



Science and Technology in Ohio

Explore how Ohio-generated science and technology has shaped our world and where it might lead us in the future.

Background

Ohio has long been at the forefront of scientific and technological progress. From early anthropological studies and surveying efforts in the 18th century to the early development of the automobile and the engine-powered airplane, Ohioans have made indispensable contributions to the fields of science and technology.

Transportation and Communications

Ohioans have made a prominent mark in the areas of transportation and communications. They made improvements in the shipping industry by creating technologies to increase the efficiency of freight transport.

Granville T. Woods (1856-1910), a Columbus native known as the "Black Thomas Edison," was responsible for multiple inventions that were crucial to the nationwide development of electric railways.

Elisha Gray (1835-1901), born in Barnesville and educated at Oberlin, filed a patent for a telephonic device on February 14, 1876. Unfortunately, Alexander Graham Bell had also filed a patent just hours earlier for a similar device. Although Gray's patent claim for the telephone was denied after a long legal dispute, he went on to make many important innovations in telegraphic technology.

James W. Packard (1863-1928), born in Warren, Ohio, built the first Packard automobile in 1899. In many ways, the early automotive patents and designs of Alexander Winton were as significant as those of Henry Ford for the future development of the automobile.

Frank A. Sieberling (1859-1955), founder of Goodyear Tire and Rubber Company, was responsible for many innovations in tire design and manufacture.

Charles Kettering (1876-1958) of Loudonville, Ohio, an Ohio State University graduate, perfected the automobile self-starter, eliminating the need to hand-crank engines. He was employed by the National Cash Register Company of Dayton prior to founding the Dayton Electric Laboratory Company (better known as Delco) and working for General Motors. Kettering also developed other noteworthy advances in transportation technology.

Garrett A. Morgan (1877-1963) of Cleveland patented the traffic signal in 1923. A self-educated African-American businessman, Morgan saw a need for a device to improve road safety. He designed a t-shaped pole with three indicators: stop, go, and all-direction stop (for pedestrian crossing). The signal was widely adopted, but eventually was replaced with the red, yellow and green signal used today. Morgan also invented a forerunner to the gas masks used in World War I.



Air and Space

The Wright brothers of Dayton, Orville (1871-1948) and Wilbur (1867-1912) inaugurated the era of aviation with their first experiments in powered flight. Starting out as bicycle repairmen, the Wright brothers later became infatuated with gliding and flying. They read all they could find on aeronautical research, which led to their glider experiments of 1900-1902 at Kitty Hawk. Returning to their Dayton repair shop, the brothers built a four-cylinder engine and proceeded to assemble the first flying machine. On December 17, 1903, at 10:35 a.m. Orville Wright made the first flight at Kitty Hawk, changing the world forever.

During World War I, there was an urgent need for an active research and development program for military aviation. McCook Field in Dayton was established on October 17, 1917. Engineers at McCook Field helped to advance military and civilian aviation. Also in 1917, Orville Wright, Charles Kettering and Edward Deeds formed the Dayton Wright Airplane Company, which became one of the largest producers of aircraft for the Army Air Services during the war. In 1927, the Army Air Corps moved its test operations to nearby Wright Field, which was larger. Wright Field and Patterson Field merged in 1948 to become Wright Patterson Air Force Base. Civilian aviation pioneers from Ohio Reinhardt Ausmus (1896-1970), Glenn Curtiss (1877-1963), and Frank Lahm (1877-1963) contributed much to the development of airplanes and popularization of flying. Ohio-based Weaver Aircraft Company of Troy and Roberts Aviation Motors of Sandusky were among the manufacturers that helped to fuel growth of aviation.

NASA maintains the John H. Glenn Research Center at Lewis Field in Cleveland, which was established in 1941 as one of three aircraft engine research centers. Subsequently renamed the Flight Propulsion Research Laboratory and the Lewis Research Center, the current name was adopted in 1999 to honor astronaut Glenn and George W. Lewis (1882-1948), former director of aeronautical research for NASA. The center has a mission to develop new capabilities in space communication that support NASA missions and to increase the industrial competitiveness of the United States.

