

DR. GEORGE W. CRILE

The father of physiologic surgery

FLOYD D. LOOP, MD
CHAIRMAN, BOARD OF GOVERNORS,
AND EXECUTIVE VICE PRESIDENT, THE CLEVELAND CLINIC FOUNDATION

THE LIFE OF GEORGE CRILE is the story of science and surgery at the turn of the century. His investigations in physiology occurred mainly between 1888 and the end of World War I. That brief era was remarkable for the sheer enormity and number of profound changes wrought in virtually every major field of endeavor. At the end of the 19th and beginning of the 20th century, gold was discovered in Alaska, baseball was invented, and the first gasoline automobile was built. The Spanish-American War was fought in 1898. Two US presidents, Garfield and McKinley, were assassinated in office. The Wright brothers flew at Kitty Hawk. Peary and Amundsen reached the North and South Poles. The Pure Food and Drug Act was passed. Medical school standards were elevated by the Flexner report, published in 1910. The Titanic struck an iceberg in 1912. Billy Sunday, Jack London, and Frank Lloyd Wright were prominent in the news, and Alexis Carrel received the Nobel Prize in 1912 for his work in suturing blood vessels, transfusion, and organ transplants.

At the beginning of the era, surgery was primitive. Anesthesia was largely a feat of strength. Prior to 1880, 90% of all surgical wounds became infected. Lister's principles were barely recognized but eventual adoption of aseptic technique led the transition from conservatism to radical surgery. In 1900, 76 million people lived in the United States; the average life span was 47 years. Cleveland had a population of 200,000 and was the 10th largest city in the United States and the fifth in industrial production.

Eighty miles south of Cleveland, George Crile was born in 1864 on a farm near Chili, Ohio, in Coshocton County. The name Crile was probably derived from the Irish, Groyle or Gyle. His mother was Dutch, Dietz;



FIGURE 1. Dr. and Mrs. Crile on the loggia of their home in Cleveland Heights, 1939.

he was the fifth of eight children, and they named him George Washington Crile. It was the custom for more than a century after the Revolutionary War to name the first son "George Washington," and the custom prevailed in the Crile family, of which George said, "I am the victim."



FIGURE 2. Dr. Crile and his young son Barney (George H. Crile), who would become a renowned surgeon in his own right. The Criles would be the only father and son to receive honorary fellowships in the Royal College of Surgeons.

He read incessantly as a youth, even as he plowed the fields. His early education was obtained at Northwestern Ohio Normal School in Ada, Ohio. At age 15 he taught school at Coon's Nest for two winters, and later became the principal of the Plainfield School. Physicians at that time included Thomasonians, Uroscopians, and Homeopaths. Most had no training; they had "read medicine" under tutelage and most had other jobs. In 1886, Crile entered medical school at Wooster, which was affiliated with Western Reserve University. This was horse-and-buggy medicine. He paid a physician-preceptor \$200 for the privilege of reading his books. He attended medical school for a total of 8 months.

EARLY PRACTICE

After internship in Cleveland, Crile and another young doctor, Frank Bunts, became Frank Weed's assistants in Cleveland. Weed was the dean at Wooster and had a large accident practice. There was a huge variety of industrial and railroad accidents and burns from tenement fires. One of Crile's earliest experiences in-

volved treating a young student whose legs had been crushed by a train. Weed performed amputations but the young man died of shock; this made a big impression on the young Crile. There was little in textbooks about shock. Crile set up a crude research laboratory and experimented on dogs in an attempt to explain his clinical observations. He had observed that heart and brain injuries depressed blood pressure. His experiments indicated that injury of nerve tissue produced more instability of blood pressure than injury of connective tissue or bone. He found physiologic changes differed by site of the injury.

Dean Weed died prematurely, and Bunts and Crile were devastated. They bought Weed's practice for \$1,778.10. By 1892, Crile had attended more than 10,000 accident cases, and the partners were overworked. Then, "good fortune knocked on our door in the form of a freckle-faced youth, my cousin, W. E. Lower, who swore violently with or without provocation, and we engaged him."

The three of them lived by a principle manifested in the organizations that Crile was later to influence: the strength of the individuals comprised the strength of the group, and the strength of the group determined the strength of the individual.

