Allen Newell (1927 - 1992)

Allen Newell, one of the founders of both artificial intelligence and cognitive science, was awarded the National Medal of Science by United States President George Bush only a month before his death in July 1992.

Newell's career spanned the entire computer era, which began in the early 1950s. The fields of artificial intelligence and cognitive science grew in part from his idea that computers could process symbols as well as numbers and that if suitably programmed they would solve problems the way humans do. In cognitive science, Newell focused on problem-solving and the cognitive architecture that supports intelligent action in humans and machines. In computer science, he worked on areas as diverse as list processing, computer description languages, hypertext systems and psychologically based models of human-computer interaction.

As of the early 1980's, Newell's work had centered on developing SOAR, a software system capable of human-like learning and problem-solving. SOAR has been in use for the past five years as a framework for intelligent systems designed at several U.S. research institutions.

A native of San Francisco, Newell received a bachelor's degree in physics from Stanford University in 1949. He spent a year at Princeton University doing graduate work in mathematics and then worked for the Rand Corporation as a research scientist from 1950-61. While at Rand, he met Herbert A. Simon, then a professor of industrial administration at Carnegie Institute of Technology (CIT). Their discussions of how human thinking could be modeled led Newell to come to Pittsburgh so the two could collaborate. He earned a doctoral degree in industrial administration from CIT's business school in 1957.

Newell joined the CIT faculty as a professor in 1961. He played a pivotal role in creating Carnegie Mellon's Department (and later School) of Computer Science and elevating it to international distinction. At the time of his death he was U.A. and Helen Whitaker professor of computer science at Carnegie Mellon University.

Newell wrote and co-authored more than 250 publications, including 10 books. He co-authored Human Problem Solving *with Herbert Simon in 1972, and* The Psychology of Human-Computer Interaction *with two other colleagues in 1983. His most recent book,* Unified Theories of Cognition, *published by Harvard University Press in 1990, explores the possibility that the tools are already at hand that will allow cognitive scientists to develop one unified theory to describe many different types of behavior instead of building separate theories to account for isolated aspects of behavior, as has been the case to date. This book is under review in this issue of* BBS. *Newell completed his Response to his 26 commentators during the last months of his struggle against the illness that finally claimed him.*

Newell's other awards and honors include the Harry Goode Award of the American Federation of Information Processing Societies (1971); the A. M. Turing Award of the Association for Computing Machinery, jointly with Herbert Simon (1975); the Alexander C. Williams Jr. Award of the Human Factors Society (1979); the Distinguished Scientific Contribution Award of the American Psychological Association (1985); the Research Excellence Award of the International Joint Conference on Artificial Intelligence (1989); the Emanuel R. Piore Award of the Institute for Electrical and Electronic Engineers (1990); and the Franklin Institute's Louis E. Levy Medal (1992). He has been awarded honorary doctoral degrees by the University of Pennsylvania and Groeningen University in the Netherlands.

Newell was a member of the National Academy of Sciences, the National Academy of Engineering and the American Academy of Arts and Sciences. He was the first president of the American Association for Artificial Intelligence and president of the Cognitive Science Society. In 1987 he delivered the William James Lectures to the Department of Psychology at Harvard University, the lectures that formed the basis for Unified Theories of Cognition.

Allen Newell died on July 19, 1992, at the age of 65. He is survived by his wife of 45 years, Noel, and his son, Paul.

https://doi.org/10.1017/S0140525X00069466 Published online by Cambridge University Press

Herbert A. Simon, *Carnegie Mellon University, Remarks at Memorial Service, July 27 1992:*

Three days after I had written the following remarks, I heard for the first time Allen's Distinguished Lecture of last December -- the videotape -- heard him say it all, describing his path in life with invariable clarity and humor.

From time to time there comes a man or woman who has a dream, a vision: who not only dreams it but gives body to it, brings it to life. Allen Newell was such a man. He had a vision of what human thinking is. He spent his life enlarging that vision, shaping it, materializing it in a sequence of computer programs that exhibited the very intelligence they explained.

If you asked Allen Newell what he was, he would say, "I am a scientist." He played that role almost every waking hour of every day for nearly half a century. As a great scientist, he was also a great artist, struggling to create form against the severe constraints imposed by nature. Science is not science fiction. It accepts the tests of observation and experiment, acknowledges the supremacy of fact over wish or hope. The smallest experiment can crash to earth the most attractive theory.

