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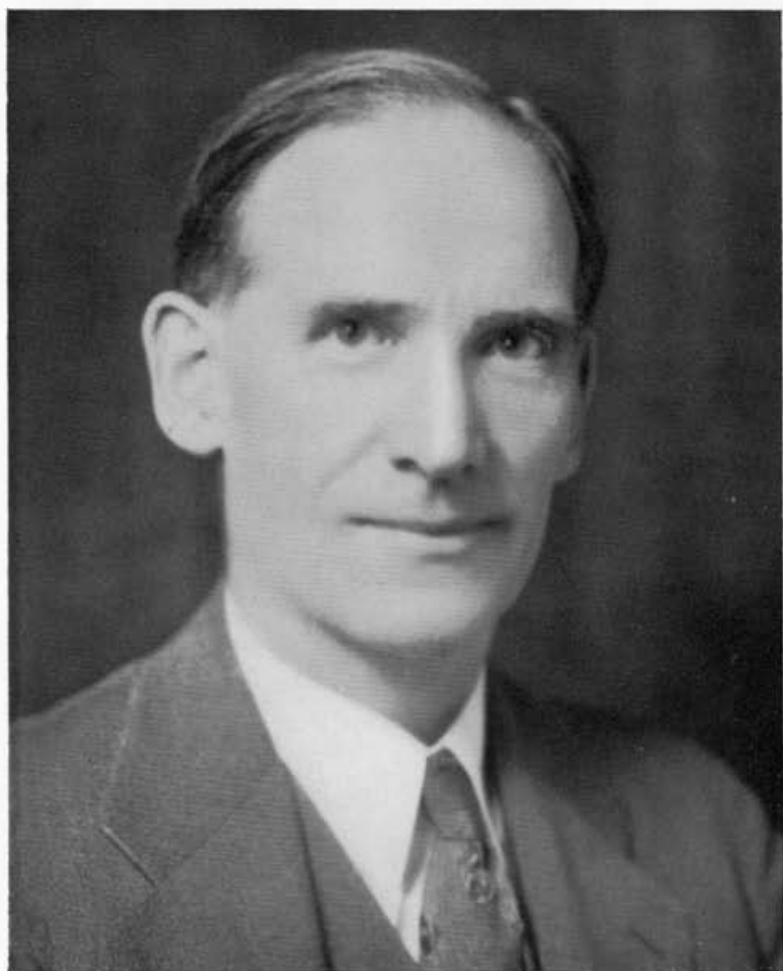
FREDERICK GARDNER COTTRELL
1877—1948

A Biographical Memoir by
VANNEVAR BUSH

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Biographical Memoir

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J. F. Cottrell.

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The words in which the Western Society of Engineers in 1937 cited Frederick Gardner Cottrell for the Washington Award are a tribute and an estimate that well merit repetition. That Award was presented to Dr. Cottrell "for his social vision in dedicating to the perpetuation of research the rewards of his achievements in science and engineering." Here are summed up the past accomplishments and the continuing benefactions of a long and distinguished career which was marked throughout not only by vigorous pioneering initiative in physical chemistry and industrial engineering but also by a constant and lively sense of the social significance of scientific and engineering advances and the social responsibility of the scientist and engineer. Coupled with this sense of social responsibility was recognition—conviction, indeed—of the intrinsic value and the human utility of research.

Out of this combination there came in 1912 the creation of a unique enterprise, characterized in the beginning by its initiator as an *experiment in the public administration of patent rights*. It was an innovation, a fire-new pioneering idea, and out of it has grown over the years a new philosophy concerning the utilization of the results of creative endeavor. We know it today as the Research Corporation, a corporate entity which is almost a contradiction in terms, since it is at once a business and a non-profit undertaking. The Research Corporation was founded through gifts by Dr. Cottrell and his associates of valuable rights in patents in the field of electrical precipitation, for the purpose of utilizing the proceeds from applied research for the further advancement of science and technology. The Corporation, operating in the same field and in the same general fashion as any private business, pays no dividends to personal stockholders; rather, all its income above expenses—apart from what is needed for reserves or for operating capital—is ex-

pended to assist scientific and educational institutions in carrying on research.

The social philosophy underlying the Research Corporation was never better stated than by Dr. Cottrell himself in 1937, in his address "The Social Responsibility of the Engineer," delivered in acceptance of the Washington Award. Referring to the Research Corporation and its offshoot, Research Associates, Inc., which was active from 1935 to 1938, Dr. Cottrell said:

"Briefly these two corporations may be said to hold a place and typify a new class midway between such privately endowed research and welfare foundations as Carnegie, Rockefeller, Russell Sage, Rosenwald, Macy, and the like on the one side, and university research foundations, such as those at Wisconsin, Purdue, and more recently Ohio State on the other. They differ from the first category in starting with no large monetary endowment, that interest or dividends on securities purchased as investment are not intended ever to be a significant factor in their income, but that normally they earn their way currently through services in invention development and production for use. They differ from the university foundations on the other hand chiefly by being entirely free from commitments to any one institution and thus being able to work with any and all of them, either individually or co-operatively. Also, I think it is still fair to say, though this I do with much reservation, that as yet most of the university foundations have been conceived and administered more largely from the standpoint and hope of revenue for further scientific research in the universities than from that of a laboratory in social economics, which I have particularly tried to emphasize as the outstanding opportunity among the purposes of Research Corporation and the Associates. That is, they are frankly willing to risk or even sacrifice on occasion possible legitimate profits from the licensing or operation of patents or developments if thereby a more important public service can be rendered by demonstrating the relative value and pertinency of proposed reforms in business and social administration of such rights, monopolies, or other social-economic structures as the corporation may control or operate at a given time."

