Physics Today

Anthony Leonid Turkevich

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Citation: Physics Today **56**(6), 78 (2003); doi: 10.1063/1.1595067
View online: http://dx.doi.org/10.1063/1.1595067
View Table of Contents: http://scitation.aip.org/content/aip/magazine/physicstoday/56/6?ver=pdfcov
Published by the AIP Publishing

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Anthony Leonid Turkevich, a nuclear radiochemist and physicist and a professor of chemistry at the University of Chicago, died in his sleep on 7 September 2002 at his home in Lexington, Virginia. He was widely esteemed for his great intellectual powers, deep physical insight, and personal integrity.

Tony was born in New York City on 23 July 1916, the son of a Russian Orthodox clergyman who became a head of the Russian Orthodox Church in both North America and Japan. In 1937, Tony earned a BA from Dartmouth College and, in 1940, a PhD in physical chemistry from Princeton University. His doctoral work was on diffusion determination of molecular structures and dielectric investigations of the motion of organic molecules in the solid state. Shortly after his graduation, he was invited to the University of Chicago as a research physicist in the department of physics; he worked on UV spectroscopy and the radiochemical studies of the fission products.

During World War II, Tony was a member of the Manhattan Project. He worked closely with W. F. Libby, Enrico Fermi, and Edward Teller, first at Columbia University, then at the University of Chicago, and finally at Los Alamos. His first contributions to the Manhattan Project were on chemical problems associated with uranium hexafluoride isotope diffusion separation and radiochemical studies of uranium fission products; he carried out that research at the University of Chicago's Metallurgical Laboratory. That work led to his participation in the test of the first atom bomb, which was detonated in Alamogordo, New Mexico, in July 1945; for that effort, he made accurate estimates of the released power. Later that year, he joined the theoretical group at Los Alamos where he worked under the direction of Teller on problems associated with thermonuclear reactions.

After the war, Tony decided to call himself a chemist. He accepted a position at the newly formed Institute for Nuclear Studies (now the Enrico Fermi Institute) at the University of Chicago and, in 1946, joined the university's department of chemistry. Tony was a meticulous, inventive experimentalist and a brilliant theoretician. All of his experimental and theoretical research during the postwar years was published in the *Physical Review*, although his teaching was in the chemistry department. His experimental research

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addressed radiochemical studies involving a variety of high-energy particle accelerators. Theoretical research during the early 1950s that stands out included unpublished but widely cited calculations he did with Fermi on nuclear processes; their calculations indicated that the Big Bang produced a mixture of gases comprising 75% hydrogen and 25% helium by mass. In collaboration with Nick Metropolis and others, Tony used the MANIAC computer at Los Alamos to perform Monte Carlo calculations on high-energy intranuclear cascades.

Tony played a key role in 1958 as an expert adviser to the US delegation on disarmament negotiations with the USSR. He was also directly involved in development of a major program for measuring the atmospheric accumulation of long-lived krypton-85. That isotope became the definitive measure of the amount of fission generated in processed fuel elements and atmospheric weapons tests. Tony, George Reed, and Hiroshi Hamaguchi carried out (in 1957) the first precise and reliable determination of uranium in iron meteorites, thus providing fundamental information about chemical fractionation in planetary formation.

In 1961, Tony proposed to NASA that it use a novel nuclear technique he was developing to obtain, in situ, the chemical composition of the lunar surface. His "alpha scattering instrument" was flown on the Surveyor 5, 6, and 7 missions and provided the first chemical analysis indicating that the Moon was a differentiated body and not a primitive chondrite, as was the prevailing thought. The results he obtained on the Surveyor missions proved to be a sound basis for all of the science later done on the Apollo missions. He and his colleagues later flew similar instruments with improved capabilities on the Soviet Phobos 1 and Phobos 2 missions (1988); the Russian Mars-96 mission (1996); and on NASA's successful Pathfinder mission to Mars (1997), which provided the first detailed analyses of Martian rocks.

In 1965, Tony was named the James Franck Professor of Chemistry at the University of Chicago and, in 1970, the James Franck Distinguished Service Professor. During the 1970s and 1980s, Tony performed some of his most exotic experiments, in which he searched for polyneutrons, delta particles, and super-heavy particles within the nucleus. Those studies pointed toward the elucidation of high-energy reactions that involve complex nuclei and probe the basic properties of matter. A senior fellow at Los Alamos, he conducted highly classified work on the Soviet Union's nuclear technology at both Los Alamos and at Argonne National Laboratory.

Long after he achieved emeritus status in 1986, Tony switched gears again to one of the most interesting questions in theoretical physics: the double beta-decay of uranium-238 to plutonium-238. With George Cowan and one of us (Economou), he determined the extremely long halflife of that process and proposed the existence of neutrinos with a small mass. That notion is now gaining acceptance but, at the time, ran against the prevailing thinking. In a quite different field, Tony carried out pioneering work on heavy methane ($^{13}CD_4$) tracers for modeling the dispersion and atmospheric circulation of pollutants.

Among the numerous awards bestowed on Tony were the E. O. Lawrence Memorial Award from the Atomic Energy Commission (1962) and the Nuclear Applications Award from the American Chemical Society (1972). He was elected to the National Academy of Sciences in 1967. In 1969, he was elected to the American Academy of Arts and Sciences and received the Atom for Peace Award from NAS for his work in the lunar program.

Tony was a dedicated teacher and guided many doctoral students and young postdoctoral scientists. His retirement at age 70 did not much change his research schedule. He continued to pursue his scientific interest until his health failed him shortly before his death.

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