This is the art Allen Newell practiced: modeling mind, testing his models by experiment and observation, revising them to suit the obdurate facts.

We humans have long been obsessed by four great questions: the nature of matter, the origins of the universe, the nature of life, the workings of the mind. Allen Newell chose for his life work answering the fourth of these, explaining the human mind. That choice had already been made when I met him in Santa Monica, early in 1952, and conversed with him as he perched on a desk in RAND's Systems Research Laboratory. In the first ten minutes of our acquaintance I knew his urge to understand the mechanisms of human thought. The great issues that occupied Allen were never held secret for long.

SOAR, as it stands just now, and *Unified Theories of Cognition*, represent the answer Al had reached when his work was brought to an end -- not a final answer, as he would be the first to say, but an arrangement of important masses of stone in the cathedral, salient for defining the shape it will take.

Allen was serious, but not solemn. Whimsy and laughter came easily and often to him. Life, sometimes perplexing, was not a plodding march but a vivid drama, in which he acted with brilliance and *éclat* -- quite unaware of the dramatic effects he was producing. This too was obvious early on. The Systems Research Laboratory (which Allen built with three colleagues) operated a human experiment on the grandest scale, simulating an Air Force Early Warning Station, its cast an entire Air Force unit. Only Allen and his co-directors could have dreamed up theater on this megabuck scale at a time when behavioral scientists might timidly request five or ten thousand dollars for their research.

Understanding that great science could only be done inside nurturing institutions, Al devoted much of his energy to building and improving the environments in which he worked: first the Systems Research Laboratory; then the burgeoning computer simulation research in the basement of the GSIA building, then the Computer Science and Psychology Departments at Carnegie; in later years, the computer networking of the entire campus. His contributions to national institutions were no less important: for example, his advisory roles in DARPA and other Washington agencies, and presidencies of two young professional organizations, the American Association for Artificial Intelligence and the Cognitive Science Society.

How was Allen seen and felt as a person? Sometimes his energy, his intensity, his single-mindedness could overwhelm people, but only until they came to understand what motivated those qualities. And anyone who can, as Allen did, deal with me for forty years on a nearly daily basis without a single quarrel (occasional scientific disagreements, of course, but no quarrel) has remarkable qualities of endurance and forgiveness.

Our friendship is so interwoven with our work together that there can be no thought of the science without the friendship. What a bonanza to have such a companion to share the risk and the excitement, the effort and the pleasure of striving toward discovery; one with whom you advance with bravado, side by side, on a skeptical world -- a companion as competitive and willful as yourself, but between you a synchrony of goals and heuristics that lets you pursue a common path for forty years.

Allen's loyalty was immense, as was his willingness to shoulder the tasks that make organizations work. In every organization he served he acquired, as if by a law of nature, a major leadership role, collaborating with all in an atmosphere of utmost trust and cordiality. He devoted enormous time and energy to counselling his colleagues, taking their concerns, professional and personal, as his; from dean and department head to junior faculty member and newest graduate student.

Allen was trusted, respected, and loved because his motives were totally clear. There was no guile in him. Like all of us, he was pleased to be recognized -- receiving the National Medal of Science in his last months gave him great satisfaction -- but recognition

(save the ultimate recognition of his contributions to understanding mind) was not his lodestar. He worked to enable good science to be done. He worked to advance the resources, the effectiveness, the human warmth of the organizations in which he lived.

There is much more to say about Allen as a friend, as a husband to Noel, and as a father to Paul. He was all of these, and these partnerships provided crucial support for his life as a scientist. He devoted himself to them at least as thoughtfully and lovingly as he did to his professional activities. But saying more about that part of Allen will have to wait a few weeks or months, until the pain of losing him has dulled a little.

Zenon W. Pylyshyn, *University of Western Ontario and Rutgers University, Associate Editor, BBS:*

Allen Newell, more than any other researcher, has been the intellectual midwife of the field we now call Cognitive Science. He leaves behind much more than a body of important work. He leaves his imprint on the style in which Cognitive Science is practiced and thus the style by which natural science is attempting to understand the mystery of mind. While most psychological theorists have typically been concerned with working out the details of small scale phenomena in the form of micromodels, Newell took the high road and extended the vision of cognitive psychology well beyond that of modeling individual experimental paradigms. In a now classical paper called "You Can't Play 20 Questions With Nature and Win" (1973, *Visual Information Processing*, W.G. Chase (Ed.) Academic Press) he set a challenge for the entire field: Keep your sights high. In building theories, a major constraint is that the parts will eventually have to fit together to form nothing less than a comprehensive theory of mind. It is perhaps ironic that although that paper was highly cited, only one person took its challenge seriously enough to attempt the grand project, and that was Newell himself -- in the book which is being reviewed in this issue of *BBS*.

