Celebrating 100 Years

Nobel Laureates of AAI

Sir Alexander Fleming, F.R.C.S. (1881–1955)

Alexander Fleming, F.R.C.S., AAI ’14, was awarded the 1945 Nobel Prize in Physiology or Medicine jointly with Ernst Boris Chain and Sir Howard Walter Florey “for the discovery of penicillin and its curative effect in various infectious diseases.”

Scientific Accomplishments

The story of penicillin’s discovery has long been mythologized as one of the most fortuitous “accidents” in the history of medicine. Chance, no doubt, played a large role, but, as the British Medical Journal pointed out at the time of Fleming’s death, all of humanity has benefitted from the fact that this particular accident was observed by the “prepared mind” of Alexander Fleming in September 1928. Upon returning from vacation to his laboratory at St. Mary’s Hospital, Fleming found that one of the staphylococcus cultures he had left out was contaminated by fungus. Fleming noted that a ring had formed around the fungus in which staphylococci did not grow. Curious, he began culturing the fungus, which he identified as Penicillium notatum, and called the antibacterial substance it produced “penicillin.”

After months of observation, Fleming discovered that penicillin continued to inhibit the growth of bacteria even when diluted up to 800 times. Moreover, unlike the antiseptics in use at the time, penicillin appeared to be nontoxic to animals, a property that led him to believe it might be used as a topical treatment to fight infection in humans. He reported these findings in the British Journal of Experimental Pathology in 1929, but the paper was largely ignored. Although he continued to cultivate Penicillium and provided samples to other laboratories, Fleming primarily used penicillin in the lab as a filtrate to isolate penicillin-insensitive from penicillin-sensitive bacteria in mixed cultures and did not pursue its use as a therapeutic. That line of investigation was left to Chain and Florey at the Department of Pathology at the University of Oxford.

While surveying the literature on naturally produced antibacterial substances in 1938, Chain ran across Fleming’s 1929 paper, which, according to him, “had been forgotten completely in the vast mass of scientific literature.” Intrigued by Fleming’s findings, in July 1939, Chain and Florey began working with a sample of Penicillium that Fleming had given one of their Oxford colleagues one decade before. Chain, a biochemist, succeeded in purifying penicillin in early 1940, and he and Florey reported its therapeutic value on mice later that year and on human volunteers in early 1941. That summer, Florey promoted the drug in the United States, and, by early 1942, American pharmaceutical companies were mass producing penicillin for distribution to Allied soldiers.
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during the Second World War. By war’s end, the supply was large enough to use the drug in the treatment of civilians. Together, Fleming, Chain, and Florey had discovered and developed the first antibiotic, providing physicians with what was colloquially called the “wonder drug” in the 1940s and 1950s for its ability to effectively treat previously fatal bacterial infections.

Prior to his discovery of penicillin, Fleming had already enjoyed a successful career as an immunologist. Working under the guidance of Almroth Wright (AAI ’14) in the Department of Inoculation at St. Mary’s Hospital in London, Fleming established himself as a highly capable research scientist. His earliest accomplishments included making two improvements on methods for testing and treating syphilis. He simplified the Wassermann test so that it could be performed using a small blood sample derived from a finger prick rather than a vein. He also described an improved technique for treating syphilis patients with Salvarsan, or “606,” the notoriously difficult-to-administer antisyphilis drug developed by Paul Ehrlich.

More than just a technician who improved upon others’ ideas, Fleming made many discoveries in his own right. While working at a makeshift laboratory in France during the First World War, Fleming and Wright demonstrated that the antiseptics used by surgeons in the field were more harmful than helpful: they were often more effective at killing the body’s infection-fighting leukocytes than infection-causing bacteria. Thereafter, Fleming began searching for a nontoxic antibacterial substance, and, by November 1921, he had found one. Examining cultures of his own nasal mucus that he had made two weeks prior while suffering from a common cold, Fleming discovered that, although bacteria had formed colonies on parts of his cultures, they had not grown in or directly near the mucus. He coined the term “lysozyme” to describe the enzyme in mucus capable of inducing bacteriolysis and soon detected its presence in human tissues and secretions, including saliva and tears and, later, in egg whites. Although lysozyme’s antibacterial properties proved considerably weaker against bacteria other than the airborne Micrococcus lysodeikticus that had colonized Fleming’s cultures, he had nevertheless opened a new field in immunological research and renewed hopes about the possibility of finding a nontoxic antiseptic. Once penicillin was proven to be such a substance, Fleming devoted himself to furthering research on the drug and promoting its use.

Because penicillin has saved countless lives, Fleming has been elevated to heights that few scientists reach. Upon Fleming’s death, French Biologist Jean Rostand stated, “The world has lost its greatest scientific benefactor since Pasteur.” The British Medical Journal concurred, calling Fleming “one of the immortals of medical history.” Even world leaders recognized Fleming’s accomplishments. While at the Potsdam Conference on postwar settlement in July 1945, U.S. President Harry Truman declared that Fleming was one individual to whom “the whole world owes a debt of gratitude difficult to estimate.”

Biography

Born into a large farm family in Lochfield, Scotland, on August 6, 1881, Fleming was the youngest of eight children. After demonstrating scholarly promise early on, he left home at the age of 13 to live with an older brother in London to increase his educational opportunities. There, he attended Regent Street Polytechnic for three years before economic hardship forced him to leave school and work as a clerk for a shipping company. When he turned 20, Fleming received an inheritance from an uncle and decided to use this sum to attend medical school at St. Mary’s Hospital. After completing his coursework at the top of his class in 1906, he began working as a research assistant under Wright, head of the Inoculation Department at St. Mary’s. Fleming
received his M.B., B.S. in 1908 and, unsure of his career path, prepared for the Fellowship of the Royal College of Surgeons exam while continuing to work in the Inoculation Department. Although he passed the exam and was accepted as a fellow in 1909, he chose to stay in Wright’s laboratory and pursue research rather than become a practicing surgeon.

Fleming remained at St. Mary’s for the entirety of his career, absent from the hospital only during the First World War, when he served as a captain in the Royal Army Medical Corps along with Wright and the rest of the Inoculation Department at a makeshift army laboratory in Boulogne, France. Upon Wright’s retirement in 1946, Fleming became director of the department, which was renamed the Wright-Fleming Institute in 1947, following Wright’s death. Fleming also taught bacteriology at the hospital’s medical school from 1920 to 1948. In December 1954, he retired from his directorship of the institute, although he continued to visit the laboratory regularly until his death.

Fleming died of a heart attack at his home in London on March 11, 1955, at the age of 73. His ashes were interred at St. Paul’s Cathedral.14

### Awards and Honors

Fleming was a fellow of the Royal Society (1943) and an honorary fellow of the Royal College of Physicians (1944), Royal College of Physicians of Edinburgh (1945), and the Royal Society of Edinburgh (1947). He was also an honorary foreign member of several national academies, including the French Académie Nationale de Médecine and the Pontifical Academy of Sciences (1946).15

In addition to the Nobel Prize, Fleming’s honors and awards include the John Scott Award of the City of Philadelphia (1944), the Cameron Prize of the University of Edinburgh (1945), the Moxon Medal of the Royal College of Physicians (1945), the Albert Medal of the Royal Society of Arts (1946), the Honorary Gold Medal of the Royal College of Surgeons (1946), the Medal for Merit awarded by the U.S. President (1947), and the Gold Medal of the Royal Society of Medicine (1947). He was knighted by King George VI in 1944 and named a commander in the French Legion d’Honneur the following year.

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