tive education. Not only must they accept responsibility for research along basic conceptual lines, but they must assist in the development of a climate of public opinion that recognizes the supreme worth of intellectual freedom. They must resist every effort to have education serve a society that maintains the symbols of political democracy, but actually concedes final control to covert concentrations of power that use educational skills to arrogate to themselves the administration of national welfare. Perhaps psychologists and psychiatrists might make their most valuable contributions in the next few years if they would concentrate their research, not on how to influence and manipulate people, but on how to free people from the compulsion to control others.

Less than one half of 1 per cent of the inhabitants of the United States are professionally engaged in scientific research, the technological application of its results, and the teaching of science. These scientists share the responsibility for human welfare with all other citizens. They cannot, however, escape the fact that because of their intellectual powers and their influence in forming public opinion, theirs is a larger share of that responsibility than their numbers alone would indicate.

Only those scientists who have both a social conscience and a large measure of courage will take the calculated risk of cultivating the common ground of science and politics. Knowing my colleagues as I do, I am confident that there are enough of them to make a powerful and beneficent impact upon public affairs in this country of ours, which even now has some claim to be "the land of the free and the home of the brave."

Warren Weaver, AAAS President-Elect

Chester I. Barnard

Chairman, National Science Foundation

WARREN WEAVER, the new President-Elect of the AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, is director of The Rockefeller Foundation's Division of Natural Sciences and Agriculture. Elected at the Association's 119th meeting at St. Louis last December, Dr. Weaver will take office in 1954.

Dr. Weaver, who began his career with a strong interest in engineering and mathematical physics, was born in Reedsburg, Wisconsin, on July 17, 1894. From the University of Wisconsin he received a B.S. degree in 1916 and the degree of civil engineer in the following year. His early teaching experience at Throop College and the California Institute of Technology was interrupted by service as a second lieutenant in the U. S. Army Air Service from 1917 to 1919. In 1920 Dr. Weaver returned to his alma mater as assistant professor of mathematics completing his doctoral dissertation on electromagnetic theory and receiving the Ph.D. in 1921. Four years later he was promoted to the rank of associate professor, and in 1928 he became a full professor and chairman of the Department of Mathematics. During this period Dr. Weaver's published research, as well as his graduate teaching, was largely concerned with electrodynamics and diffusion theory. To Charles S. Slichter and Max Mason, with whom he was closely associated at this time, Dr. Weaver gives credit for directing him into his chosen specialty. With Professor Mason he collaborated in writing *The Electromagnetic Field,* in 1929. Four years earlier he was co-author with Charles S. Slichter of *Elementary Mathematical Analysis.*

In 1932 Dr. Weaver was invited to succeed Herman A. Spoehr as director of the Natural Sciences Division at The Rockefeller Foundation in New York. Dr. Weaver also served (1932–37) as director for the Division of Natural Sciences of the General Education Board, another Rockefeller board which at that time became interested in strengthening science teaching in our Southern universities. In these capacities he has had unusually broad experience and contacts in science.

Called upon to return to his original interests in applied mathematics during World War II, Dr. Weaver directed government research projects in the Office of Scientific Research and Development. From July 1940 until December 1942 he served as chairman of Section D-2, the Fire Control Division, of the National Defense Research Committee, and from 1943 to 1946 as chief of the Applied Mathematics Panel, an organization of over 200 mathematicians and statisticians working on a wide variety of military problems.

As early as 1941 Dr. Weaver had served on an official scientific mission, under James Bryant Conant, to investigate British weapons development. For his outstanding services in connection with the development of antiaircraft fire-control devices (prediction computers and controlling servomechanisms) and of bombsights and computing sights for use in air-to-air combat Dr. Weaver in 1948 received the Medal for Merit, the highest award made to civilians in the United States. He was also decorated with the King's Medal for Service in the Cause of Freedom by the

British government, and in 1951 he received the decoration of Officier of the Légion d'Honneur of France. Since the end of World War II Dr. Weaver has served as chairman of the Naval Research Advisory Committee and as a member of the Research Advisory Panel of the War Department.

In 1919 Dr. Weaver married Mary Hemenway. The Weavers have two children, Helen Hemenway and Warren, Jr., who is on the editorial staff of the New York *Times*.

One of Dr. Weaver's intense personal interests is in communication and mathematical probability theory. In some recent articles on this subject, he stresses the view that all scientists are deeply concerned with probability.

Science deals (as in mathematics) with statements about theory which are logically accurate, but to which the concept of "truth" does not apply; it also deals (as in physics) with statements about nature which can never in a rigorous sense be known to be true, but can at best only be known to be highly probable. It is rather surprisingly the case that the only time man is ever really sure is not when he is dealing with science, but when he is dealing with matters of faith. . . . For in a vast range of cases in which it is entirely impossible for science to answer the question "Is this statement true?" probability theory does furnish the basis for judgment as to how likely it is that the statement is true. It is probability which, in an important fraction of cases, enables man to resolve the paradoxical dilemma pointed out by Samuel Butler: "Life is the art of drawing sufficient conclusions from insufficient premises" (*Sci. Amer.*, **183**, 47 [Oct. 1950]).

In 1949 Dr. Weaver collaborated with Claude E. Shannon, of Bell Telephone Laboratories, in a book entitled *The Mathematical Theory of Communication*. The theory developed in these pages holds that communication—whether by speech, music, pictures, signs, gestures, or any other of the variety of means that men use to convey ideas—is based on the statistical nature of language. Dr. Weaver regards the Shannon theory so broadly and imaginatively motivated that it applies to all forms of communication. It is basic to the science of coding, contributes to the problem of translation from one language to another, and connects closely with the design of mechanical computers, differential analyzers, and other so-called thinking machines.

