Lillian Gilbreth
1878-1972
American engineer

Lillian Gilbreth was one of the founders of modern industrial management. She brought psychology to the study of management in the early twentieth century and then brought them both to the forefront of the business world. She broke new ground with her book *The Psychology of Management,* which concerned the health of the industrial worker. An outstanding academician who developed new curricula for major universities throughout the United States, Gilbreth became widely known for making human relations an integral part of management theory and practice.

Gilbreth was born Lillian Evelyn Moller on May 24, 1878, in Oakland, California. She was the oldest of nine children of William and Annie Delger Moller, who ran a devout household of strong German influence. Her mother was the daughter of a prominent Oakland businessman, and her father was a dedicated husband who had sold his New York business to buy into a partnership in the hardware industry in California. Because of her mother's poor health, Gilbreth's public school education did not begin until she was nine, but she progressed quickly and was academically successful in high school. Her passions at the time were literature and music, which she studied with composer John Metcalfe. She was well traveled as a high school student, visiting New York, Boston, and Chicago with her father.

Although very proud of his daughter's talents, Gilbreth's father did not believe that women should attend college. She convinced him, however, to let her enter the University of California and live at home, continuing to care for her sisters. She studied modern languages and philosophy, and her goal was to teach English. Gilbreth was the first woman in the university's history to speak on commencement day in 1900, when she received her B.A. in literature. After graduation, Gilbreth entered Columbia University to pursue a master's degree in literature, but illness forced her to return home in her first year. She reentered the University of California, finished her master's degree in literature in 1902, and began work on a Ph.D.

In 1903, Gilbreth took a break from her studies to travel abroad. She stopped first in Boston, where she met **Frank Gilbreth**. Ten years her senior, he owned a construction business and was working on the development of motion-study techniques—methods to minimize wasted time and energy and increase productivity in industry. They corresponded through the mail for ten months after they met, and they were married on October 19, 1904. They would have twelve children, two of whom would later record their humorous memories of family life in the popular books *Cheaper by the Dozen* and *Belles on Their Toes.*

Lillian Gilbreth

Begins Work on Time-and-Motion Studies

Work was the focus of Frank Gilbreth's life. He wanted a complete partnership with his new wife and began to teach her about construction. He saw that her interest in the human aspects of industry complemented his ideas and he encouraged her to work with him. Their goals and their personalities influenced each other so strongly that both of their careers were redirected into new areas. The mental and physical health of workers was then largely neglected, and Lillian Gilbreth became increasingly interested in her husband's work as she recognized her potential contribution. Her doctoral studies shifted from literature to psychology.

Lillian Gilbreth's marriage began with several major responsibilities—her academic work, starting a large family, and becoming acquainted with the business world. She started as a systems manager in her husband's consulting business and was soon acknowledged as an expert in the study of worker fatigue and production. Her reputation was partially due to her precise measurements when collecting data. Among her contributions were the analysis of machinery and tools, the invention of new tools and the methods to simplify their use, and the standard-

ization of tasks. Most importantly, her work led to a greater understanding of the importance of the welfare of individual in business operations. This was instrumental in broadening acceptance of her husband's work on increasing productivity.

In 1910, the Gilbreths moved their growing family to Providence, Rhode Island, where Lillian Gilbreth entered Brown University to continue her doctoral studies in psychology. She began writing about industrial management from a scientific and psychological perspective. A lecture she delivered at the Dartmouth College Conference on Scientific Management in 1911 on the relationship between management and psychology became the basis for her doctoral dissertation.

In 1913, Frank and Lillian Gilbreth started the Summer School of Scientific Management. The school trained professionals to teach new ideas about management, and it emphasized the study of motion and psychology. Tuition was free, admission was by invitation, and classes were well attended by professors and business people from the United States and abroad. The Gilbreths ran the summer school for four years. Lillian Gilbreth received her Ph.D. from Brown in 1915. Her dissertation had already been published as a book, *The Psychology of Management,* in 1914. She was the first theorist in industrial management to emphasize and document the importance of psychological considerations in management.

After Frank Gilbreth's death in 1924, Lillian Gilbreth moved her family to her home state of California, where she provided a new home and college educations for her children, maintained a consulting business, and continued teaching and researching on efficiency and health in industry. Gilbreth became a well respected businesswoman; Johnson & Johnson hired her consulting firm to train their employees, and Macy's in New York had her study the working conditions of their salespeople to investigate techniques to reduce fatigue. The Dennison Co. and Sears & Roebuck were also clients, among many others. She started a new school called Gilbreth Research Associates, which catered to retail interests and went international in 1926. But by 1929, several universities were modeling motion in their engineering schools, using laboratories complete with photographic devices and movement measurement tools. Convinced that her ideas would now be carried on, she closed Gilbreth Research Associates. That same year she traveled to Tokyo to speak at the First World Power Congress. Gilbreth was now lecturing at universities such as Stanford, Harvard, Yale, and the Massachusetts Institute of Technology. She joined the Purdue University faculty in 1935 as a professor of management, becoming the first woman professor in the engineering school.

