Book Reviews

Scientific Endeavor in a Democratic Context

Science in American Society. A Social History. GEORGE H. DANIELS. Knopf, New York, 1971. xii, 402 pp. $10.

Science in America. Historical Selections. JOHN C. BURNHAM, Ed. Holt, Rinehart and Winston, New York, 1971. xii, 496 pp. Paper, $6.

Until quite recently the history of science in the United States was something of an embarrassment. On the whole, professional historians of science were preoccupied with the progressive and cumulative features of scientific thought; legitimate history of science chronicled breakthroughs, ferreted out precursors, established priorities of discovery, and analyzed Great Ideas. From this point of view, Americans had contributed little to the development of modern science, at least before the 20th century. There was Benjamin Franklin, of course, and Willard Gibbs, and perhaps Joseph Henry, but otherwise America seemed a dreary wasteland of normal science, blighted by utilitarianism and hampered by general indifference on the part of the public. No serious scholar would waste his time on science in the United States.

General American historians had reached a similar conclusion, though by a different route. Many historians lacked the training to deal with science. More lacked the interest. Science and scientists were conspicuously absent from general American histories, despite vague references to the impact of science on American life. The general attitude was summed up by Dumas Malone, editor of the prestigious *Dictionary of American Biography*: "Little can be written about the lives of most scientists because there is nothing much to say."

Recently historians have found a great deal to say about science in the American context. The list of biographies and monographs has grown yearly, and courses in the history of American science are appearing in university catalogs. There have been increasing calls for works of synthesis, interpretative frameworks, models for the study of science and American society which go beyond the crude Marxian polemics of earlier writers. Daniels and Burnham have answered this call. *Science in American Society* and *Science in America: Historical Selections* share the distinction of being the very first comprehensive assessments of the historic role of science in American life.

Daniels's volume is the more ambitious, and the more subtle, of the two. According to the preface, Daniels offers it simply as "an outline for the study of science in American society, focusing upon topics that seem important to me" (p. xi). His topics run in generally chronological order from the 15th century to the 20th. Each chapter treats a distinct theme, including exploration and natural history, the Enlightenment, science and religion, evolution, and the relationship of science to a democratic social order. Nearly three-quarters of the text is devoted to the years before 1860.

At first appearance, *Science in American Society* is a collection of individually excellent but somewhat disconnected essays on early American science, with a few general observations upon recent science tacked on to round out the volume. Closer inspection shows that not to be the case. Daniels's primary concern is the modern era and a contemporary problem. He is perturbed by what he terms "the basic dilemma of American science—namely, that scientists, dependent upon public support but also striving for intellectual independence from the source of that support, consequently suffer a degree of isolation and alienation from the larger society" (p. 276). The early chapters serve primarily to counterpoint the central theme. The colonial and early national period was another world, a world of gentleman savants and crown subsidies, of acknowledged social and intellectual elites, where the problems that most concern Daniels simply did not arise.

Patriotic oratory has always insisted that in America social progress, popular government, and scientific advance have gone hand in hand. Daniels reveals instead a complex tradition of uneasy coexistence between democracy and science. Pure science, by definition, must not be contaminated by politics, or religion, or practicality. Popular sovereignty, on the other hand, is suspicious of expertise, vaguely fearful of skepticism, insistent upon public accountability when public funds are involved, and committed to a work ethic which demands that everyone be about something demonstrably useful. Conflict was unavoidable, particularly because at the very time of democratic ascendancy in the United States (roughly 1820–1840) the sciences were moving in precisely the opposite direction. The history of American science becomes, in Daniels's view, a history of compromise and accommodation. Habitual readers of *Science* will recall this argument from Daniels's briefer statement of it several years ago ("The pure-science ideal and democratic culture," **156**, 1699–1705 [1967]).

The first period of accommodation extended from the 1830's to the 1870's. American scientists coexisted with the democracy by tricking the public into thinking that science was in fact useful, by adroitly sidestepping headlong collisions with revealed religion, and above all by concentrating their energies on what can be classed as the descriptive, geophysical sciences. Positional astronomy, geodesy, geology, and natural history suited the practical needs of a nation bent on subduing a continent. Under utilitarian guise, 19th century scientists quietly pursued basic research and slowly built the institutional structures of specialized, professional science. By the 1870's the geophysical tradition was exhausting its own possibilities. But by now the scientific community was sufficiently entrenched and self-confident to demand the pursuit of pure science for its own sake.

In this the scientists succeeded, if anything, too well: between the 1870's and the Second World War science was elevated to scientism. Science became the panacea for social ills, the model for progressive politics and social reform. Science gained power but, according to Daniels, sold its soul in the bargain. For the science that captured the public imagination was applied science; its heroes were Edison and Herbert Hoover, the Great Engineer. The conflict between democracy and science was not resolved at all. It was

merely transformed into an even more intense conflict between basic and applied research.