Crile performed one of the earliest laryngectomies; he performed radical neck dissection, invented a spring clamp to temporarily occlude the carotid artery, and continued his experiments on the origin of shock. In 1897, while visiting European research laboratories, he met Horseley, a scientist in University College, London. Their collaboration helped Crile's laboratory work immensely. He understood that hemorrhage was only one of the many variables in shock. He realized that animals in shock had lowered blood pressure, which he attributed to heart failure, fluid loss, or decrease in vessel resistance. He observed that infusion of saline intravenously restored blood pressure but that too much saline could overload the system. He was fascinated by the vasomotor center in the brain stem; however, he was mistaken when he concluded that the vasomotor center could become exhausted.

In 1898, Crile won the prestigious Columbia University Cartwright Prize for the best article on medical or surgical research. The manuscript was published as the first of his 24 books, *An Experimental Research into Surgical Shock*. That year he also won the Nicholas Senn Prize of the American Medical Association. Franklin Martin, editor of *Surgery, Gynecology and Obstetrics* and the stimulus behind the American College of Surgeons, writes in his memoirs, "George W. Crile of Cleveland

had been heard of as far west as Chicago within a few years of his graduation . . . and those of us interested in organized medicine thought well enough of him to take a chance and invite him to read a paper on shock before the Chicago Medical Society. He came. He was a young man . . . with an enthusiasm that captivated us, old and young. And though more than forty years have passed, I have even now a vivid recollection of the favorable scene that he enacted in our midst on that evening."

In 1900, Crile was appointed clinical professor of surgery at the School of Medicine, Western Reserve University. There he first knew the thrill of receiving distinguished visiting physicians: the Mayo brothers, John B. Murphy, Albert Ochsner, Nicholas Senn, and Sir Berkeley Moynihan. He performed up to 20 operations a day. He also taught physiology, histology, and applied anatomy and surgery.

At a dance in 1903, he met a young woman named Grace McBride. As he danced with her, she told him she had read his new book on shock and thought it was wonderful. Recalling the event in his autobiography, Crile said her comment opened at once an interest that continued unbroken for more than 46 years (*Figure 1*). He also said, "I found in her an absorbing subject of research." She and his staff would forever call him "The Chief."

RESEARCH

Probably his most influential book, *Blood Pressure in Surgery*, was published in 1903. In it he reviewed 251 experiments testing a variety of drugs. Only adrenaline, saline, and use of an inflatable airtight suit, which he designed, could offset the volume shifts of shock. Later, Walter Cannon, the physiologist, showed that low blood pressure was a sign of shock and that a decrease in circulating blood volume was the basis for the clinical picture of shock.

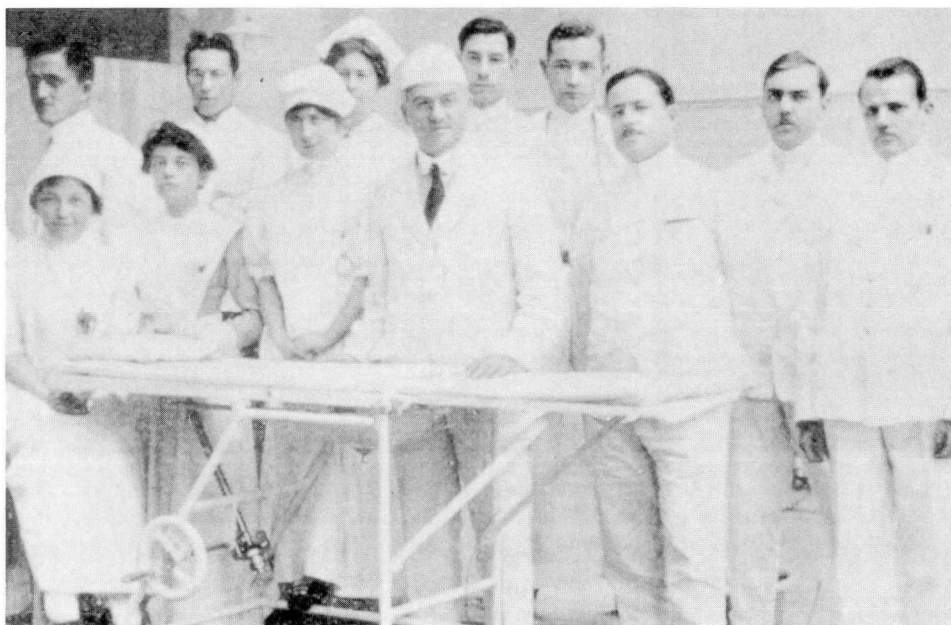


FIGURE 3. Dr. Crile and his staff at the Lakeside Unit, American Ambulance, January 13, 1915.