Medicine

The Ohio State Medical Society was organized in 1849, and state board certification for physicians was instituted by the end of the century. Dr. Daniel Drake, sometimes referred to as the "Benjamin Franklin of Cincinnati," was one of the early champions of medical education and practice in Ohio. In 1819, he founded the Ohio Medical College (the future University of Cincinnati) and taught there for many years. He also wrote an influential medical treatise on diseases in the Ohio Valley region.

The Cleveland Clinic is one of the world's largest and busiest health centers. Incorporated in 1921, the not-for-profit institution is both a teaching hospital and research center. It nearly did not survive to become a successful and well-regarded organization. Two explosions killed 123 and temporarily sickened 50 more on May 15, 1929. One of the victims was Dr. John Phillips, who, with George Crile Sr., Frank E. Bunts, and William E. Lower, founded the clinic. The explosions originated in the basement room where nitrocellulose x-rays were



stored. High combustible nitrate film emits toxic gas. Although the cause was never determined, the tragedy inspired worldwide changes in safety codes. Less flammable cellulose triacetate safety film was subsequently used for x-rays.

Another Ohio medical center with national prominence is based at The Ohio State University. The Arthur G. James Cancer Hospital and Richard J. Solove Research Institute is among the few freestanding hospitals in the country providing clinical care and conducting important research into prevention, testing, treatment and genetics.

Bainbridge, Ohio, has been called the "cradle of dental education" in America. Dr. John Harris, a medical doctor specializing in dentistry, taught medicine and dentistry in his Bainbridge home starting in 1828. Harris, a medical doctor from Cincinnati, settled in Bainbridge in the mid-1820s. James Taylor (1808-1881) founded the Ohio College of Dental Surgery, the second dental school in the country in 1845. Taylor was born in Bainbridge and studied with John Harris. The Ohio State Dental Society was established in 1866.

Agriculture and Veterinary Medicine

Agricultural productivity benefited from the ideas and inventions of many Ohioans. Obed Hussey and Albert Ball were both well known for the design and improvement of reapers. These reapers were commercially successful before the advent of McCormick's reaper. Ohio inventors also made improvements to mowers, plows, binders, threshers and other important agricultural machinery. Ohio agricultural researchers contributed significantly to the scientific literature and disseminated their knowledge statewide to farmers through a network of fairs and farm organizations. The state's commitment to promoting agricultural knowledge and practice is also evident in the founding of the Ohio Agricultural and Mechanical College in 1870, later to be known as Ohio State University. Ohio State established a school of veterinary medicine in 1885, making it one of the earliest veterinary schools in the country. It also owns the distinction of having graduated more veterinarians than any other school.

Natural Sciences

An important figure in the field of botany was Franklin County native William S. Sullivant. A graduate of Ohio University, Sullivant made many significant contributions to the scholarly literature, including important chapters in the classic *Manual of the Botany of the Northern United States*. Virginia and Estelle Jones drew intricate illustrations for an important ornithological guide entitled *The Nests and Eggs of the Birds of Ohio*.

Chemical Abstracts Service, a division of the American Chemical Society founded in 1907 and headquartered in Columbus, indexes and summarizes scientific publications in the fields of chemistry and life sciences. Its substance registry is the largest of the kind. More than 21 million substances are recorded; each entry includes a molecular structure diagram, molecular formula, systematic chemical name, and CAS registry number.

Columbus is also home to the nation's largest independent research organization, Battelle Memorial Institute, which was established in 1929. The Battelle family was a leader in the U.S. steel industry. Working for both industry and government, the institute's research focuses on manufacturing, pharmaceutical and agrochemical industries, trade associations and



government agencies related to energy, the environment, health, national security, and transportation. Notable developments in which Battelle played a part are the photocopier, product barcodes, and compact discs.

Frank Sherwood Rowland (1927-2012) won the Nobel Prize in chemistry in 1995 for his research on the effects of chlorofluorocarbon compounds on the ozone layer. Rowland was born in Delaware, Ohio, and graduated from Ohio Wesleyan University.