In his hobbies, Dr. Weaver carries over his interest in statistical thinking. He is a collector of the writings of Lewis Carroll and is the author of several highly entertaining articles on *Alice's Adventures in Wonderland* and its creator.

In line with his deep interest in the communication problems of science, Dr. Weaver possesses an unusual talent for interpreting one branch of science to other scientists. He also has the ability to reduce abstruse mathematical theory into terms that can be understood, or at least appreciated, by the layman, and to relate this theory to phenomena of everyday life. He is frequently called upon to lecture before groups outside his own fields of interest or to write for publications that have a general audience. He has recently contributed a chapter, "Probability and Statistics," to the volume *Facing the Future's Risks,* edited by Lyman Bryson and published this year. A few years ago he served as chairman of the advisory committee of the Intermission Science Series of the New York Philharmonic-Symphony Broadcasts. These Sunday afternoon programs brought more than eighty American scientists to the microphone to present various aspects of modern science to the lay public. The speeches were published in a volume entitled *The Scientists Speak,* edited by Dr. Weaver.

Further evidence of Dr. Weaver's breadth of interest is his constant concern about community affairs. In 1951 he spoke before the New York Herald Tribune Forum on local problems of freedom and how these are solved in his own community of Scarsdale, New York.

In his position as director of the Division of Natural Sciences and Agriculture, Dr. Weaver has had contact with most of the physical and biological sciences. Geographically, his work has involved extensive travel in Western Europe, Mexico, Central America, South America, and the United States. He has long-standing personal acquaintance with scientists of all countries.

Although his own interests lie in the mathematical

and physical sciences, he has looked upon his major task at The Rockefeller Foundation as that of obtaining greater support for the development of experimental biology, including such fields as genetics, cellular physiology, biochemistry, and experimental embryology. The physical sciences, in dealing with inanimate nature, which can be broken up into bits and analyzed without losing its essential character, have stolen a march on the biological sciences; but wisdom to utilize properly this increased knowledge of physical nature is not yet available. If man is to avoid becoming degraded by gadgetry or destroyed by physical force, Dr. Weaver is convinced that certain basic problems involved in understanding individual human behavior must be solved. And before so complex a subject as the behavior of man can become clear, scientists obviously must gain a tremendous amount of information and insight regarding living organisms in general, starting necessarily with simpler forms of life. At the same time, it is clear that the physical sciences have, in technique and in experimental procedures, a great deal to contribute to the study of biological problems.

A large part of Dr. Weaver's administrative effort has thus been devoted to the promotion of cross-disciplinary studies; for example, in mathematical biology, in biochemical genetics, in biophysics. His stress is on basic, central problems that demand concerted attack from many sides: "The coming of age of biology will be seriously impeded unless the circumstances of encouragement and support are favorable for the breaking down of old orthodox compartments in science, unless all the tools and techniques of the physicist, the chemist, and the mathematician can be brought effectively to bear."

In 1943 agriculture was added to the foundation's program in the natural sciences. Agriculture, Dr. Weaver explains, is in large part applied biology and hence is a logical part of an expanding program in biology. His division has two kinds of activities in agriculture. It cooperates with foreign governments in agricultural research. Programs are under way in Mexico and Colombia, with the practical aim of using science to improve both the quality and quantity of basic food crops. The other activity places increasing emphasis on agricultural science—the encouragement of advanced research and the training of personnel.

Dr. Weaver became a fellow of the AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE in 1928 and has served as a member of the Executive Committee since 1950. From 1936 to 1939 and from 1944 to 1947, Dr. Weaver was a member of the National Research Council's Division of Physical Sciences, and in 1951 he was asked to serve on the council's committee on high-speed computing machines. In 1951, also, he was appointed to the board of scientific consultants of the Sloan-Kettering Institute for Cancer Research.

The foregoing biographical notes, which resemble an expanded *Who's Who* account, were prepared for me "from the record" by The Rockefeller Foundation publication office, and some of them were, in fact, news to me. But this man and his career deserve a more personal appraisal. I have worked with Warren Weaver for nearly thirteen years, intermittently from 1940 to 1948 as a trustee of The Rockefeller Foundation and always as a member of its Executive Committee; and from 1948 to 1952 as an officer of the foundation, in almost daily contact with him and spiritually in persistent association with him. Space is not available here to write all I would like to, and all that would be worth reading; but I must say at least the following:

First: The extraordinary versatility of Weaver's scientific interests and experience implies intellectual flexibility, but might suggest a lowering of standards of precision and rigor, for in some fields only first and very rough approximations are available. It is my view that, in his case, there has been no deterioration of intellectual and scientific standards. Knowing the variety of efforts required of him, this is really a noteworthy achievement.

Second: His natural talent, as a teacher, in communicating science to laymen is outstanding. No one having that talent could appear month after month before the Rockefeller board and committees to defend recommendations without developing it effectively, but the impulse starting all this comes from the belief that an important function of scientists is to make the significance and aesthetic experience of science available to the literate public. Scientists have neglected or disregarded this function, but its importance is increasingly evident.

Finally, I must say that I regard Warren Weaver primarily as a humanist. This is not because of his interest in Lewis Carroll's writings or in any other subject ordinarily regarded as humanistic. It is because these interests are combined with an essentially similar approach to science, which he considers good in itself. Science is a value to be cultivated for its own sake, not necessarily or chiefly for utilitarian purposes. The curiosity, the initiative, the imagination, the persistence, the patience, the frustrations, that must be experienced and endured in science cannot be adequately motivated by the current exaggeration of the usefulness of science, but must be founded on the belief that all this toil is justified as an expression of the superior faculties of mankind and as a contribution to the values of man as a whole. So I hail Warren Weaver as superbly exemplifying this philosophy.