



LANDMARKS AND LEGACY
Neurosurgery at the University of Pennsylvania

Carol Benenson Perloff



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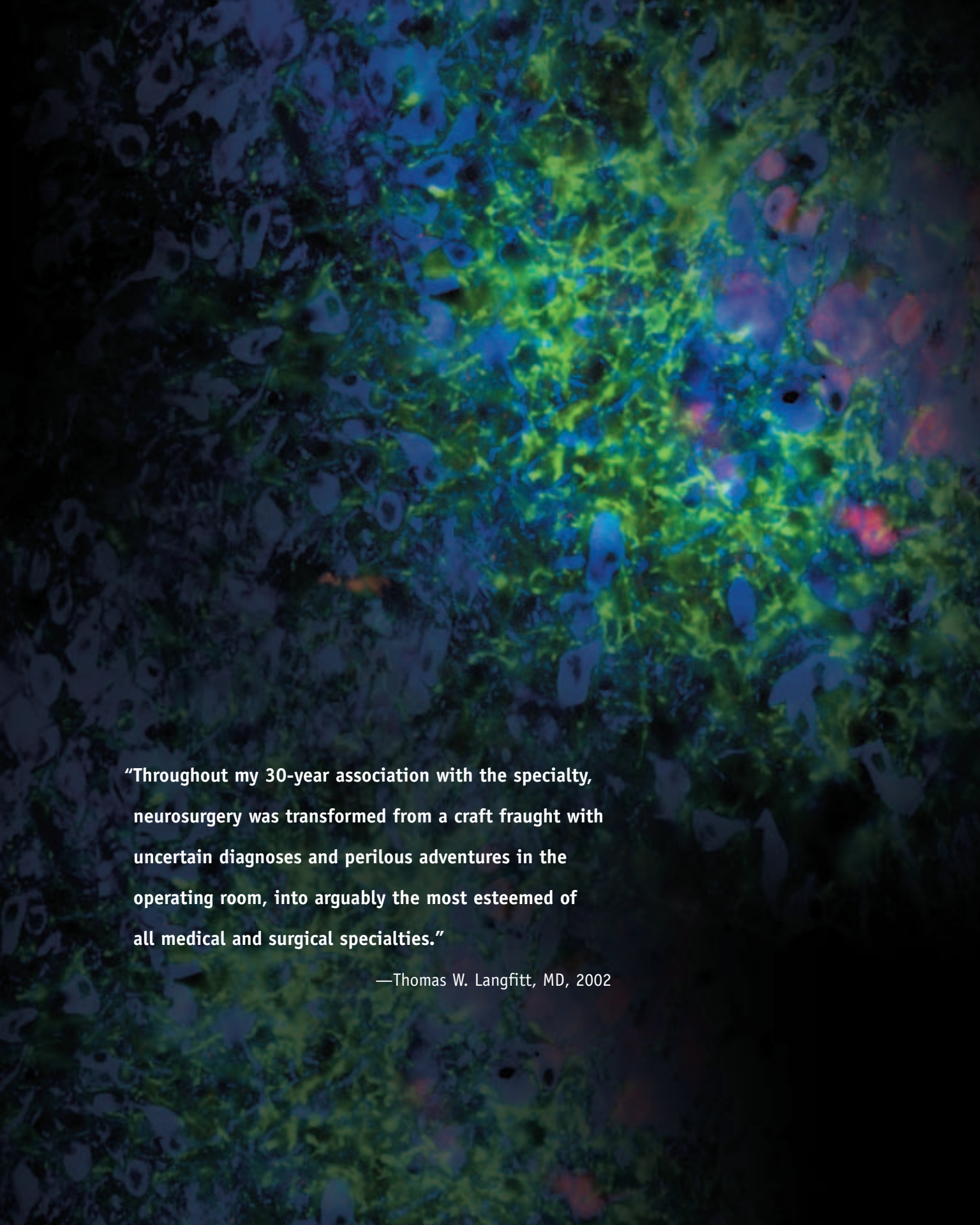
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“Throughout my 30-year association with the specialty, neurosurgery was transformed from a craft fraught with uncertain diagnoses and perilous adventures in the operating room, into arguably the most esteemed of all medical and surgical specialties.”

—Thomas W. Langfitt, MD, 2002

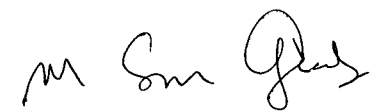
Foreword

Uncovering the history of the Department of Neurosurgery at the University of Pennsylvania has been a fascinating experience for me. I hope the reader will be transported back to a time when neurosurgery was in its infancy. Pioneers like Charles Harrison Frazier, MD set the tone for a specialty and a department in which we combine high tech with high touch for our patients, strive to advance neurosurgery to improve people’s lives, and train future leaders of our specialty.