The work which gave the Research Corporation its original financial support, and which in 1919 brought to Dr. Cottrell the Perkin Medal of the Society of Chemical Industry, began

in 1906, when he investigated the problem of sulfur trioxide fumes. The successful development of methods for the electrical precipitation of particles of liquids and solids, originating with this study, culminated in the Cottrell precipitator, invaluable in smelters, cement kilns, and wherever fumes and dusts are a hazard to life and an economic waste. This work is covered in patents on processes and apparatus for separating and collecting particles of one liquid suspended in another liquid, or separating and collecting suspended particles from gaseous bodies for the purification of gases or for the abatement of smoke, fumes, and dust.

Initially, rights in six patents were offered by Dr. Cottrell and his associates to the Smithsonian Institution in order that profit resulting from them might be applied to the advancement of scientific research and investigation. The business administration required was outside the range of the Smithsonian's activities, however, and so the Research Corporation came into being. In the years since 1912, it has made millions of dollars available for the support of research, through grants to institutions and individuals, and it has contributed invaluable through intangible aids such as advice and counsel in the handling of inventions and the administration of patents. Dr. Cottrell himself served in this work not only through the Research Corporation; he was closely associated with the Wisconsin Alumni Research Foundation and was a director of the Purdue University Research Foundation.

In addition to the Washington Award and the Perkin Medal, many other expressions of recognition of his achievements came to Dr. Cottrell. These included the Willard Gibbs Medal of the Chicago Section of the American Chemical Society, the Gold Medal of the Mining and Metallurgical Society of America, the Holly Medal of the American Society of Mechanical Engineers, and the Medal of the American Institute of Chemists. The University of California conferred upon him in 1927 its honorary degree of LL.D.

Dr. Cottrell was a member of the National Academy of Sciences, the American Institute of Mining Engineers, the American Association for the Advancement of Science, and

the American Electro-chemical Society, and an honorary member of the Société de Chimie Industrielle. Phi Beta Kappa, Sigma Xi, and Alpha Xi Sigma also claimed him as a member. His chairmanship of the Committee on International Auxiliary Language of the International Research Council expressed one phase of his wide-ranging interests—the development and propagation of means for simple universal communication.

Frederick Gardner Cottrell was born at Oakland, California, on January 10, 1877, the son of Henry and Cynthia L. (Durfee) Cottrell. Through his mother, he was of Mayflower descent. His early education was in The Horton School at Oakland, and the Oakland High School. He received the bachelor's degree in chemistry from the University of California in 1896, and spent the following year at the University as Le Conte Fellow. During his undergraduate years, he showed such energy and aptitude that by faculty vote he was given a duplicate key to the laboratories and was authorized to come and go at his pleasure and to carry on any experiments and research he desired.

He made good use of this privilege during the three following years while serving as a teacher of chemistry in the Oakland High School, going then to Germany for further study. In 1900-1901, he studied under van't Hoff at the University of Berlin, and the next year with Ostwald at the University of Leipzig, where he received the doctorate of philosophy in 1902. There followed a return to the University of California where from 1902 to 1906 he was an instructor in physical chemistry and from 1906 to 1911 an assistant professor.

In 1904 he married Jessie M. Fulton of San Francisco. Their two children died in infancy. Of Dr. Cottrell's career as a teacher *The California Alumni Weekly* in 1913 remarked, "He was a good instructor; he possessed the power of interesting his students and many of our best graduates who have made a success of their work, either in universities or in technical life, received their inspiration from him. He made companions of his students, without formality, and they felt a genuine respect."

Dr. Cottrell went from the University of California in 1911 to the United States Bureau of Mines as chief physical chemist

on field duty, serving successively thereafter as chief chemist 1914-15, chief metallurgist 1916-19, assistant director 1919-20, and finally as director commencing in 1920. He resigned from this post on January 1, 1921, to become chairman of the Division of Chemistry and Chemical Technology of the National Research Council, continuing as consulting metallurgist to the Bureau of Mines until 1922. In September of that year, he was called from the National Research Council position to serve as director of the Fixed Nitrogen Research Laboratory of the United States Department of Agriculture.

