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## HOLBROOK WORKING

1895–1985

In Memoriam

Holbrook Working, Professor Emeritus of Prices and Statistics in the Food Research Institute, died on October 5, 1985, at the age of 90. He came to Stanford in 1925 and, except for his absence during World War II, lived and studied here for 60 years. He is survived by his wife, Elisabeth Crenshaw Working of Stanford; a son, John W. Working of Palo Alto; two daughters, Barbara Milligan of Palo Alto and Elizabeth Swift of Seattle, Washington; and nine grandchildren.

A native of Fort Collins, Colorado, he received his A.B. from the University of Denver, his M.A. in 1919 from Cornell University, and his Ph.D. in Agricultural Economics from the University of Wisconsin in 1921. Mr. Working taught at Cornell while he was a student and then spent five years on the faculty at the University of Minnesota before joining the Food Research Institute. In World War I, Brook served as 2nd Lieutenant in the U.S. Army. During World War II, he served as Statistical Consultant for the Fourth Air Force before being appointed Chief Statistical Consultant of and then Economic Advisor to the Office of Production, Research, and Development (OPRD) of the War Production Board, and finally Director of the OPRD's Quality Control Program.

Brook's professional colleagues bestowed high honors upon him. He was very much an economist, but he was much more. He was an accomplished statistician and mathematician. He was a pioneer in quantitative methods before such an endeavor was fashionable for economists. He was a founding member of the Econometric Society and also first Chairman of the Committee (later Department) of Statistics at Stanford. Measures of his remarkable breadth *and* depth are that he was elected a Fellow of three major professional organizations—the American Agricultural Economics Association, the American Statistical Association, and the American Association for the Advancement of Science.

Most recently, Working won the Samuel S. Wilks Award of the American Statistical Association “for co-authoring the remarkable 1929 *JASA* paper in which confidence-limit envelopes for an entire linear relation were introduced, for pioneering work in applying the random walk concept as a model of price movement in an ideal market, and especially for his exceptional contribution to the Allied effort in World War II by organizing, administering, and teaching in a program of intensive courses in statistical quality control attended by about 10,000 persons from industrial concerns in the United States and in Canada.”

While his contributions in the field of statistics were remarkable in themselves, they came in large part as a by-product of his studies of prices and

markets that were the central focus of his interest. His contributions in this field were even greater. Three interwoven strands of his research led to seminal contributions toward understanding and interpreting price behavior. He discovered quite early in his studies of wheat prices and the prices of wheat futures contracts that it was more fruitful to analyze changes in the relationships between prices for different delivery dates than to study changes in price levels per se. Price relationships displayed more regular and understandable patterns of change than did price levels. He came ultimately to propound a theory of the price of storage, which interpreted intertemporal differences in prices as a separate price of storage and upset the prevailing orthodoxy regarding these prices. For thirty years, Working's revision has been and continues to be the prevailing orthodoxy.

In the course of these studies he came to recognize that the manner in which commercial firms responded to these price differences required fundamental revision as well. He published this theory in 1953, since which time his concepts of the purposes of commercial firms' participation in futures markets have become not only the standard definitions in the academic literature, but also to the point of being incorporated into federal regulations of futures markets.

These two strands and their concern with the economic role of futures markets then led Working to concern himself with the process by which futures prices are formulated. His descriptions and analyses of the activities of professional market makers on the floors of the exchanges and his theory of anticipatory prices adumbrated major lines of research in economics and finance by nearly 20 years. Both also demonstrate the importance of statistics in his work as they required the development of new statistical measures to adequately describe the underlying process of market price formation. Every economist and every market participant owes a lasting debt of gratitude to Working for his profound insights into price behavior.

When Working formally retired in 1960, the Food Research Institute had only recently inaugurated a formal teaching program. As a consequence, his classroom students at Stanford were only a fortunate few. His students have been those who read his published works and these are many. The Chicago Board of Trade published a volume of his writings that continues to be in demand from scholars and practitioners alike. One measure of the respect which he earned from participants at the institutions he studied is that fifty members of the major Chicago futures exchanges endowed a chair at Stanford in his honor.

In addition to his research, Working found the time to participate actively in university and professional leadership roles. He was a director of the Social Science Research Council, was for eight years Associate Director of the Food Research Institute, and was the first chairman of the Business and Economics Statistics Section of the American Statistical Association. He enjoyed gardening, photography, and music—but most of all the Sierra Nevada, where he skied, hiked, and gained inspiration. He achieved proficiency in everything that he undertook to accomplish. Searching persistently for knowledge, he entertained no dogma and embraced no ideology.