Blood transfusions were used in obstetrics in the 17th century, but transfusion reactions prevented wide usage. In 1904, Crile transfused blood between animals, and he had reported 200 such experiments by 1907. He developed a napkin-ring cannula in which the artery was stretched over the vein so that the endothelia touched and blood did not clot. Landsteiner's paper on blood typing was published in 1900, but blood was not routinely matched until after World War I. By 1909, Crile had performed 60 transfusions in humans. Crile later commented that it took almost 30 years from the time he had used transfusions clinically in 1905 until widespread acceptance. Such, he said, is the inertia of the human race.

His first son, George Harris Crile, called "Barney," was born in 1907 (*Figure 2*). He became a famous surgeon in his own right in breast and thyroid surgery. He and his father were both surgical innovators. The elder Crile opened new frontiers in radical surgery. The younger Crile voiced conservatism in cancer operations. Barney Crile died in early September this year at age 84.

By 1909, Barney's father had become the leading physiologic surgeon. He was a great experimentalist. Walter Cannon wrote to him, "It seems to me you have taken the ideal position for the medical man today, turning to experiment for the settlement of problems

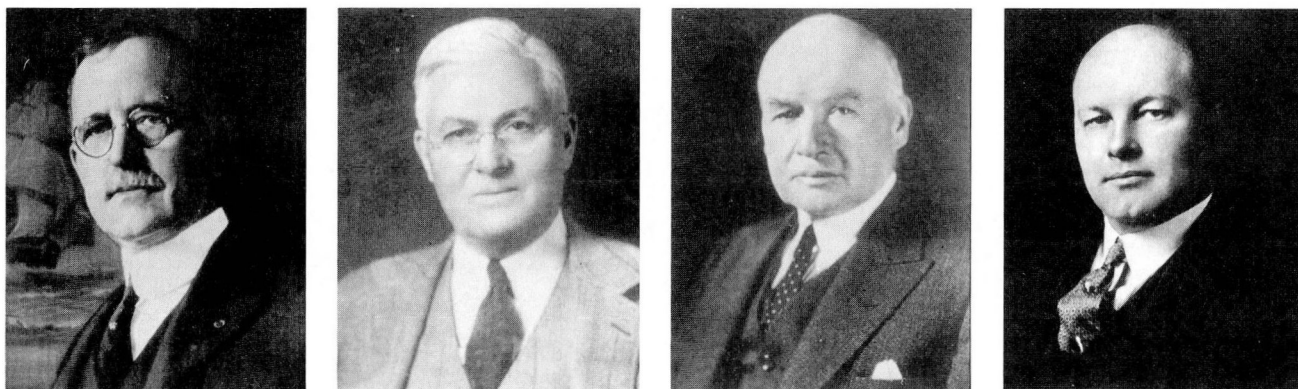


FIGURE 4. The four founders of The Cleveland Clinic Foundation (from left): Frank E. Bunts, 1861-1928; George W. Crile, 1864-1943; William E. Lower, 1867-1948; and John Phillips, 1879-1929.

and returning with your fruits for the relief of man's estate. That is the ideal I am trying to arouse in the young men studying physiology with me." Crile brought the study of shock into the laboratory. But he also contributed to physiologic surgery by emphasizing preoperative assessment, including use of laboratory values, intraoperative monitoring of pulse, respiration, and blood pressure, accounting for blood loss, and measuring urine flow. He lectured repeatedly on the merits of measuring blood pressure during an operation. He reduced the mortality for surgery for thyrotoxicosis from 16% to 2% by what he called "stealing the gland," combining anesthesia of novocaine locally with use of nitrous oxide gas anesthesia. He called the technique "anoci-association." This confusing term was derived from Sherrington's "noci-receptor" and Darwin's "serviceable associated habits." It meant prevention of impulses of pain or fear from reaching the brain.