Till 1927 Dr. Cottrell continued in this post, where he felt the opportunity to direct research without too great a burden of administrative detail was especially valuable. When the Fixed Nitrogen Research Laboratory was reorganized in that year, he remained as chief of the Division of Fertilizer and Fixed Nitrogen investigations of the Bureau of Soils in the Department of Agriculture. When in 1930 he resigned from this post, he continued as consultant to the Bureau, which responsibility he carried for a decade. During the earlier period also he had served as consultant to the Smithsonian Institution in 1928-29.

After the end of the First World War, Dr. Cottrell was chairman of a small committee of scientists and engineers assigned the task of collecting chemical and metallurgical information for the Government. The undertaking involved a tour of nearly all the countries of Europe. During it, Dr. Cottrell not only inquired into the progress of projects for an international auxiliary language for the Smithsonian Institution, but also represented the National Academy of Sciences and the American Chemical Society at the Interallied Chemical Conference in Paris, London, and Brussels. At the latter city he also represented these organizations at sessions of the International Research Council.

Organization of Research Associates, Inc., a non-profit corporation growing out of the activities of the Research Corporation, engaged much of Dr. Cottrell's energies in 1935, and for three years thereafter he served as its president. The purpose of the new enterprise was to conduct scientific and social re-

search and to eliminate as far as possible the time lag between the perfection of scientific ideas and their introduction into the national life. The period of Research Associates' activity, from 1935 through 1938, was a most stimulating one. After the organization was dissolved in 1938, some of its functions were returned to the Research Corporation, and Dr. Cottrell devoted himself to numerous scientific projects mainly by means of liaison work among universities, science groups, and foundations. One of his main purposes between 1938 and the time of his death was the promotion of additional research organizations and the furtherance of closer co-operation between those already in existence. Here his long acquaintance with problems of administration of research and invention, through the Research Corporation itself and the university research foundations with which he had been long associated, was of profound value. The informal and unofficial visits to universities which he made during this period in the effort to keep abreast of research developments in virtually all fields, to become acquainted with the investigators concerned and to give such aid as he could, were stimulating to all.

In 1939, through his advocacy, the University of Wisconsin initiated experiments which might lead to the fixation of nitrogen on an industrial scale. These involved application for the heating and quick chilling of air of the Royster pebble-bed furnace method which was prominent among Dr. Cottrell's studies in earlier years. His publications and patents began in 1906, and include not only applications of the pebble-bed furnace and electrostatic precipitation but also cryogenic separation of gases, laboratory apparatus, the dehydration of petroleum, and the recovery of wastes, among others.

Nitrogen fixation continued among his major interests in the final decade of his life, the process under development by the Food Machinery Corporation at San Jose, California, being a focus thereof. During the second World War, he advised on various projects including the industrial use of domestic manganese resources, the production of magnesium, the manufacture of high-temperature ceramics. The magnesium process at the Kaiser plant in Permanente, California, was of great

interest to him, and in 1942 and 1943, as a consultant for the Reconstruction Finance Corporation, he studied the technological problems it involved. In 1944 he removed from Washington, D. C. to Palo Alto, where he continued to devote time and interest to the fixed nitrogen process in San Jose, the patents on which had been assigned by him to the Wisconsin Alumni Research Foundation.

Dr. Cottrell's death occurred November 16, 1948, during a meeting of the National Academy of Sciences on his well loved campus of the University of California at Berkeley. Appropriately, among the technical papers which he had heard the day before his death was an account of the development of the cyclotron, in which a grant from the Research Corporation had been of early assistance.

KEY TO ABBREVIATIONS USED IN BIBLIOGRAPHY

- Am. Chem. J. = American Chemical Journal
 Ann. Rept. Smithsonian Inst. = Annual Report, Smithsonian Institution
 Cal. J. Tech. = California Journal of Technology
 Chem. Met. Eng. = Chemical and Metallurgical Engineering
 Elec. Rev. = Electrical Review
 Eng. Min. J. = Engineering and Mining Journal
 Intern. Cong. Appl. Chem. = International Congress of Applied Chemists
 J. Am. Chem. Soc. = Journal, American Chemical Society
 J. Ind. Eng. Chem. = Journal of Industrial and Engineering Chemistry
 J. Phys. Chem. = Journal of Physical Chemistry
 J. West. Soc. Eng. = Journal, Western Society of Engineers
 Proc. Am. Min. Cong. = Proceedings, American Mining Congress
 Rev. Sci. Instr. = Review of Scientific Instruments
 Sci. Mo. = Scientific Monthly
 Sitzber. kgl. preusz. Akad. = Sitzungsberichte, Koeniglich Preussische
 Akademie, Akademie der Wissenschaften, Berlin
 Tech. Eng. News = Tech Engineering News
 Trans. Am. Inst. Chem. Eng. = Transactions, American Institute of
 Chemical Engineers
 Trans. Am. Inst. Mining Eng. = Transactions, American Institute of
 Mining Engineers
 Trans. Commonwealth Club Cal. = Transactions, Commonwealth Club of
 California
 Zeit. anorg. Chem. = Zeitschrift für anorganische Chemie
 Zeit. physik. Chem. = Zeitschrift für physikalische Chemie

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