Book Reviews

A Seer among the Benefactors

Scene of Change. A Lifetime in American Science. WARREN WEAVER. Scribner, New York, 1970. xii + 228 pp. + plates. $7.50. Scribner's Scientific Memoirs.

In 1931, when Warren Weaver was invited to join the staff of the Rockefeller Foundation, he recommended that the Foundation give major support to experimental biology, for, as he explains in his autobiography, he

> was convinced that the great wave of the future in science, a wave not yet gathering its strength, was to occur in the biological sciences. The startling visions that were just beginning to open up in genetics, in cellular physiology, in biochemistry, in developmental mechanics—these were due for tremendously significant advances.

What impelled a mathematician who had been working on electromagnetic theory to see so early and so clearly the promise of experimental biology? It was physics that was flowering then; the ideas of Bohr, Heisenberg, de Broglie, Schrödinger, and other theoretical physicists were captivating scientific imaginations. Why should a man trained in engineering and mathematics have proposed a leap into biology?

However this question be answered, the president and trustees accepted Weaver's recommendation, and in doing so they exhibited the ability that makes a foundation great, the ability to recognize very early a development that promises large intellectual or social benefit. The Foundation took Weaver's advice; he accepted the Foundation's invitation; and biologists soon began to learn what fires that match had lit. From 1932 to 1959, first as Director of the Division of Natural Sciences and later as Vice President for the Natural and Medical Sciences, Weaver demonstrated how a philanthropoid—a name he has sometimes used for himself and his fellow foundation officers—can shape and foster the development of science by finding men with seminal ideas and giving them opportunities to get on with their work.

Scene of Change includes an account of those Rockefeller years. In length, the chapter is in balance with the rest of the autobiography, but scientific readers may want to turn again to "A Quarter Century in the Natural Sciences," a fuller account that Weaver wrote at the request of Dean Rusk, then president of the Rockefeller Foundation, and that appeared in the Foundation's 1958 annual report. "A Quarter Century in the Natural Sciences" describes the state of science at the time of the decision to support experimental biology and the evolving programs that put that decision into effect. And it also reviews the research developments—largely supported by Rockefeller funds—that led to the spectacular results of recent years in molecular genetics and closely allied fields.

Weaver credits these results to the men who conducted the research and developed the synthesizing ideas. Of course he is right. But they know how much they and their work owe to him. George Beadle, who won the Nobel Prize in 1958 for his work in genetics, has pointed out that between 1954 and 1965 the Nobel Prize was awarded to 18 men who had worked in one or another aspect of molecular genetics. Fifteen of the 18 had earlier been assisted by the Rockefeller Foundation, on the average 19 years before the Nobel Prize was conferred.

The 19-year lapse is illuminating, and is of a piece with Weaver's 1931 advice. In 1931, the Rockefeller Foundation had already been supporting the physical sciences; theoretical physics had "taken off"; it would advance without further special help from Rockefeller. But experimental biology needed help. Weaver and his colleagues gave that help by searching out and supporting in the 1930's and 1940's men whose accomplishments would bring them laureate status in the 1950's and 1960's.

Molecular biology also reached the takeoff stage, but that came later, and by then Weaver had moved to new ground. World War II caused an interlude in his Rockefeller activities. During the war years he served first as Chairman of the Fire Control Section and then as Chief of the Applied Mathematics Panel of the Office of Scientific Research and Development. The devices and techniques that were developed under the sponsorship of the OSRD offices he headed had much to do with winning the Battle of Britain.

When the war was over and he returned to the Rockefeller Foundation, others had recognized the importance of the life sciences he had earlier helped to stimulate. Many more scientists were becoming interested in them; the Office of Naval Research was beginning to make grants to universities; the National Science Foundation was in the offing; and the laboratories and agencies that developed into the National Institutes of Health were getting ready for their spectacular postwar development. Just as in 1931 the opportunities in physics were too well recognized to need Weaver's special brand of nurturing, so now experimental biology had outgrown that need.

Shortly before the war, he had become interested in the improvement of agriculture in Mexico, and had started the studies that eventuated in the Foundation's Mexican agricultural program. It was to this program that he began to give major attention when the war was over. The worldwide outgrowths of the Mexican program are generally known: the breeding of improved varieties of corn, beans, and wheat; the training of native agronomists and agricultural agents; the spread of the program to other Latin American countries; the transfer of the whole idea to the Asian scene with the creation of the Rice Research Institute (to which the Ford Foundation also contributed); and the development of the miracle rice and other grains that are responsible for "the green revolution." Some countries that were importers of rice only a few years ago have become exporters, and in some areas the miracle rice is called "Honda" rice because there is not only enough to fill the stomach but enough more to bring in some cash. In 1970 it is easy to see the success; in 1941 the Rockefeller Foundation was willing to gamble on the promise.