Crile may have pushed his ideas too hard, but his theories and investigations improved anesthesia. He set up the first school of nurse anesthesia. As a result of better intraoperative monitoring, improved anesthetics, and blood transfusions, he and his colleagues reduced the operative mortality at the Lakeside Hospital from 6.8% in 1898 to 1.9% in 1912.

AMERICAN COLLEGE OF SURGEONS

The Clinical Congress of Surgeons of North America met in 1910, and from this group grew the American College of Surgeons (ACS). Crile was the 12th person on the founding committee. That was the same year that he was awarded an honorary fellowship

in the Royal College of Surgeons of England, along with Harvey Cushing, William J. Mayo, and John B. Murphy. The Criles would be the only father and son to receive honorary fellowships in the Royal College of Surgeons. In 1916, Crile succeeded John Finney who was the first president and chairman of the Board of Regents. The topics of debate in those early years of the ACS included qualifications for fellowship, fee-splitting, location of the College office, and the endowment. Crile and Franklin Martin focused on the scientific and educational aspirations of the College. Crile also suggested that Fellows build the endowment. By 1914, 1,000 surgeons had contributed \$500,000. Crile served as chairman of the Board of Regents from 1916 to 1939.

WORLD WAR I

When America entered World War I in 1917, 90% of the 3,795 Fellows of the ACS volunteered for military duty. Several years earlier, Crile proposed a university-sponsored field hospital. His Lakeside Hospital Unit sailed for Europe in December 1914, where between January and April 1915, they were responsible for the American Ambulance (*Figure 3*). Crile was instrumental in bringing both blood transfusion and gas oxygen anesthesia into wartime surgery. There was a great spirit of cooperation.

In that Great War of 1914 to 1918, the leading problems were lice, fleas, scabies, trench diseases, war neurasthenia, phosgene and mustard gas poisoning, shell concussions, wound infection, exhaustion, and compound fractures. Crile reported to the National Council of Defense about these matters and called for a

practical plan of organization, which included staffing with experienced physicians and surgeons, not "cloistered academics." As you might imagine, this suggestion became controversial. Crile explained that when a professor was sent to the trenches to kill rats, he became so interested in the age of the rats, their heredity, and the number of whiskers that he often neglected to kill the rats. The Council loudly approved his recommendation, shouting "Kill the rats!"

General Hospital #9 was a British army base located in Rouen. It was there that Crile dreamed of a new hospital. He wrote in 1918, "What a remarkable record Bunts, Crile, and Lower have had all these years. We have been rivals in everything, yet through all the vicissitudes of personal, financial, and professional relations, we have been able to think and act as a unit" (Figure 4). Thus it was "on walks through the forest, punctuated by the roar of cannon, the uncertainty as to the outcome of the war and of life itself," that they formed the organization of a new kind of hospital.

THE CLEVELAND CLINIC FOUNDATION

This horizontally integrated structure called The Cleveland Clinic Foundation opened February 26, 1921. The dedication address was given by Dr. William J. Mayo (Figure 5). "Medicine's place is fixed by its services to mankind," Mayo said. "If we fail to measure up to our opportunity, it means state medicine, political control, mediocrity, and loss of professional ideals. The internist, the surgeon, and the specialist must join with the physiologist, the pathologist, and the laboratory workers to form the clinical group. Union of all these forces will lengthen by many years the span of human life and as a byproduct will do much to improve professional ethics by overcoming some of the evils of competitive medicine." At the time of this founding, Crile was 57 years old. He said, "This seemed to us an ideal setup for the most altruistic and the most effective way of practicing a great profession. The clinic is the crucible of the research laboratory."

If Crile was the driver, Lower, a urologist, was the brake. A perfect treasurer, a born conservative, to the point of keyhole incisions, Lower knew every brick and nail in the new Clinic building. The Clinic prospered. At one time, Crile owned a huge tract of land east of Cleveland, called "The Knob," where he and his family enjoyed the great outdoors. In 1929, after the stock market crash, he lost a substantial amount of the property. He called the remaining piece "the promised land" in honor of the promissory notes owed.

