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The Century’s Giant: An Obituary of Economist Kenneth Arrow

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Kenneth Arrow was arguably the leading figure of mainstream economics in the post-World War II era. His contributions to microeconomic theory were monumental. But his precision of thinking always shone through, and he carefully delineated the many limitations of free market solutions. The social, real-world aspects of his work were highly influential. The author, an eminent economic historian, was a colleague of his at Stanford University.

Kenneth Joseph Arrow died February 21, 2017, at his home in Palo Alto, California, aged ninety-five. He was an undisputed and deserved giant of twentieth-century economics, awarded the Nobel Memorial Prize in Economics in 1972 (jointly with the British theorist John Hicks) at the age of fifty-one, the youngest person ever to win the prize. He received the National Medal of Science in 2004, among many other accolades.

I was privileged to be a colleague of Ken Arrow’s at Stanford University for nearly thirty-five years and have many fond memories, some of which I will relate later in this piece, but let me begin with his monumental achievements in many important areas of economics. The Nobel citation noted three of Arrow’s earliest and most fundamental theoretical contributions.

• First, the Impossibility Theorem, which demonstrated that under plausible conditions, no decision-making mechanism can ensure transitive group choices even when individual preferences are transitive (Social Choice and Individual Values, 1951, which was the published version of Arrow’s dissertation). In general, it showed the limits to satisfying all members of a group.
• Second, an extension of the basic theorems of welfare economics, to include nondifferentiable functions and corner solutions (1951), which had generally been obstacles to establishing the benefits of markets.

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• Third, proof of the existence of general equilibrium in a competitive economy (Arrow and Gerard Debreu, *Econometrica*, 1954), meaning that under specific assumptions, prices would be set to equilibrate supply and demand in all markets simultaneously.

In the same period of intense creative activity, Arrow formalized the role of financial markets in resource allocation by introducing the concept of a “contingent commodity” whose value depended upon the “state of the world” when it is deliverable (the French version was published in 1953, translated into English as “The Role of Securities in the Optimal Allocation of Risk-Bearing,” *Review of Economic Studies*, 1964).

This prize-winning work was highly abstract and mathematical, so much so that one might question its value for practical economic matters. But it has reconfigured intellectual pursuits in several academic disciplines. *Social Choice and Individual Values* virtually created the field of social choice theory, a significant specialty in both economics and political science. “Arrow securities,” hypothetical instruments with a fixed payout only in one specified state, are said to provide a cornerstone of the modern theory of finance. The existence of competitive general equilibrium is sometimes claimed by libertarians as a fundamental basis for laissez-faire economic policies, but Arrow himself never took this view. Instead, he argued that “the logic of competitive equilibrium is closely related to that of economic planning” (*Collected Works of Kenneth Arrow*, 1983, Vol. 2, v), serving as a useful benchmark for confronting the inefficiencies of the competitive system in the real world. Similarly, although the concept of Arrow securities suggested that it might be possible under certain conditions to set up formal mechanisms to achieve an optimal allocation of risk by competitive methods, Arrow was careful to note that the empirical validity of these conditions was highly doubtful, and that “many of the economic institutions which would be needed to carry out the competitive allocation in the case of uncertainty are in fact lacking” (*Collected Works of Kenneth Arrow*, 1983, Vol. 2, 57).

Ken Arrow clearly cared about the real world, and from the 1960s onward he wrote many “middle-brow” theoretical analyses of policy issues, with equal or perhaps even greater impact. “The Economic Implications of Learning by Doing” (*Review of Economic Studies*, 1962)—an interest that dated back to his days at the Rand Corporation in the 1940s—prefigured the rise of endogenous growth theory decades later. “Economic Welfare and the Allocation of Resources for Invention” in *The Rate and Direction of Inventive Activity* (1962) is a foundational work in the economic analysis of technology, identifying three properties that distinguish investments in knowledge from conventional investments: to be technical, *indivisibilities, inappropriability, and uncertainty*. Probably his most influential paper
was “Uncertainty and the Welfare Economics of Medical Care” (*American Economic Review*, 1963), which highlighted features of health care that render normal market relationships inefficacious. That is to say, unlike food and clothing, health-care needs are unpredictable; information is highly asymmetric between doctor and patient (one knows much more than the other). Their relationship requires trust and confidence, even though the patient cannot completely enforce standards of care. Arrow’s own comments (in volume 6 of his collected works) 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.” The article was cited as recently as January 2017 by *New York Times* columnist David Brooks as one that progressives “point back to” in making the case that markets for health care do not work. Speaking to visitors during his final illness, Arrow acknowledged that the column’s summary of his argument was accurate, but he was completely unpersuaded by Brooks’s claim that health care’s exceptional features have diminished over time.

