MEMORIAL RESOLUTION
KENNETH JOSEPH ARROW
1921-2017

Kenneth Arrow, Joan Kenney Professor of Economics and Professor of Operations Research, Emeritus, died on Tuesday, February 21, 2017 at his Stanford home at age 95. Ken was one of the greatest economists of the 20th Century and is still the youngest person to win the Nobel Prize in Economics (at age 51). Among many other accolades, Ken won the National Medal of Science in 2004, the ninth economist to win that highest of distinctions.

Ken was born in New York City on August 23, 1921, to Romanian-born Jewish parents who came to this country as infants. His mother completed high school and his father worked his way through the New York City School of Business, rising to a responsible banking position in the 1920s. However, his family lost everything in the Great Depression, and the family was reduced to what Arrow called hand-to-mouth living for about seven years. Having advanced rapidly in school, Ken graduated from Townsend Harris High School while not yet fifteen years of age.

Ken earned his Bachelor degree in Mathematics in 1940 from CCNY, where tuition was free. He planned on a career as a high school math teacher, only to find that no examination for new teachers would be offered because of the long depression-era backlog of applicants. Lacking job prospects, Ken enrolled at Columbia's graduate school to study statistics, his eye on a possible career as a life insurance actuary. But there was no statistics department at Columbia, so Ken enrolled as a math student, hoping to work with theoretical statistician Harold Hotelling. Realizing that he would need financial support, Ken approached Hotelling for a letter of recommendation for a fellowship. Hotelling replied that he had no influence in the Math Department but could be helpful with the Economics Department, so Ken switched his Ph.D. field. As he later explained: "Well people ask me how did I get into economics? I was bought."

After Pearl Harbor, Ken enlisted in the armed forces, choosing a meteorology program in hopes of using at least some of his talents. Wartime service took him first to Washington DC, then to Asheville, North Carolina, finally to Langley Field, Virginia, generating a first publication in meteorology. Back at Columbia in 1946, Ken had support for a fellowship and the GI Bill, but still no good ideas for the very serious thesis he hoped to write. Already known as a brilliant student, he accepted a position at the Cowles Commission in Chicago in 1947.

The breakthrough came during the summer of 1948 at the RAND Corporation in Santa Monica, where theorists were eagerly adapting the new field of game theory to the study of international relations. During a coffee break, the philosopher Olaf Helmer posed the question of how an entire country could be said to have an objective function. Ken replied that the question had already been answered by the Bergson-Samuelson social

welfare function. But when he set out to write up this assertion, Ken soon realized that there were problems with any proposed method of combining individual preferences into a satisfactory aggregate. He went on to prove that such aggregation was in general impossible. When the monograph was presented to Columbia as a Ph.D. thesis, it was unrecognizable as economics to any of Ken's advisors, so the young econometrician T. W. Anderson – later Ken's colleague at Stanford – was called in to pass judgment. Anderson pronounced the work sound, a decided understatement, as Ken's thesis opened the whole field of Social Choice.

At Cowles, Ken met Selma Schweitzer, who had been awarded a fellowship for women pursuing quantitative work in the social sciences. Ken and Selma were married four months later, a marriage that lasted until her death in 2015. In 1949 they decided to accept Ken's offer from Stanford, beginning as an Acting Assistant Professor of Economics and Statistics. Ken was on the Stanford faculty from 1949 to 1968 and then again from 1979 until his retirement in 1991. (He was at Harvard from 1968 to 1979.) He continued to be an active researcher and regular at the department until his death.

The Nobel citation noted three of Ken's earliest and most fundamental theoretical contributions: the Impossibility Theorem; an extension of the basic theorems of welfare economics; and the proof (joint with Gerard Debreu) of the existence of general equilibrium in a competitive economy: a set of prices that under specified assumptions clear all markets simultaneously. In the same period of intense creative activity, Ken formalized the role of financial markets in resource allocation by introducing the concept of a "contingent commodity" whose value depended on the "state of the world" when it is deliverable. These "Arrow Securities" are the cornerstone for modern theories of finance.