Considering their importance, the Rockefeller years get too brief treatment in *Scene of Change*, but the vol-

ume is an account of a whole life, and there are other parts of the story. Earlier chapters tell of Weaver's boyhood; of his student days at the University of Wisconsin and his conversion from engineering to mathematics; of his appointment to teach mathematics at Throop College (then soon to become the California Institute of Technology—an institution he was allowed to leave but from which he was not permitted to resign; Robert Millikan's reply to his letter of resignation concluded, "You will continue to be a professor of the California Institute of Technology, on leave until you return"); and of his return to Wisconsin and his collaboration with Max Mason on *The Electromagnetic Field.* Later chapters tell of his work at the Sloan Foundation and other "retirement" activities.

It is all written by a man who has for long successfully practiced the art of writing. Any autobiography ought to let the reader know what kind of man the author is. This one does. It is neither overly introspective nor does it hide the personality, the values, or the manner of thinking that lie behind the actions. The three final chapters are not personal chronology at all, but essays that express some of Weaver's ideas and values: "Science then and now," "Some limitations of science," and "Science, contradiction, and religion."

Weaver is one of a number of men who changed, in midcareer, from the scholarly life for which they had prepared to an administrative role which they had not earlier anticipated. There are not yet autobiographies of many such scientists, and Weaver's is therefore of value not solely as the story of an unusually effective man but also because of what he can tell us of such midcareer changes and of the life of a science administrator. Why should a successful professor of mathematics turn into an impresario of experimental biology? He explains:

> I think . . . that I was both realistic and accurate about my abilities and my limitations. I loved to teach, and knew that I had been successful at it. I had a good capacity for assimilating information, something of a knack for organizing, an ability to work with people, a zest for exposition, an enthusiasm that helped to advance my ideas. But I lacked that strange and wonderful creative spark that makes a good researcher.

The positive part of this statement has often been verified. Toward the end of the Rockefeller period and later he was a trustee of the Alfred P. Sloan Foundation and a member of the Sloan Foundation staff, a member of the National Science Board, a director and president of AAAS, a member of research advisory groups for a variety of private and governmental agencies—all positions that capitalized on the abilities he recognized in himself in deciding to forsake his Wisconsin professorship to become a philanthropoid.

As for the negative part of his explanation ("I lacked that strange and wonderful creative spark that makes a good researcher"), it takes a mathematician to appraise mathematical creativity, and I am no mathematician; but I do not think he should be accused of false modesty. Some eminently successful research scientists have gone on to become highly successful administrators, but research originality of the highest caliber is not essential for the effective administration of scientific affairs. The ability to formulate research questions whose answers will open new vistas is not necessarily the same kind of imagination and originality that allowed Weaver in 1931 to bet on experimental biology and in 1941 to bet on experimental agriculture.

Men of high research competence receive research grants and professorships; they are elected to the National Academy of Sciences; if they are good enough they receive Nobel Prizes. But how should we reward the men who make it possible for other men to win Nobel Prizes? Weaver has received a goodly number of honorary degrees and similar recognitions. France, Great Britain, and the United States have decorated him. In 1957 he was awarded the National Academy of Sciences' Public Welfare Medal. In 1969 he was elected to the National Academy of Sciences. This election illustrates one of the problems of giving due recognition to nonresearch contributions. In terms of quality, and in terms of the significance of the research Weaver's assistance helped other scientists to perform, his election to the most prestigious national group of scientists was merited decades ago. But his own work was not of the kind that is normally honored by election to the Academy; electing him after he had twice retired was both an honor and an anomaly.

Perhaps the esteem of one's fellows is the best recognition of all. That he has had in abundance. When he was given the first Arches of Science Award for his outstanding contributions to the improvement of the public understanding of science (an aspect of his work scarcely mentioned in his autobiography), Rockefeller-assisted Nobel laureates from both hemispheres and from both sides of the equator cabled their congratulations.

There is another kind of reward—the satisfaction of enjoying one's work and knowing it has been good. This reward Weaver has had:

> When one spends years on a job involving a mass of almost daily detail and a multitude of projects, he is fortunate if, looking back, he has the satisfaction of having been associated with one or two activities that have had sizable, successful, and permanent impact. . . . I have that sort of satisfaction.

Scene of Change is an illuminating and graceful introduction to a man who has earned that satisfaction through four decades of remarkably effective work in advancing science and its useful applications and in promoting better general understanding of both the technical and the humane aspects of the scientific enterprise. As scientific activities become larger, more highly organized, and more intimately related to the other affairs of mankind, we need more men of his kind.

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Very Early Influences

Prenatal Determinants of Behaviour. J. M. JOFFE. Pergamon, New York, 1969. xii + 368 pp., illus. $13. International Series of Monographs in Experimental Psychology, vol. 7.

This volume is a thesis expanded to the proportions of a book. As a thesis, it is a first-rate job. For a book, however, the thesis format leaves much to be desired. The first half of the volume consists of a review of the literature on prenatal influences (stress) on the subsequent behavior of animals. This leads to a detailed account of the author's thesis experiment and is followed by a three-chapter addendum about human studies, which is interesting but of limited relevance to the preceding sections. The author argues that substantive findings must be predicated on reliable methodologies, and his focus is on methodological points rather than substantive results, issues, or concepts.

The coverage and organization of the literature are excellent, and this