Somewhat less famous, but directly relevant for research on the economic history of race, are Arrow’s papers on the theory of discrimination in labor markets: “Models of Job Discrimination” and “Some Mathematical Models of Race Discrimination in the Labor Market” in *Racial Discrimination in Economic Life* (ed. A. H. Pascal, 1972), and “The Theory of Discrimination,” in *Discrimination in Labor Markets* (ed. O. Ashenfelter and A. Rees, 1973). Responding to what he called “the awakened conscience of the country with regard to racial discrimination,” Arrow’s papers built upon earlier work by Gary Becker but showed that under plausible assumptions regarding employer prejudice and feedback effects on skills, a discriminatory outcome could constitute a stable equilibrium. Although the analysis is highly abstract and advanced in a tentative spirit, the conceptual development constitutes a profound intellectual alternative to Becker’s result that discrimination is ultimately nonviable in a competitive market setting. Nobel laureate James Heckman and his coauthors referred to the Southern cotton textile industry—which remained virtually all-white for a century—as an “ideal textbook example of Kenneth Arrow’s model of discrimination.”

Arrow’s personal history offers a few clues as to the origins of these humane sensibilities. He was born in New York City on August 23, 1921, of Romanian-born Jewish parents who came to this country as infants. As Arrow told an oral history interviewer, “Their English was different from other people’s only in the fact that it was better.” His mother completed high school and his father worked his way through the New York University School of Business, rising to a responsible banking position in the 1920s. However, his family lost everything in the Great Depression, and they were reduced to what Arrow called hand-to-mouth living for about seven years.
Having advanced rapidly in school, Arrow graduated from Townsend Harris High School while not yet fifteen years of age.

Arrow attended the City College of New York, where tuition was free. Less well known is that he had also applied to Columbia University. After securing an application waiver because of his age, Arrow appeared for the standard interview, and at the end he asked about the forms for financial assistance, knowing that his family could never afford to pay Columbia’s tuition. The interviewer replied: “Don’t bother with those, you won’t be getting in.” In the event, Arrow was put on the wait list and ultimately admitted. By then the deadlines for financial aid had long passed, so the Columbia possibility had to be dropped. It is difficult to avoid the inference that anti-Semitic discrimination was at work.

Of CCNY, Arrow always said that although the facilities were poor, he could not possibly have received a better college education. The move into economics, however, was fortuitous, the unlikely result of a series of historical accidents. Having majored in mathematics, he planned on a career as a high school math teacher, taking the education courses required and even doing a stint as a practice teacher. After graduation, Arrow found that no examination for new high school teachers would be offered, because there was a long backlog of people who had passed the previous exam back to seven years earlier. Lacking job prospects, Arrow enrolled in 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 Arrow registered as a mathematics student, hoping to work with theoretical statistician Harold Hotelling. Arriving at Columbia in the fall of 1940, Arrow found out that Hotelling was a professor of economics—appointed only because the one statistical economist in the department had suddenly left. Realizing that he would need financial support, Arrow 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 Arrow 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, Arrow enrolled in the armed forces, choosing a meteorology program in hopes of using at least some of his talents. The economics department chair urged him to complete a thesis before being called up, but Arrow felt that he wanted to do something important although he lacked promising ideas. Wartime service took him first to Washington, DC, then to Asheville, North Carolina, finally to Langley Field, Virginia, generating a first publication in the Journal of Meteorology but not, in his view, contributing much to the war effort. Back at Columbia in 1946, Arrow had support from 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, California, 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. Arrow answered at the time that the question had already been answered by the Bergson-Samuelson social welfare function. But when he set out to write up this assertion, Arrow 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 not possible. “The development of the theorems and their proofs then required only about three weeks, although writing them as a monograph took many months” (Collected Works of Kenneth Arrow, 1983, Vol. 1, 4). When the monograph was presented at Columbia as a Ph.D. thesis, it was unrecognizable as economics to any of his advisers, so the young econometrician T. W. Anderson—later Arrow’s colleague at Stanford—was called in to pass judgment. Anderson pronounced the work sound, and the rest is history.

At Cowles, Arrow met Selma Schweitzer, who had been awarded a fellowship for women pursuing quantitative work in the social sciences. Kenneth and Selma were married four months later, a marriage that lasted until her death in 2015. In 1949 they decided to accept Kenneth’s offer from Stanford University. They were eager to leave Chicago, in part because of the arrival at the University of Chicago of Milton Friedman, who was antagonistic to the Cowles Commission and what he took to be its Keynesian views. But they were also attracted by the presence at Stanford of statistician Meyer A. Girshick (known as Abe), for whom Selma had previously worked at the Agriculture Department in Washington, DC, and who was well known to Kenneth from the summers at RAND. Arrow insisted on a joint appointment in statistics at Stanford. But he joined an economics department that included such notable figures as Bernard Haley, Edward Shaw, Lorie Tarshis, Tibor Scitovsky, Moses Abramovitz, Melvin Reder, and the Marxist Paul Baran.