Then came the war, and the Bomb, and Big Science, and Soft Money. Science and scientists were finally integrated into American life. This, in Daniels's view, was unfortunate, because previously the great strength of American science had been, ironically, its presumed irrelevance to everyday life. Now scientists enjoyed prestige and affluence as never before in American history. But they had bought power at the price of freedom. "Power, in a democratic society, must bring responsibility, and responsibility means an increasing subjection to political, social, and economic forces" (p. 344). Daniels doubts that American science will lose its vigor. What is more likely, he concludes, is that it will lose the last vestiges of its autonomy.

In part because of the very nature of his book, Burnham appears more optimistic. *Science in America: Historical Selections* is a collection of documents designed to augment university courses in the history of American science. Since Burnham's introductory essays total only 35 out of nearly 500 pages, he cannot be expected to elaborate an explicit thesis. Moreover, in the interest of coverage, to make the collection most useful to others, he has selected documents illustrating a whole range of significant issues. He pinpoints several: social conditions which encourage or discourage scientific endeavor; the development of scientific institutions; the justifications for science in a democratic culture; the character and role of the scientist; the argument between pure and applied science; mechanism, materialism, and their critics; and the scientific attitude and its opponents. The documents, selected from three centuries of scientific literature, are well chosen both for scientific content and literary style. Nearly half the selections come from the 20th century.

Although the two volumes have many points of mutual contact (one can frequently support an argument from one with evidence from the other), Daniels and Burnham appear to have fundamentally different casts of mind. Daniels is, in a way, a pure historian tracing, a little sadly, the decline of pure science in America. He is most at home in the earlier period, where he can subject pure science to pure historical analysis. His early chapters are superb, models of the genre. They represent a continuation of his desire, expressed in his earlier study *American Science in the Age of Jackson*, to "recapture a small part of the past as uncontaminated as possible by present judgments as to importance." At the same time Daniels is, like his backslidden scientists, too much involved in contemporary affairs to remain entirely aloof. *Science in American Society* derives its dynamic qualities from the author's divided loyalties to the past and the present.

Burnham is much more in the tradition of progressivist history of science. He sees science (and especially technology) advancing at an ever-accelerating pace, dispelling illusions, solving social problems, contributing to the general welfare. Where Daniels keeps at least one eye on yesterday, Burnham can hardly wait for tomorrow. The really serious problems confronting science are those, like environmental contamination, which confront us all.

Individual readers must decide which of these two approaches is more congenial. But they should read these excellent volumes together. For from them we can gain a much clearer notion of where American science has been, and where it may be going.

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On Ecological Regulation

Concepts of Pest Management. Proceeding of a conference, Raleigh, N.C., March 1970. R. L. RABB and F. E. GUTHRIE, Eds. North Carolina State University, Raleigh, 1970. xii, 242 pp., illus. Paper, $4.

This is a good book. It consists of 15 papers (plus audience discussion) which were presented at a conference having the following objectives: to stimulate and establish guidelines for the initiation of pest management programs, to ascertain the practicality and limitations of the pest management concept, to describe training programs for qualified pest management specialists, and to promote the international exchange of ideas on the subject. Even though the conference evidently failed in all its goals but the last, the proceedings provide much stimulating reading on the theoretical basis and underlying ecological principles of pest management programs.

It is immediately evident that attempts to deal with agricultural pests have grown considerably more sophisticated since the "spray and count" days of two decades ago. Rather than striving for eradication, the science attempts to regulate pest populations at such low levels that they do not become economically important. This regulation is achieved by a variety of methods which include releases of sterile insects, the use of attractants and repellents, the use of all natural mortality factors, and occasional applications of nonpersistent, target-specific pesticides. The ecological expertise of most of the participants in the symposium is evident throughout the book. For example, the opening paper discusses basic ecological subjects such as diversity and stability, growth and invasion rates, and the theoretical relationships between predators and their prey. Later papers discuss somewhat more specialized topics such as the use of systems analysis, bioclimographs, and life tables for understanding the dynamics of both populations of pests and populations of their natural enemies.

The current deemphasis of pesticides is evident, and only one paper deals with their use and limitations in pest management programs. On the other hand, two papers discuss various aspects of genetic manipulations of pest populations and field crops as alternatives to chemical controls. Two chapters grapple with the important questions of economic and practical feasibility of pest management programs, and one discusses the philosophical choices which must be made when the decision is for suppression, management, or eradication of pest populations.

An excellent paper by P. S. Corbet of the Canadian Department of Agriculture focuses on the human population explosion. He points out that if a pattern of increase leading to an estimated population of 7 billion individuals within less than two generations were observed in any other organism no one would hesitate to call it an outbreak of serious proportions. He rightly concludes that the world's chief concern should be the "earthpest" explosion, and that the major problem in pest management lies in stabilizing the human population at a level appropriate to the needs and resources of the biosphere.

The one disappointing aspect of this symposium lies in its failure to concoct a practical plan for implementing pest management programs. This failure was not unnoticed by the organizers of the conference, as it is pointed out