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John J. "Jack" Rush (1936–2017)

John J. "Jack" Rush, a pioneer in the use of neutron scattering to study chemical materials, died on his birthday, April 20, 2017. He was 81.

Jack was born in Brooklyn, NY. After high school, he attended St. Francis College with the intention of teaching math, but he became enamored of science and decided to switch majors to chemistry. During this time, he spent two summers at Brookhaven National Laboratory where he measured radioactive fallout from atomic bomb tests in both Nevada and Russia, and studied radiation chemistry at a reactor that was operating at Brookhaven at that time.

In 1957, Jack decided to leave Brooklyn to attend graduate school in physical chemistry at Columbia University. He fondly remembered his earlier time at Brookhaven, an exciting place with a staff open to anybody who came there, even students, and decided to look for a thesis project that would allow him to work there. The only Columbia faculty who had funding from the Atomic Energy Commission (AEC) worked in the physics department, and so Jack ended up working in a physics group under the guidance of chemistry professor, T. I. Taylor, a former student of Harold Urey. For his thesis, Jack made pioneering measurements of the neutron scattering cross sections in molecular materials. Jack always remembered his experience at Brookhaven as one of the best times of his life: he met his wife, Terry, there, and he realized the research that he wanted to pursue.

During this time, Allen Astin, the Director of the National Bureau of Standards (NBS), decided to build a multi-use reactor at the new NBS site in Gaithersburg, MD. To jump-start the NBS neutron scattering program, he and Nicholas Golovin decided to hire a young scientist to initiate a program with one of the AEC national laboratories. So in 1961, Jack got a call from Carl Muehlhause, who was leading the design and construction of the NBS reactor, offering a job that would send Jack to Argonne National Laboratory while the NBS reactor was being built.

Dr. Jack Rush. Photo by Yiming Qiu.

This was another very influential period in Jack's career. His task was to provide the scientific and technical underpinnings for the D_2O-ice cold-neutron sources that were to be installed in both the Argonne and NBS reactors. Beyond this, he could pursue whatever science he wanted that could be transferred to the NBS reactor when it came on line. Thus, Jack continued his lifelong fascination with molecular solids and their phase transitions. He also met Mike Rowe, who became his close collaborator and friend for more than 50 years. With Mike, Jack started a program on hydrogen in metals, which became his main research area for the next 20 years.

In 1966, with the reactor ostensibly nearing completion, Jack moved from Argonne to NBS. But after he arrived, it quickly became evident that the reactor was still some way off from starting operations. Jack spent this time conducting neutron experiments with Mike and others at Argonne and Brookhaven and learning about infrared, Raman, and NMR spectroscopy. In 1969, the NBS reactor began routine operations. In 1972, Jack became the leader of neutron-scattering science, a position he held with various name changes until his retirement in 2005.

Over the next 20 years, Jack and Mike published a series of very influential papers, particularly on the structure, dynamics, and phase transitions of hydrogen in metals and KCN-KBr systems, primarily using the instrumentation they developed at the NBS reactor. But they had a vision of larger things. By the early 1980s, the center of neutron scattering had passed from the US, where it had begun in the late 1940s, to Europe, where the Institut Laue-Langevin had developed the world's leading cold-neutron capabilities. These opened the doors to new applications in soft matter science and propelled the ILL to become the world's most productive neutron facility. While these capabilities were extremely limited in the US, the NBS reactor design included a large beam tube for a cold-neutron source. This presented Jack and Mike with an opportunity to develop the first internationally competitive cold-neutron facility for the US scientific commu-

nity. After several attempts, funding was finally secured in 1987 for the NBS Cold Neutron Research Facility, which included a 20,000 square-foot guide hall, neutron guides, and new neutron instruments, many of which were the first of their kind in the US. The new guide hall opened in 1989, the same year that NBS became the National Institute of Standards and Technology (NIST). New instrumentation, invariably developed with Jack's sage input, was continually added over the next decade. The success of this initiative required a higher profile within the NIST organization. Thus, in 1997, the entire reactor facility became the NIST Center for Neutron Research (NCNR). Jack's vision, his early work on cold sources, and his expert mentoring of the staff that he largely hired drove the transformation of NIST's small neutron-scattering effort into the internationally acclaimed program it is today.

Jack was a national and international figure in neutron science and an expert in the development and operation of large-scale facilities for materials research. Throughout his career, he was distinguished by his excellent judgment. Thus, he was asked to serve on almost every neutron-scattering panel, committee, or meeting convened in this country. Of note was his service as a member of the very influential 1984 Seitz-Eastman study "Major Facilities for Materials Research and Related Disciplines," which set priorities for national facilities for two decades, and which recommended the construction of the Advanced Photon Source, the Advanced Light Source, and the development of the cold-neutron research facility at NIST. Jack always regretted the cancellation of the Advanced Neutron Source, which was also recommended for construction by the Seitz-Eastman committee, for which he had served as chair of the steering committee. In 1993, he served as a vice chair of the Kohn Panel. This committee's report entitled "Neutron Sources for America's Future" led directly to the decision to build the Spallation Neutron Source, which began operating at Oak Ridge National Laboratory in 2006. Although he never enjoyed committee work because it took him away from science, he took his responsibilities seriously, and his efforts helped to shape the landscape of neutron and synchrotron facilities to this day.

Upon his formal retirement in 2005, Jack immediately went back to research full time. He was extremely excited that he now had the time to use the instrumentation that he had helped to develop. Over the next dozen years, he continued to work closely with Terry Udovic, his long-time colleague at NIST, co-authoring over 50 papers that advanced the fundamental understanding of a variety of energy-related materials including complex metal hydrides, which are promising as both hydrogen-storage materials and solid electrolytes for all-solid-state rechargeable batteries. Until the last year, he was at NIST on most days working on his latest experiment, often collaborating with and mentoring younger staff. He also became interested in the history of neutron science, and wrote a short article on neutron facilities in the US that was published in *Physics in Perspective* in 2015.

Jack's influence on the neutron community certainly lives on, but what we most remember was his enthusiasm for science and scientists. He was the friendly face that everyone enjoyed seeing and he was always thrilled to speak with visiting scientists who were at NIST using the instrumentation that his efforts enabled. He provided exceptional scientific leadership at the NCNR, which became a leading neutron facility under his guidance. He truly was a constant inspiration to all those who had the pleasure of knowing him.

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