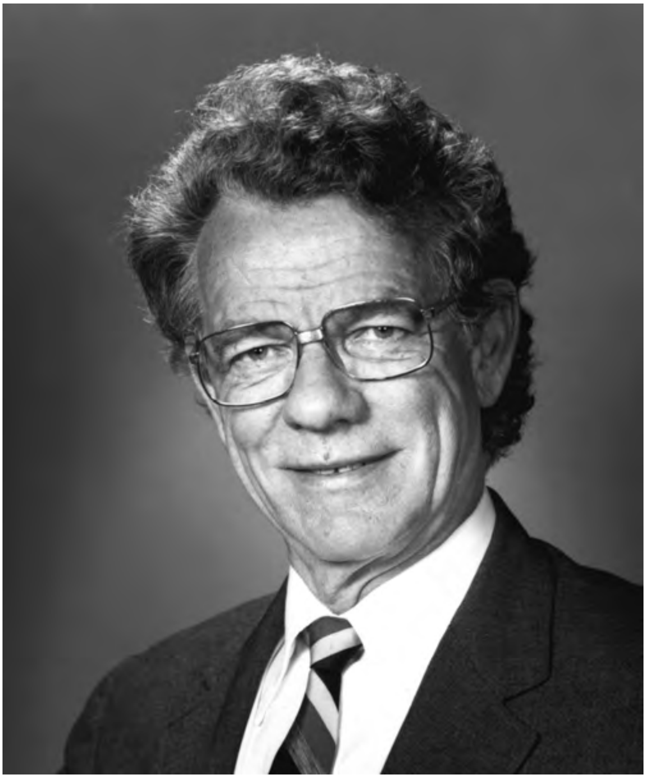

JOHN A. SIMPSON

1923–2011

Elected in 1988

"For creativity and innovation in developing a unique computer-controlled research facility for studying fully automated manufacturing."

BY JOHN W. LYONS

JOHN AROL SIMPSON, former director of the Manufacturing Engineering Laboratory at the National Institute of Standards and Technology (NIST), died December 6, 2011, in Falls Church, Virginia. He was 88 years old. He is survived by his wife Arlene, a son, and three grandchildren.

John was an electron physicist, a metrologist, and an expert in factory automation. He devoted most of his working life to these three areas while serving at the National Bureau of Standards (NBS)—later named the National Institute of Standards and Technology. Born in Toronto on March 30, 1923, he served in the US Army during World War II and then attended Lehigh University in Bethlehem, Pennsylvania, where he received BS (1946), MS (1948), and PhD (1953) degrees in physics.

While working on his PhD degree he was also employed at NBS in the Electron Physics Section led by L.L. Marton. This group studied a number of electron analogs of optical systems. His thesis was on an electron interferometer, work he described as very difficult both theoretically and experimentally. Subsequently he worked on a high-resolution electron spectrograph in association with Ugo Fano of the University of Chicago. The NBS group grew in size and became "one of the most active electron physics groups in the world."[1] Dr. Simpson later became section chief.

During this time the bureau was very much focused inward; precision measurements advanced apace. Ernest Ambler and his colleagues performed the critical set of experiments demonstrating that parity is not always conserved. These experiments supported the theoretical work of Chen Ning Yang and Tsung-Dao Lee at Columbia University that earned them the Nobel Prize in Physics in 1957. Later work by Russell Young, also a metrologist at the Bureau, laid the foundation for the 1986 Nobel Prize in Physics to Gerd Binnig and Heinrich Rohrer for the scanning tunneling microscope. Young's device—the Topografina—showed the way but the needed technology to make it practical had not yet been developed. This was an exciting time for high-precision metrology; John Simpson was there.

When need for change arose in the Metrology Division of NBS, Dr. Simpson was assigned, in 1975, as acting division chief (then renamed the Mechanics Division) to restructure and modernize it. He became expert in the details of fundamental measurement science. He told amusing stories about the international standard of mass held in a vault at the International Bureau of Weights and Measures in Paris and the copies distributed to the nations who had signed the Treaty of the Meter. It was and is an artifact made of a platinum-iridium alloy and has a nasty habit of changing in mass very slightly over long periods of time. Simpson felt along with most knowledgeable people that all the measurement standards should be traceable to immutable laws of nature. Developments in physics during his time at NBS included discoveries in quantum physics including the maser, the laser, and the Josephson effect. Applying these and other developments in physics, all of the international units of measurement except the kilogram were tied to these laws. Only the kilogram has defied attempts to replace it.

[1] Interview with John Simpson, The Oral History Program, National Institute of Standards and Technology, May 20, 1993.

