LEDERBERG, JOSHUA

(1925–2008), Nobel laureate geneticist and microbiologist. Joshua Lederberg was born 23 May 1925, in Montclair, New Jersey, one of three sons of Zvi and Esther Lederberg. A 1941 graduate of Stuyvesant High School in New York City, he entered Columbia University at age 16 and joined the accelerated wartime Navy V-12 program. In 1944 he received a BA in zoology and started medical school at Columbia.

In response to the seminal publication by Avery, McCarty, and McLeod (1944) on DNA-medicated transformation in pneumococcus, Lederberg and his mentor, Francis J. Ryan, who was a prominent biochemist, attempted to demonstrate this phenomenon in *Neurospora*. Lederberg soon turned his attention to sexual phases of bacteria and isolated mutants of *Escherichia coli* to study possible recombination events. Edward Tatum had a collection of mutants of *E. coli* and Lederberg proposed a collaboration to study possible genetic recombination in that organism. Within six weeks of joining Tatum at Yale in early 1946, Lederberg had obtained evidence of recombination in Tatum's *E. coli* K12 strain. This discovery resulted largely from his lucky choice of one of the rare, recombination proficient strains of *E. coli*.

By the fall of 1947 Lederberg was awarded a PhD from Yale University and received an offer of a faculty position in the Department of Genetics at the University of Wisconsin. Lederberg and his wife, Esther Zimmer Lederberg, also a geneticist, spent the next 11 years in Madison, where they continued to explore the genetics of bacteria and bacteriophages. He never returned to his medical studies.

Lederberg received the Nobel Prize in Physiology or Medicine in 1958 for his work in bacterial genetics. He also made significant contributions in computer science, artificial intelligence, and exobiology. Lederberg's broad interests, incisive mind, and openness to new ideas coupled with a strong social conscience and unusual organizational skills all combined to make him a forceful spokesperson for science as well as a leading public intellectual.

In 1959 Lederberg moved to Stanford University as the chair of genetics and expanded his interests into the application of computers to biological problems including artificial intelligence, structural chemistry, and information management. He developed a "dendritic algorithm," dubbed DENDRAL, which is regarded as a significant contribution in computer science. His interests encompassed the challenges of space biology and he coined the term "exobiology" for this new field.

Lederberg assumed the presidency of the Rockefeller University in 1978, a position that allowed him a platform as a spokesperson for science and public policy. He retired in 1990, but continued as one of the nation's most visible and respected public intellectuals in science.

[***See also* Artificial Intelligence; Biological Sciences; Computer Science; Genetics and Genetic Engineering; Germ Theory of Disease; Medicine; Nobel Prize in Biomedical Research; Space Science; *and* Zoology.**]

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William C. Summers

LEE, TSUNG-DAO

(Li Zhengdao in pinyin, 1926–), a leading theoretical physicist, a prominent Chinese American, and one of the most influential scientists in U.S. and Chinese science and educational policy.

Lee was born in Shanghai, China, to father Li Junkang, a fertilizer factory manager, and mother Zhang Mingzhang. He received primary education

at home but was forced into exile inland during the Japanese invasion in the 1940s. He studied physics at Zhejiang University for one year before enrolling in the Southwest Associated University in Kunming in 1944. He did so well at Southwest that even before graduation his professors selected him as part of a Chinese Nationalist government mission to the United States in 1946 to learn how to make an atomic bomb.

Because secrecy requirements made that mission impossible, Lee enrolled instead at the University of Chicago, pursuing graduate studies in physics with the eminent nuclear physicist Enrico Fermi. After receiving his PhD, in late 1949, with a thesis on white dwarf stars, Lee spent several months at Yerkes Observatory in southeastern Wisconsin before taking up an assistant professorship at the University of California, Berkeley, where he married Jeanette Chin. A year later, he moved to the Institute for Advanced Study at Princeton, New Jersey, before settling down two years later at Columbia University; he started as an assistant professor of physics in 1953 but was quickly promoted to full professor in 1956.

That same year Lee collaborated with Chen Ning Yang, a fellow Chinese student at Chicago who was then a physicist at the Princeton institute, to formulate a theory that would mark a turning point in modern physics. Studying the behaviors of the so-called "strange particles," they proposed that the long-accepted left–right parity broke down in a nuclear process called "weak interactions." The idea was met with strong resistance initially, but soon was confirmed by an experiment conducted by Chien Shiung Wu, Lee's Chinese American colleague at Columbia, in collaboration with scientists at the Bureau of Standards in Washington, D.C. Lee and Yang won the Nobel Prize for Physics in 1957.

Lee and Yang continued their fruitful partnership on many important topics in physics, facilitated by Lee's spending two years from 1960 to 1962 at the Princeton institute. But the partnership ended in 1962 when personal friction, in part over credit for their joint scientific discoveries, reached a breaking point. Lee returned to Columbia, where he remains a professor of physics, conducting research on a wide range of areas from particle physics to high-temperature superconductivity to dark energy. He also played an active role in the development of the Relativistic Heavy-Ion Collider at the Brookhaven National Laboratory in Long Island that has produced important discoveries since its completion in 2000.

The reopening of U.S.–China relations in the early 1970s allowed Lee to return to China in 1972 for his first visit back. He has since devoted much time and energy to U.S.–China scientific collaboration, including the creation of the China–U.S. Physics Examination and Application program that brought approximately one thousand Chinese physics graduate students ("Lee scholars") to the United States. Lee also played an active role in Chinese science and education policy, especially in the introduction of the postdoctoral system, the establishment of the Chinese National Natural Science Foundation, and the building of the Beijing Electron–Positron Collider.

[***See also* Fermi, Enrico; Lee, Tsung-Dao; Nobel Prize in Biomedical Research; Nuclear Weapons; Physics; *and* Yang, Chen Ning.**]

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Zuoyue Wang

LEIDY, JOSEPH

(1823–1891), naturalist and polymath. Leidy was born, raised, and educated in Philadelphia, where he spent his entire professional career. Born into

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