When America entered World War II, Gilbreth consulted at the Arma Plant in Brooklyn, New York, which handled huge Navy contracts. The staff at the plant grew from a few hundred to eleven thousand men and women, and she managed the personnel restructuring and worker training for this enormous expansion. Especially notable was her development of an exercise program for the women; although white-haired and over sixty years old, she kept up with the younger women.

In 1948, Gilbreth began teaching at the Newark College of Engineering in New Jersey. She was the first woman professor in this school of engineering as well, and she stayed there for two years. She went on to teach in Formosa from 1953 to 1954 and at the University of Wisconsin in 1955. Gilbreth remained active professionally well into her eighties, speaking and writing on management issues. She also became a widely sought speaker on human relations problems in management. Gilbreth received over a dozen honorary degrees. She was the recipient of the Hoover Medal from the American Society of Civil Engineers in 1966, and other engineering and management professional organizations around the world bestowed many awards upon her for her pioneering work. She died in Phoenix, Arizona, on January 2, 1972.

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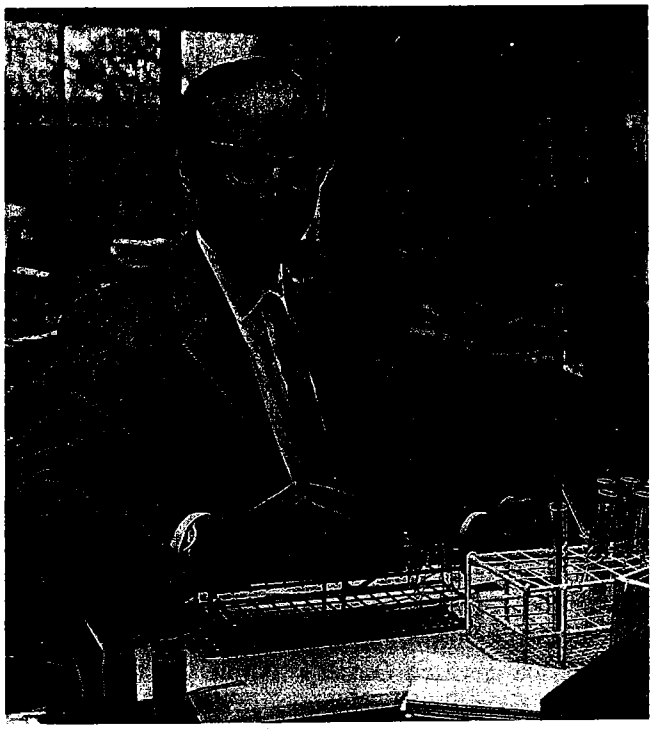
—Sketch by David N. Ford



Donald Glaser

Donald Glaser
1926-
American physicist

The work for which Donald Glaser is best known, his bubble chamber invention for tracking the movement of high-energy particles, is said to have begun over a glass of beer. In the early 1950s, while teaching physics at the University of Michigan, Glaser followed a hunch that bubbles rising from a glass of beer might provide a clue for detecting high-energy radiation. Although his first attempt to prove this hypothesis, using beer, soda water, and ginger ale, failed, he kept working. In 1953 he created a small bubble chamber filled with superheated ether that was successful in capturing the trail of bubbles left by nuclear particles as they passed through the liquid. The bubble chamber invention won Glaser the 1960 Nobel Prize in physics and was a vital step in understanding atomic function. It also enabled the discovery of new atomic particles, such as the rho and omega minus particles, at the same time advancing visualization of charged-particle interactions, and furthering the study of particle mass, lifetime, and decay modes.

Donald Arthur Glaser was born in Cleveland, Ohio, on September 21, 1926, to William and Lena Glaser. Glaser's parents had come to the United States from Russia. His father operated a wholesale sundries business in Cleveland and Glaser attended elementary and secondary schools there. As a child he was given violin and viola lessons. Later he studied composition at the Cleveland Institute of Music. An accomplished musician, he became a member of a local symphony orchestra at age sixteen. Glaser remained in Cleveland for his undergraduate education, entering Case Institute of Technology (now Case Western Reserve University) to study mathematics and physics. He completed his graduate course work at the California Institute of Technology (Caltech) and received his Ph.D. in 1950, a year after he accepted a position as instructor at the University of Michigan. He remained at Michigan until 1959, and was made full professor there in 1957 at the age of thirty-one. He left Michigan to accept a visiting professorship at the University of California at Berkeley. That position was made permanent, and Glaser was to remain at Berkeley for the rest of his career, except for brief periods away on fellowships.

Bubble Chamber Fills a Gap

Other physicists before Glaser had attempted to make nuclear particles visible. The 1927 Nobel Prize was given to **C. T. R. Wilson**, a British scientist, for his cloud chamber method. In 1950 **C. F. Powell** received that honor for an emulsion method. But both these methods, while effective for elementary particle study, became inadequate with the advent of high-energy particle acceleration machines, such as that built at Berkeley in the late 1950s. These accelerators had capacities one thousand times greater than those used for the cloud chamber and emulsion techniques.

NOTABLE TWENTIETH-CENTURY SCIENTISTS

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