As the department moves into the 21st century, this monograph commemorates those individuals who established and developed the national and international reputation of Penn Neurosurgery. These leaders are highlighted in the following chapters, however their efforts would have been fruitless were it not for the outstanding faculty, resident physicians, nurses and staff at the University of Pennsylvania. Their dedication to the department’s mission and our patients has been selfless and essential.

All of us owe a great debt to these individuals who have helped. In the words of Sir Isaac Newton, “If I have seen further it is by standing on the shoulders of giants.” We in the department now dedicate ourselves to shaping the history of Penn Neurosurgery for the 21st century.

Numerous individuals and institutions have participated in the development of this monograph. I would like to thank those listed on the following page. If there are errors or omissions, I apologize and take full editorial responsibility.



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*Archives of the School of Nursing of the Hospital
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Introduction

At a time when President Theodore Roosevelt was leading America's charge into the 20th century, a small group of surgeons pioneered the field of neurosurgery. Possessed with intellectual curiosity and bravado, they developed many basic surgical techniques for operating on the brain and nervous system, moving neurosurgery toward a distinct specialty of its own. Two names stand out in this early stage of American neurosurgery: Drs. Harvey Cushing and Charles Harrison Frazier. The latter was a man of Pennsylvania — the University of Pennsylvania.

Charles Harrison Frazier, MD founded a rich tradition of neurosurgery at Penn, one that has flourished continuously for more than a century. He started a program steeped in research to find new surgical remedies, in clinical excellence to care for patients, and in first-rate education to send forward future generations of neurosurgeons. As the baton of leadership passed from chairman to chairman, so too did Frazier's legacy. Today, Penn's Department of Neurosurgery ranks among the nation's top academic neurosurgical centers, offering outstanding care in a full range of subspecialties, nationally and internationally regarded training programs, and research initiatives showing great promise for the 21st century.

1900s-1930s: Pioneering a Specialty



J. William White Surgical Pavilion, 34th and Spruce Streets, begun in 1912 and completed in 1922. For several decades, neurosurgical operations took place in this building. *University of Pennsylvania Archives*

In the very early years of the 20th century, general surgeons interested in the problems of the brain and nervous system evolved into the first generation of neurosurgeons. While they increasingly devoted their attention to neurosurgery, they continued to perform a wide range of surgical procedures – for the time being anyway.

World War I pulled more general surgeons into the realm of neurosurgery. Forced to operate on gunshot and shell wounds to the head, many began to develop special surgical techniques, as well as an interest in neurosurgery. An understanding of asepsis and the introduction of novocaine anesthesia for cranial surgery

expanded the possibilities for successful outcomes. The battlefield also created unique opportunities for clinical research in areas like peripheral nerve injury.

Soon after the armistice sent the Medical Corps home to civilian practice, Johns Hopkins neurosurgeon Walter Dandy revolutionized the diagnosis and surgery of brain tumors. Dandy developed ventriculography and pneumoencephalography, which made it possible to localize, and therefore operate on brain tumors. Electroencephalography, developed in 1929 from Dr. Hans Berger's observations, enabled neurosurgeons to study the brain's rhythms — an important aid in diagnosing focal lesions. In 1931 Drs. Egas Moniz and Almeida Lima of Portugal presented their pioneering work on the development of cerebral angiography, enabling X-ray examination of arteries in the brain and the ability to diagnose intracranial aneurysms.

Meeting of the Society of Neurological Surgeons at the Neurological Institute, New York City, 1922. Frazier, seated in the middle, was a founding member and president of the Society of Neurological Surgeons (1921-1923). He later served as president of the American Neurological Association (1929).

The Society of Neurological Surgeons



Better diagnostic tools created opportunities for neurosurgeons to perform more radical surgical procedures. But they needed better technical methods to make those operations successful. Innovations during this time included blood transfusions, the use of clips and electrocoagulation, as well as improvements in anesthesia and suction.