Measurement of length (the meter) is done with lasers. When making measurements at the micrometer level and below there are some uncertainties that have to be addressed. John talked about the problem of determining exactly the edge of a solid object. It can be thought of most basically in terms of the extension of the molecular orbitals extending from surface atoms but this doesn't help much with making a laboratory measurement. The measurement is done optically by observing diffraction at the edge. John considered the problem as an exercise in metaphysics. He was a great fan of Robert Pirsig's books on the metaphysics of quality, especially *Zen and the Art of Motorcycle Maintenance* (William Morrow & Company, 1974).

In a reorganization of NBS in 1978 Dr. Simpson was named the first director of the Center for Manufacturing Engineering and Process Technology, a group that included the mechanical engineering program from his earlier division and chemical engineering from other parts of the bureau. There was not enough compatibility between the mechanical and chemical pieces and the new center was divided in two: the Center for Chemical Engineering and the Center for Manufacturing Engineering (CME, later the Manufacturing Engineering Laboratory) with John Simpson as director. The relatively new technology of robotics, formerly in the computing center, was added to CME. Thus was NBS's new effort in manufacturing technology born.

One of the many accomplishments of this period was improving the accuracy of coordinate measuring machines. Simpson and his colleagues devised a means of establishing an independent set of lasers such that the actual position of the machine's probe could be established independent of the machine's indicators. The deviation so measured was then fed into the machine's software and the true position determined and displayed. The result was a computer-controlled self-correcting measuring machine. This work improved the accuracy substantially and, since the team had determined that the machine errors are repeatable, this characterization only had to be made on occasion rather than with each measurement.

The result has since been incorporated in the manufacture of coordinate measuring machines.

The experience with coordinate measuring machines led to the realization that this same approach could be applied to numerically controlled manufacturing machines, namely, self-correcting devices incorporating on-machine metrology and applying software adjustments to the machines' controls. This approach quickly evolved into studying an ensemble of machine tools in an automated environment. The result was the NBS Automated Manufacturing Research Facility (AMRF).

At that time the NBS also had one of the early programs in robotics. Dr. Simpson incorporated that effort in the AMRF, thereby enabling a fully automated flow of material from raw material storage through various machines fed by robots to finishing and final metrology, also fed by robots. To accomplish this required a software control architecture and various standards for describing material properties and for enabling interfaces between disparate machines with their own proprietary software. The control architecture, developed by James Albus, was based on an earlier model of the human cerebellum. Refinements of this approach are widely used in today's automated systems. Thus the AMRF was based on the physics of materials, metrology, robotics, and computer engineering. The lasting results of this work were control architecture, product description standards, and techniques for interconnecting all sorts of computer-controlled machines and devices.[2]

John Simpson's AMRF program was a pioneering effort that attracted a great many guest researchers from universities and industry. It also attracted the attention of the Congress in the person of Senator Ernest Hollings of South Carolina. His interest, in turn, led to the reauthorization of NBS, changing

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[2] For a detailed history of the AMRF including several appendices that list sponsors, numbers of companies, and universities that sent guest workers to the program, see Joan M. Zenzen, *Automating the Future: A History of the Automated Manufacturing Research Facility 1980–1995*, Diane Publishing Company, Darby, PA, March 2001. This is a reprint of NIST Special Publication 967, available from the NIST Information Center in Gaithersburg.

its name and incorporating increased emphasis on technology in support of the American economy. It became clear to Dr. Simpson that large companies in the United States were quite capable of handling this technology, but the vast majority of small companies were not. Dr. Simpson and his colleagues adapted NBS's method of achieving efficiencies in delivering services to state and local governments through a cascading chain of laboratories. Measurement assurance was achieved through NBS/NIST calibration support. Dr. Simpson proposed establishing demonstration facilities out in the states where the new technology could be brought before small companies. The idea was adopted and became the Hollings Manufacturing Extension Partnership in 1989. Beginning with three centers, the program now has 400 centers and field offices with 1,300 staff in the 50 states. In this way, Simpson's manufacturing automation program turned NBS outward, offering full-blown integrated automated process technology to US industry. This in turn led to the reauthorization of NBS as NIST, calling for more emphasis on working with US industry in support of the national economy.

John Simpson was an interesting character and fun to be around. He was a good storyteller and had many tales about the early days of his 48 years of government service—he was dean of the staff when he retired. On snow days he would bring his cross-country skis to work and make the rounds of NIST's considerable acreage. He was an avid bicyclist and led a group of like-minded staffers on the roads of NIST. One day he was thrown over the handlebars and suffered a fairly serious shoulder injury, but that didn't deter him from continuing his noon-day rides.

John's broad range of expertise in the various components of NBS/NIST was rare at the time; we shall not likely see such breadth of experience in a single individual again. His career spanned the evolution of NBS into NIST; his work provided the impetus for the increased attention to transitions of NIST technology to the private sector. He was a key player in the history of the institution.