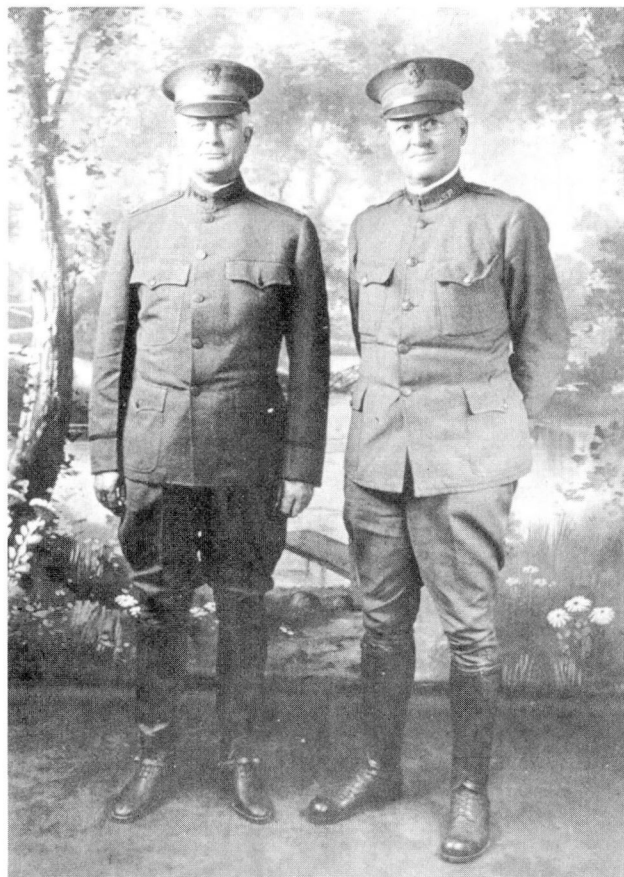


FIGURE 5. Major Will Mayo of the Mayo Clinic, at left, and Major George Crile, October 1917. Both served "over there" in separate units. Dr. Mayo gave the dedication address at the opening of The Cleveland Clinic Foundation, February 26, 1921.

At 11:30 a.m. on May 15, 1929, disaster struck the Cleveland Clinic. Incomplete combustion of nitrocellulose x-ray film stored in the basement of the Clinic building occurred, forming toxic nitrous fumes and carbon monoxide. There were explosions and the gas permeated the entire building, causing the death of 123 people. The nitrous fumes were converted to nitric acid by contact with moisture in the lungs, causing acute rupture of the alveolar walls and pulmonary edema. Dr. John Phillips, a young internist and one of the Clinic founders, died the evening of the disaster. Letters of sympathy poured in from all over the world. Harvey Cushing came to Cleveland to offer his services. Over the next few years Crile and Lower settled approximately \$4 million in lawsuits. "Disasters uncover realities," Crile said, and the Clinic persevered. By 1936 Crile had performed 25,000 thyroidectomies.

After Franklin Martin died in 1935, Crile served as acting director of the ACS through 1939. At the annual oration on surgery at the San Francisco Clinical Congress in 1935, Crile said, "We are building not in the interest of the profession but primarily in the interest of the people at large. . . our task is to see to it that there are good surgeons all over the United States and Canada, and wherever there is a human being who requires the service of a surgeon, we must have a good surgeon and a good hospital."

He and Grace travelled extensively, even in their later years. He still had irrepressible curiosity. He loved hunting in Africa, and he dissected most of the kills to study the comparative anatomy and physiology of wild animals.

At the end of the 1930s, his health began to fail. He had glaucoma. His friends Charlie Mayo and Harvey Cushing had died. In 1943, Dr. Crile contracted a streptococcal septicemia and died of bacterial endocarditis.

Thus one of the most remarkable careers in American surgery ended. The past had held no interest for The Chief. It was the future that his mind penetrated. Grace Crile recalled his "buoyancy of nature, the energy of mind and body, the wonderful smile, the kindness, almost courtliness, his consideration of others, his talent to see ahead of his time, his talent for correlation of scientific data, his philosophic understanding of human foibles, his ability to teach clashing

personalities to work together, his gift of leadership, his humor and appreciation of nonsense, his hearty laugh, his delightful intrepid quality of mind and person . . . without a doubt, one of the greatest known in surgery." In the eulogy, the once freckle-faced boy, Ed Lower, who practiced with him for 30 years, noted that George Crile had a quest and a vision which he pursued throughout his entire adult life with a devotion "amounting almost to mystic fervor." This is the striking thing that distinguished Crile from other surgeons and that gave special meaning to his life. Dr. George W. Crile was "a great and vivid personality" and the first physiologist in American surgery.

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