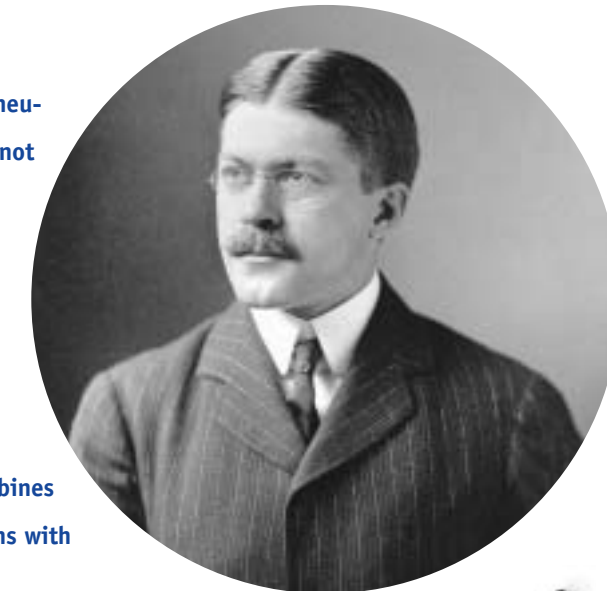
The excitement about neurosurgery led to the formation in 1920 of the Society of Neurological Surgeons, the first of several societies intended to advance the study and techniques of the emerging specialty. In 1937 the American Medical Association recognized neurosurgery as having its own system of formal postdoctoral education. But academic neurosurgery centers remained few in number. At Penn, Charles Harrison Frazier, MD and his successor Francis Clark Grant, MD ran one of the nation's best.

A Founding Father

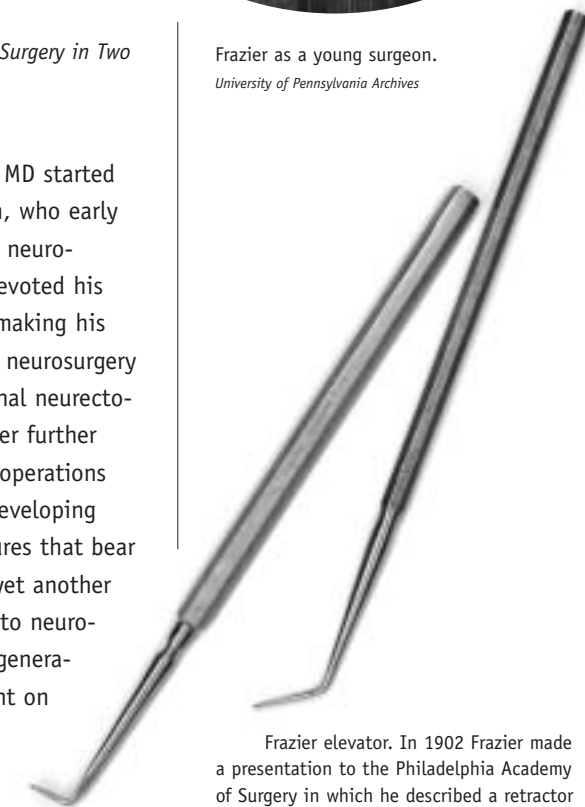
“His conception of its [neurosurgery] domain has not been that of a surgeon prepared to lend his skill to the neurologist who had indicated what may be done, but rather that of the neurosurgeon who combines neurological conceptions with surgical solutions.”

—Alfred Stengel, MD in *Surgery in Two Parts*, 1935

Charles Harrison Frazier, MD started out as a general surgeon, who early on became interested in neurosurgery. He eventually devoted his career to the specialty, making his biggest contributions to neurosurgery in pain relief by trigeminal neurectomy and cordotomy. Frazier further refined these and other operations throughout his career, developing instruments and procedures that bear his name. Frazier made yet another significant contribution to neurosurgery. He mentored a generation of trainees who went on to found neurosurgery departments throughout the country and become innovators in their own right.



Frazier as a young surgeon. *University of Pennsylvania Archives*



Frazier elevator. In 1902 Frazier made a presentation to the Philadelphia Academy of Surgery in which he described a retractor to elevate the brain. This instrument became known as the Frazier elevator.

Early Career

With a Penn medical degree (M1892) in hand, Frazier spent two years as resident physician at the University Hospital (later known as HUP) and Episcopal Hospital. In 1895 he ventured to Berlin for further education in surgery and surgical pathology under surgeon Ernst von Bergmann and pathologist Rudolf Virchow. He returned to Penn in 1896, receiving an appointment to the surgical and teaching staff. Two years later the Philadelphia Academy of Surgery welcomed Frazier into its elite membership. At the time, his two chief surgical interests were surgery of the central nervous system and goiter. Frazier, one of the first thyroid surgeons in the United States, presented many papers on thyroid and innovative surgical techniques before the



Surgical wing, 1897. Archives of the School of Nursing of the Hospital of the University of Pennsylvania



Men's Surgical Ward M, 1898. Archives of the School of Nursing of the Hospital of the University of Pennsylvania

Academy. These techniques included the transfrontal approach to the hypophysis and the suture of the recurrent laryngeal nerve.