Arrow moved from Stanford to Harvard in 1968, in part because he felt that Stanford’s economics department was too small and not competing for the best young theorists. Afterwards, Arrow had only positive comments about his experience at Harvard, but he always returned to Stanford for the summer sessions of the Institute for Mathematical Studies in the Social Sciences (IMSSS), an institution that he had helped to found. He came back to Stanford to stay in 1979, remaining active in departmental and university life long after his retirement (compelled by the mandatory rule still in place) in 1991. That is where I came to know Kenneth as a colleague and friend, when I came to Stanford in 1982. This is not to claim any special status. During his Stanford years, it was not possible to join the economics department without becoming a friend of Ken Arrow’s.

In the many remembrances that have come forth since Ken’s death, what shines through is the human qualities of the man. The eclectic range of his
interests and the vast extent of his knowledge were legendary. As his nephew Lawrence 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” (Wall Street Journal, February 25, 2017). His former students remember him as “accessible and unpretentious, addressed as ‘Ken’ by students, colleagues, and staff” (W. Heller, R. Starr, and D. Starrett, Essays in Honor of Kenneth J. Arrow, 1986, Vol. 1, xvii). His intellectual prowess notwithstanding, Ken had the patience to discuss anyone’s ideas and plans in a helpful and sympathetic (though rarely uncritical) manner. One story is told by Jay Bhattacharya, former Stanford Ph.D. student and now professor of medicine and by courtesy of Health Research Policy and Economics at Stanford. Taking Kenneth’s course on income inequality as an undergraduate, Bhattacharya thought he had discovered a counter-example to the impossibility theorem as presented in class. At an appointment to discuss the matter, the professor kindly corrected the student’s error and even apologized for being unclear in the presentation. They then spent the bulk of the time discussing Bhattacharya’s plans for the future. When Bhattacharya said that he planned to become a doctor and not an economist, he was surprised when Kenneth appeared disappointed and urged him to think more about it. “That meeting led me for the first time to think really seriously about a career as an economist. That brief meeting with Prof. Arrow changed my life.”

Kenneth’s political sympathies were clearly on the progressive side, but he was never one to acquiesce in the easy assumptions of liberal idealism. Policy proposals from all parts of the spectrum received critical scrutiny. When my wife and I arrived for a visit during his final illness, we found Ken at the computer, carefully inspecting a petition on air pollution to be sure he agreed with the statement before submitting his endorsement. Some time back I became involved in local school politics, and for years afterward, Ken would call during election season to get my advice on school board candidates. I never ceased feeling awestruck to be consulted by this towering figure. But how many geniuses of international stature would give such conscientious attention to their vote in local elections?

Above all, Kenneth wanted to use his intellect and knowledge to advance the common good. The best evidence for this proposition is how he devoted his time during the twenty-five years of his so-called retirement. Kenneth 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, which recommended a global subsidy to make new combinations malaria treatments available to low-income countries worldwide. According to the website of the Health and Medicine Division, the report led to the creation in 2009 of an international partnership called
Affordable Medicines Facility for Malaria, reducing the cost of combination treatments from $4 to less than 40 cents on average.

Kenneth’s most passionate policy engagement in recent years was climate change, which he believed to be a great threat to the well-being of future generations. He was a lead author for the Intergovernmental Panel on Climate Change (IPCC) 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. Always focused on the analytical core of the issue, Kenneth wrote for a broad readership and stressed two factors that differentiate climate change from other environmental problems: first, emissions of CO$_2$ and other trace gases remain in the atmosphere for centuries, making timely action urgent; second, the externality is truly global in scale, because greenhouse gases travel around the world in a few days. The implication is that global cooperation is essential for mitigation. Yet he also continued more technical work for specialists, coauthoring a 2014 article in *Nature* calling for extension of climate change models to include a wider range of social and economic impacts. As recently as December 2016, Kenneth was one of more than 5,500 scientists who signed “An Open Letter to President-Elect 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.

When a person of Kenneth’s quality lives a life so full and remains so close to peak powers virtually to the end, we should celebrate that life rather than mourn his demise. It is hard to imagine a world without Ken Arrow, but his influence is all around us, and his inspiration endures. Like Abraham Lincoln, now he belongs to the ages.