Although Newell's publications are both groundbreaking and voluminous, they are but the tip of the iceberg by which one ought to measure his contribution and his influence on the development of Cognitive Science. History may well judge his most important and lasting contributions to be what he achieved through his personal influence on his students and colleagues. His strong and charismatic presence affected everyone with whom he came in contact. He took strong and uncompromising stands on how science ought to be practiced, although he was exemplary in keeping an open mind about which theories he considered worth exploring. He believed that many opposing theories should be examined side by side and he encouraged researchers whose views were quite different from his own -- as is evidenced by the diversity of approaches he fostered around him at Carnegie-Mellon University.

An important lesson many of us learned from Newell is how one had to be "serious" about doing science. He showed, through his personal work and his struggle to understand mind as computation, how one needed to treat each new idea with solemn respect. For Allen Newell what that meant is not only that one should pursue science with a passion and commitment (as he did throughout his life), but one also had to do it with a sense of intellectual responsibility. And for Newell, to be intellectually responsible did not mean that one should pursue a safe course through well understood problem spaces (a term he might himself have used). Quite the contrary, many of Newell's ideas were, and are, radical, although some may seem less so now that we have had several decades to live with them. What being serious meant for Newell is that one needed to approach novel ideas -- however provisional they might be -- with sufficient respect, tenacity, and resoluteness that one would feel bound to explore what they entailed no matter where that led. As I once put it (to Allen's approval), he took it for granted that if you believed P and you believed that P entails Q, then no matter how odd Q might seem at the time, you had the responsibility to take seriously the prospect that Q might be true. This kind of earnestness about scientific ideas led Newell away from metaphors and toward the literal interpretation of such notions as the "physical symbol system" and the even more problematic idea of a "knowledge level" of system organization. Newell never shied away from such leaps into what appeared to some of us to be the edges of the comprehensible. Rather, he believed firmly that when the time was right -- when the right technology and theoretical machinery had been developed -- such ideas would be so transparent that, as he once put it, "you could drive a truck through them."

Another curiosity about Newell's struggle to understand mind is that he claimed to have little use for philosophical and metatheoretical activity. He once wrote to me that he thought metatheory might be useful for an individual's personal development, but it did little to affect the progress of science. But then a few weeks later he wrote me another letter, enclosing some of his papers, in which he said he realized that

he had in fact written a good deal of metatheory himself (in fact he has written incisive *BBS* commentaries). The irony of this is that his views on metatheory stand among his most important contributions. Yet he felt sufficiently ambivalent about this that when he published his "20 Questions" paper he felt he had to include in the same volume an actual running computer model of the process of rapid search through short-term memory. But then, continuing a pattern that characterized much of Newell's professional career, he recognized the importance of an idea embedded in this modest paper (the idea of a production system as a "theory-laden language"), and this touched off another serious and committed search that eventually led to the SOAR system and his unified theory.

My memory of some of the chronology and the causal sequence may not be quite right, but the narrative illustrates Newell's "seriousness" and his optimism about the prospects of a science of mind. He was troubled when he published his "20 Questions" paper not only because it contained metatheory, but also because it contained some mild criticism of the direction his colleagues were taking in developing a theoretical understanding of mental processes. Newell did not like criticizing other people's research, even though he occasionally found himself doing so. He himself took criticism seriously and thoughtfully, as he did everything having to do with the world of ideas. Yet he believed strongly that science does not make significant progress either by metatheorizing or by criticizing. Good ideas, he used to say, will win in the end; bad ideas should be treated with silence. Good research programs will yield solid results when the time is ripe; if the time is not right they will languish. In his last years Newell believed the time was right for attempting a unified theory of cognition, a summary and peer treatment of which appears in this issue of *BBS*. But he was both wise enough and sanguine enough about the long-term prospects for a computational theory of mind that he would not have been offended, perhaps not even surprised, if it turned out that the time really was not yet quite right. His willingness to make the attempt is a tribute to his intellectual courage and to the breadth of his vision. We shall miss both his vision and the example he set for us.

https://doi.org/10.1017/S0140525X00069466 Published online by Cambridge University Press