In 1901 the University promoted Frazier to professor of clinical surgery. That year he presented six major contributions, including the one for which he is best known: division of the sensory root of the trigeminus for the relief of tic douloureux (see page 12).

Just as Frazier's prolific surgical career was burgeoning, he accepted the appointment as dean of Penn's medical school. From 1902 to 1909 he served admirably in this capacity while continuing to publish numerous neurosurgical papers. In the early 1900s American medical education was undergoing reforms to reach higher standards and Dean Frazier — who had recently seen the European model for medical education — did just that for Penn. He raised the standards for entrance requirements and encouraged scientific activities and the sharing of knowledge. To this end, he established and edited the *University of Pennsylvania Medical Magazine*, a collection of research papers authored by Penn faculty.

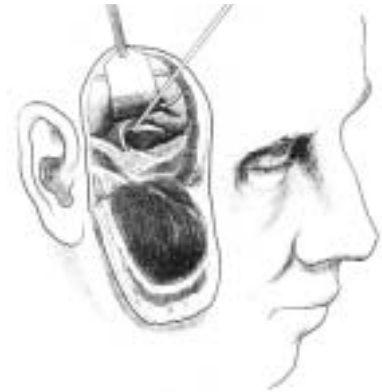


The Medical Laboratories Building (below), 36th Street and Hamilton Walk, and its surgical pathology laboratory (left), 1904. Reforms in medical education called for more extensive laboratory experience. During Frazier's tenure as dean, Penn erected the "modern" Medical Laboratories Building (now called the John Morgan Building) and within these walls started one of the nation's first surgical pathology laboratories. University of Pennsylvania Archives





Frazier and Spiller seated together roughly four decades after their 1892 graduation from the University of Pennsylvania's medical school. *University of Pennsylvania Archives*



Frazier's operation for division of the sensory root of the trigeminus. *University Medical Bulletin*, 1901. *University of Pennsylvania Archives*

Frazier the Neurosurgeon

Frazier's reputation as a pioneer in neurosurgery dates back to 1901 when the young professor of clinical surgery performed his landmark operation to relieve the pain in tic douloureux. He cut the sensory root of the trigeminal nerve behind the Gasserian ganglion, which prevented recurrence and reduced the mortality rate. Frazier became the first to devise the successful surgical solution. The idea for the procedure itself originated from renowned Penn neurologist (and medical school classmate) William G. Spiller. Over time Frazier introduced various improvements to the operation like the illuminated retractor, the upright position to decrease bleeding during the operation, and means of controlling hemorrhage.

Frazier made another important advancement in neurosurgery when he

improved upon Spiller and Martin's cordotomy for relief of pain by section of the anterolateral column of the spinal cord (see page 15). In 1914 Frazier developed a more practical operative technique which enabled cordotomy to become a routine surgical procedure. He moved the procedure to the upper thoracic spinal cord and introduced a number of technical innovations that reduced the risk of paralysis.

In addition to trigeminal neuralgia and cordotomy, Frazier authored papers on a variety of subjects relating to his interest in neurosurgery: facial palsy, cerebral palsy and athetosis, brain tumors and tabes dorsalis. In sum he published over 200 contributions to medical literature, two monographs and a textbook, *Surgery of the Spine and Spinal Cord* (1918). In 1952 medical historian and neurosurgeon Ernest Sachs remarked, "In this was assembled all the knowledge on spinal surgery that had been gathered up to that time. Little has been added to the subject of spinal tumors since then, and it stands today, thirty-five years after its publication, as the standard work." (Ernest Sachs, MD, *The History and Development of Neurological Surgery*, 1952)

