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YANG, CHEN NING

(Yang Zhenning in pinyin, 1922–), a prominent Chinese American physicist and one of the most influential theoretical physicists in the world in the second half of the twentieth century. He also played an active role in U.S.–China scientific relations.

Born in Hefei, China, Yang grew up on the campus of Tsinghua (Qinghua) University in Beijing where his father, Yang Wuzhi, was a professor of mathematics. He was an excellent student but his sheltered environment collapsed with the Japanese invasion in 1937. He fled with his family to southern China and studied physics in the elite Southwestern Associated University in Kunming. After receiving his BS in 1942 and MS in 1944, he taught in a middle school for one year, where he met his future wife, Du Zhili.

In 1945, Yang won a Boxer fellowship and came to the University of Chicago to study with the great physicist Enrico Fermi and gave himself the nickname "Frank" in honor of Ben Franklin. Although deeply influenced by Fermi's way of doing physics, Yang ended up taking his PhD in theoretical physics in 1947 with the physicist Edward Teller because Yang, as a foreigner, could not enter Argonne National Laboratory where Fermi conducted his experiments.

Yang taught at Chicago for one year before moving to the Institute for Advanced Study at Princeton, New Jersey, initially as a visitor but later as a permanent member at the invitation of its director J. Robert Oppenheimer. In the summer of 1954, when visiting the Brookhaven National Laboratory on Long Island, he devised, with the graduate student Robert Mills, the so-called Yang–Mills gauge field theory to describe patterns of interactions between elementary particles. It has since become one of the most fundamental theories in physics with far-reaching impact.

Yang's best-known contribution to physics came as a result of collaboration with T. D. Lee of Columbia University, a fellow Chinese American physicist whom he had met in Chicago when both studied under Fermi. Trying to solve the puzzles

in the behaviors of subatomic particles, they proposed in 1956 the possibility that in the so-called "weak interactions" the commonly presumed law of left–right parity was violated. Initially received with much skepticism, they were soon, however, proven right in an experiment conducted by a third Chinese American physicist, Chien-Shiung Wu of Columbia, in collaboration with colleagues at the National Bureau of Standards. The news electrified the world of physics and Yang and Lee received the Nobel Prize in Physics in 1957.

Yang and Lee continued their collaboration until 1962 when personal friction developed between the two, in part over credit for their famous discovery. In 1966 Yang moved to the new Stony Brook campus of the State University of New York, where he stayed until retirement in 1999 and contributed much to the school's development. In this period he collaborated with Rodney J. Baxter and came up with the Yang–Baxter equation, another major breakthrough in physics with widespread applications and growing importance in physics and mathematics.

Yang spent much of his energy in his later years promoting U.S.–China scientific relations, with his first visit back to China in 1971. He became president of the National Association of Chinese Americans in 1977 and pushed for the successful renormalization of U.S.–China relations. Through public speeches and frequent visits, he has played an active role in promoting science and education in mainland China, Taiwan, Hong Kong, and the rest of East Asia. In 2003, Yang moved to China following the death of Du Zhili and then married Weng Fan, a graduate student in English in Guangzhou; and during the second decade of the twenty-first century, he split his time between Tsinghua and the Chinese University of Hong Kong.

[*See also* **Fermi, Enrico; Lee, Tsung-Dao; Nobel Prize in Biomedical Research; Oppenheimer, J. Robert; Physics; Teller, Edward;** ***and*** **Wu, Chien-Shiung.**]

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Zuoyue Wang

YELLOW FEVER

Yellow fever was a major epidemic disease in the Atlantic world from the time of its importation via the West African slave trade in the seventeenth century to its effective control by the mid-twentieth. The disease is caused by a virus that is spread by mosquitoes of the *Aedes* genus, and it features dramatic symptoms of high fever, headache, jaundice, and a diffuse bleeding tendency. This last feature caused bleeding in the stomach, which, when forcibly ejected, generated the grisly symptom of black vomit that so distinguished the terrible infection. Case mortality rates could appear as high as 50 percent because the milder cases went unrecognized. Imported from West Africa, the first outbreaks struck the Caribbean in the mid-seventeenth century and reached the cities of Boston, New York, and Philadelphia in the 1690s. Throughout its history in North America, yellow fever remained largely an urban disease, traveling on the trade routes connecting American cities to tropical locales.

The disease flared dramatically in Philadelphia in 1793, when it disrupted the new federal government and caused the first major controversy over the causes of epidemic disease. One side argued that the disease arose spontaneously from the filth coating the streets and docks; others claimed that it was an imported pestilence. Arguments about public-health policy flowed from these theories, with one side promoting sanitation and the other quarantine. All segments of the population were affected, although the affluent found some protection in flight, and African Americans appeared to suffer less than others.

2014

THE OXFORD ENCYCLOPEDIA OF THE HISTORY OF AMERICAN SCIENCE, MEDICINE, AND TECHNOLOGY

Hugh Richard Slotten
EDITOR IN CHIEF

VOLUME 1
ABORTION DEBATES AND SCIENCE—LUMBERING

OXFORD
UNIVERSITY PRESS
New York, 2014