroughness of the authors. That it is less than definitive and falls short of being truly comprehensive reflects the ever-increasing vastness of the subject and the heterogeneous interests and backgrounds of the practitioners of the art.

Twenty years ago two communications reported the first observations of nuclear magnetic resonance in bulk matter. Useful applications of the new techniques to physics and chemistry soon followed, as did the discovery and characterization of new nmr phenomena, such as the "chemical shift" in 1949, the electron coupling of nuclear spins or indirect spin-spin interaction in 1951, and the spectral averaging effects of chemical exchange in 1953. These three phenomena were found to govern the detailed fine structure which appears in the high-resolution nmr spectra of liquids and gases and which is a very sensitive indicator of molecular structure, including some of the most subtle conformational changes and differences. Thus it soon became clear that nmr was a field of great promise for chemical research.

The promise has been realized during the past 10 years by the design and commercial availability of nmr spectrometers of increasingly higher sensitivity and resolution and by their successful application to an astonishing range and number of chemical problems. The success of nmr as an aid to research is shown in quantitative terms by the present publication rate, greater than 450 per month, of papers referring in a more than incidental way to some aspect of nmr. Most of the current papers involve the use of high-resolution nmr to solve structural problems in chemistry. Many of these applications are empirical in nature and require little more than comparing the spectra for compounds of known and unknown structure. Others require detailed analysis and understanding of the spectra, and some even need to use or extend the basic theory relating the spectral parameters to molecular structure.

The first volume of Emsley, Feeney, and Sutcliffe's book is directed toward the latter needs. It treats the basic theory of nmr, especially of the phenomena governing high-resolution spectra and the relation of these phenomena to molecular electronic structure. The practical aspects are covered in a chapter on instrumentation principles and another on the operating procedures and lore employed to obtain usable spectra. Strong emphasis is placed upon the analysis of a complex spectrum to obtain the chemical shifts and scalar coupling constants which, after all, are the basic spectral parameters related to molecular structure. Initially the authors planned a single volume, but the exponential increase in nmr determinations of molecular structures led to the publication of their survey of such applications as a second volume. This volume includes separate chapters on proton and fluorine resonance and a third on other nuclei. Many useful tabulations of chemical shifts and coupling constants are given and many typical spectra are reproduced.

It is not surprising that there is some unevenness in such a lengthy monograph by several authors, and each reader will no doubt find his own points to carp about. In my case, although Erwin Hahn's studies of the indirect spin-spin coupling were by spin-echo rather than high-resolution methods, I feel that his contributions to this area should have been cited, as should have been his addition of chemical exchange terms to the Bloch equations. Moreover, with the general availability of high-speed computers, I believe that a 5-page discussion of computer methods for analyzing spectra would have been much more useful than 25 pages of appendices listing frequencies and intensities of A_mB_n spectra. Also, I wish that volume 1, besides being a comprehensive reference for the theory and practice of high-resolution nmr, were more critical or were better suited for students. But in any case, the authors are to be congratulated for having fitted such a large and diverse field into one book. Practitioners of the art will find that the usefulness of the monograph makes it well worth its high price.

H. S. GUTOWSKY
W. A. Noyes Laboratory of Chemistry, University of Illinois, Urbana

Ratios and the Celestial Spheres

Nicole Oresme, speculative mathematician and natural philosopher, translator of Aristotle's *Ethics* and *De coelo* into French, friend and protégé of the King of France, opponent of astrology, schoolman extraordinary, was without question one of the most original thinkers of the 14th century. His **De proportionibus proportionum** and **Ad pauca respicientes**, now published together in a definitive edition (University of Wisconsin Press, Madison, 1966. 488 pp., illus. $10.75), with English translation, commentary, and notes by Edward Grant, set forth one of his most original pieces of thought: an analysis of the quantitative relations of ratios that is equivalent to the introduction of fractional and irrational exponents, and an anti-astrological application of this analysis to the motions of the planets.

To understand this achievement of Oresme, one needs to recall the nature of ratio as conceived in Euclid's *Elements*: a relation with respect to size