Earth Sciences and Astronomy

The growing preeminence of Ohio geologists and the establishment of the Ohio Geological Survey in 1837 are indicative of the increased importance of the state's mineral resources. Colonel Charles Whittlesey (1808-1886) was a tireless chronicler of Ohio's geological landscape, authoring more than 50 reports and 200 scientific papers. John Wesley Powell, the great U.S. geologist, was educated at Oberlin College.

For a time in the 19th century, the astronomical observatory built in Cincinnati in 1844 was the envy of astronomers all over the world. Largely the result of the efforts and enthusiasm of Ormsby MacKnight Mitchel (1809-1862), the observatory gave local astronomers a distinct edge over their peers located elsewhere in the country.

In 1977, the strongest radio signals ever recorded were received by the Ohio State University's radio observatory, known as the Big Ear. Located in Delaware, Ohio, on land owned by Ohio Wesleyan University, the radio telescope was designed by Dr. John D. Kraus and was equivalent in size to three football fields. It was used to pick up radio waves from space. The 1977 radio waves are familiarly known as the "Wow!" signal, after the margin notation made by astronomer Jerry Ehman on the computer printout of the telescope's data. Its origins are unknown, but some astronomers speculate that the signal could be evidence of intelligent life in the universe, or an earth-bound signal that bounced off space debris. Before the Big Ear was demolished in 1998, the *Guinness Book of World Records* credited it with conducting the longest continuous search for extra-terrestrial life.

The scientific breakthroughs of Albert Einstein might not have been possible without the pioneering work of Albert Abraham Michaelson (1852-1931) and Edward William Morley (1838-1923). Their research on the speed of light, known as the Michaelson-Morley experiments, is considered a landmark in astrophysics, paving the way to our modern understanding of the universe. Michaelson taught physics at the Case School of Applied Science in Cleveland and later became the first American to win the Noble Prize (1907). Morley taught at Case Western Reserve University from 1869-1906.

The establishment of the aluminum industry was made possible by the efforts of Charles Martin Hall (1863-1914). Born in Thompson, Ohio, and educated at Oberlin College, Hall invented a process of inexpensively extracting aluminum using an electrolytic method. Later he took his knowledge from the lab and put it into practice, founding a company to produce aluminum cheaply. As a result of his efforts, aluminum went from being a precious metal to playing a vital role in the aviation, automobile, and other industries.



Electrical Engineering

Research into electrical power and the invention of electrically-powered devices are areas in which Ohioans have particularly excelled. The work of Columbus-born Sidney Howe Short (1858-1902) emphasized improvements in electric motors, electric railways and trolleys, and electric generators. Well before Edison invented the light bulb, Charles F. Brush (1840-1929) invented the electric arc lamp. On April 29th, 1849, he lit up Monumental Park in Cleveland with this new invention. Brush also introduced the dynamo, a machine for producing a steady flow of electrical current, sufficient for use in central power stations. All of these were put to great effect in 1881, when Cleveland became the first lighted city in the world. Later, Brush's company merged with Thomas Edison's firm to form the General Electric Company.

One who had seen and admired Brush's work on the electric arc and dynamo was Springfield native Benjamin Lamme (1864-1924). After graduating from Ohio State University, Lamme worked for the Westinghouse Electric Company in its early years and invented many important electrical devices, including the single-reduction motor, the rotary converter, and the first electrical generators for the Niagara Falls.

Although the great inventor Thomas Edison (1847-1931) spent most of his productive life outside of Ohio, he was born in Milan, Ohio, and spent his first seven years there before his family moved to Port Huron, Michigan.

Other Areas of Science and Technology

The face of printing was changed in the late nineteenth century by a Troy native, Tolbert Lanston (1844-1913). In 1887, he patented the Monotype Keyboard and Caster, a 120-key machine designed to allow operators to key in characters of different typefaces and fonts and later cast them on a casting machine.

The business transactions of all modern economies begin at the cash register--a device invented by James Ritty (1836-1918) of Dayton. The "Incorruptible Cashier," as it was first called, was later bought by another Daytonian, John H. Patterson (1844-1922), who founded the National Cash Register Company in 1881.

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