This prize-winning work was highly abstract and mathematical, but from the 1960s onward, Ken also wrote many analyses of policy issues, with equal or sometimes even greater impact. "The Economic Implications of Learning by Doing" (1962) prefigured the rise of endogenous growth theory decades later. "Economic Welfare and the Allocation of Resources for Invention" is a foundational work in the economic analysis of technology, identifying three properties that distinguish investments in knowledge from conventional investments: indivisibilities, inappropriability, and uncertainty. Perhaps Ken's most impactful paper was "Uncertainty and the Welfare Economics of Medical Care" (1963), which highlighted features of health care that render normal market relationships inefficacious. Ken's own comments about this piece are understated but appropriate: "This paper is one that I cherish highly. It represented an attempt at understanding an issue to which standard economic theory was clearly only partly applicable, and it led to the beginnings of a new conceptualization." Indeed, the article has defined the agenda for the field of health economics ever since.

Arrow's work arguably qualified him for at least four Nobel Prizes. At an Academic Tribute to Kenneth Arrow held on October 9, 2017, twelve Nobel Prize winners, including three of his five Nobel-winning students, spoke.

Above all, Ken sought to use his intellect and knowledge to advance the common good. The best evidence is how he devoted his time during the 25 years of his so-called retirement. Ken chaired two study committees of the Institute of Medicine, including one that generated a major report on the economics of antimalarial drugs: *Saving Lives, Buying Time*, whose recommendations have been effective in dramatically reducing the cost of treatments. Ken's most passionate engagement in recent years was climate change, which he considered a great threat to the well-being of future generations. He was a lead author for the Intergovernmental Panel on Climate Change Second Assessment Report in 1995, which identified carbon dioxide as the most important contributor to global warming and issued what now seems a prescient warning that "important aspects of climate change are effectively irreversible." He was a co-author of the "Economists' Statement on Climate Change," issued in 1997 and signed by 2,400 U.S. economists. As recently as December 2016, Ken was one of more than 5,500 scientists who signed an Open Letter to President Trump and the 115th Congress, calling on them to ensure that science continues to play a strong role in protecting public health and well-being.

Ken and his wife Selma have two sons, David and Andrew, both professional actors. His economist sister, Anita Summers, whose son Larry Summers was the President of Harvard and the U.S. Secretary of Treasury, also survives him.

Despite Ken's remarkable intelligence and prodigious accomplishments, he was humble, kind and generous. He thought he could learn something from anyone and everyone. As his nephew Larry Summers has written: "Save for the NFL, there was no topic – from politics to music, from classics to physics – on which Kenneth was not infinitely curious and apparently omniscient." Yet Summers went on to say: "Kenneth knew more about everything than most know about anything, but he never flaunted his intelligence." His former students remember him as ``accessible and unpretentious, addressed as 'Ken' by students, colleagues, and staff." Ken had the patience to discuss anyone's ideas and plans in a helpful and sympathetic (though rarely uncritical) manner.

It is hard to imagine a world without Ken Arrow, but his influence is all around us and his inspiration endures.

Resolution Committee
Matthew Jackson, Alvin Roth, John Shoven, Gavin Wright

Links to Other Tributes and Information:
SIEPR Arrow Tribute Videos and Tributes: https://siepr.stanford.edu/events/arrow-tribute
Stanford Report: https://news.stanford.edu/2017/02/21/nobel-prize-winner-kenneth-arrow-dies/
Econometric Society Obituary and Tributes:
https://www.econometricsociety.org/content/remembrance-kenneth-arrow
New York Time Obituary: https://www.nytimes.com/2017/02/21/business/economy/kenneth-arrow-dead-nobel-laureate-in-economics.html?_r=0
Wash Post Obituary: https://www.washingtonpost.com/national/kenneth-arrow-nobel-laureate-and-seminal-economist-with-wide-impact-dies-at-95/2017/02/21/089c3888-f8aa-11e6-be05-1a3817ac21a5_story.html