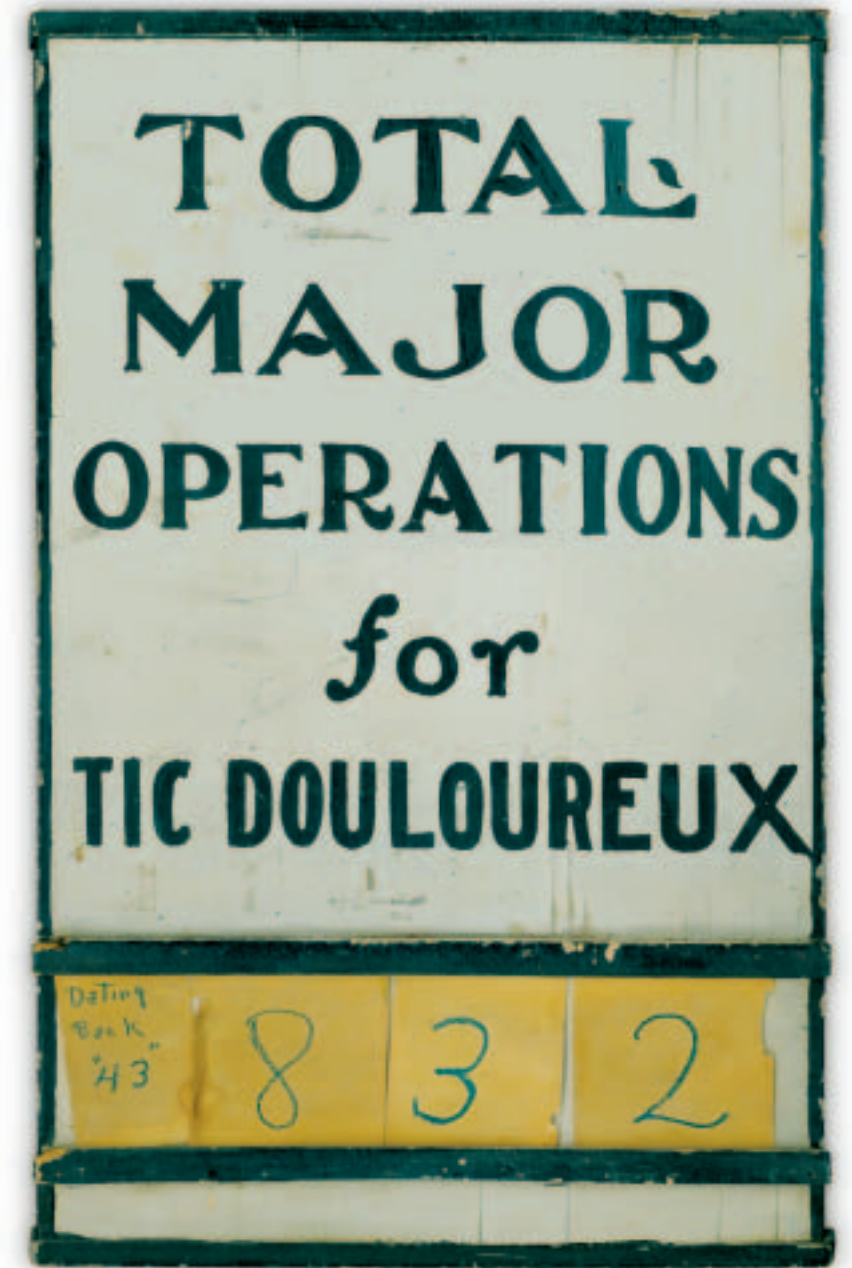
Frazier patient after section of the right 5th sensory root, showing the area of numbness where there previously was pain, 1921. *Library of the College of Physicians of Philadelphia*



Title page, *Surgery of the Spine and Spinal Cord*, 1918. *Library of the College of Physicians of Philadelphia*

"In those day [1930s] a craniotomy usually took about 6 hours. We interns didn't get any lunch but Pop had a flask of milk-shake attached to his belt and a rubber tube leading under his mask to his mouth so he got nourishment."

—Pendleton Tompkins, MD, "Memoirs of Charles H. Frazier," 1989



Frazier's "tote" board for tallying tic douloureux operations. During the course of his career, Frazier performed more than 700 operations for the relief of tic douloureux. In 1939 his successors performed the operation at Penn for the 1000th time! *Frederick W. Pitts, MD*

On the eve of World War I, Frazier stood out as a leader in neurosurgery. When America entered the war, Frazier's reputation earned him the position of consultant to the surgeon-general in charge of the neurosurgical services at base hospitals in Cape May and Staten Island. He treated hundreds of soldiers sent back from France with gunshot wounds to the head and peripheral nerve injuries, and improved the technique of laminectomy. Many prominent neurologists and neurosurgeons learned from him at these army hospitals. Frazier also represented the surgeon-general at the 1920 International Surgical Conference in Paris where he presented a paper on the results of the treatment of peripheral nerve injuries. Following this war experience, Frazier devoted his career to the development of neurosurgery.

The Educator

Frazier returned to Penn where he resumed his clinical and teaching responsibilities. In 1922 the University appointed him John Rhea Barton Professor of Surgery, a position he held until his death in 1936. Frazier also headed Neurosurgery, then a division of the Department of Surgery. Frazier established a fellowship program in neurosurgery, fostered coordination between clinical and research activities, and held weekly conferences for the neurosurgical staff.

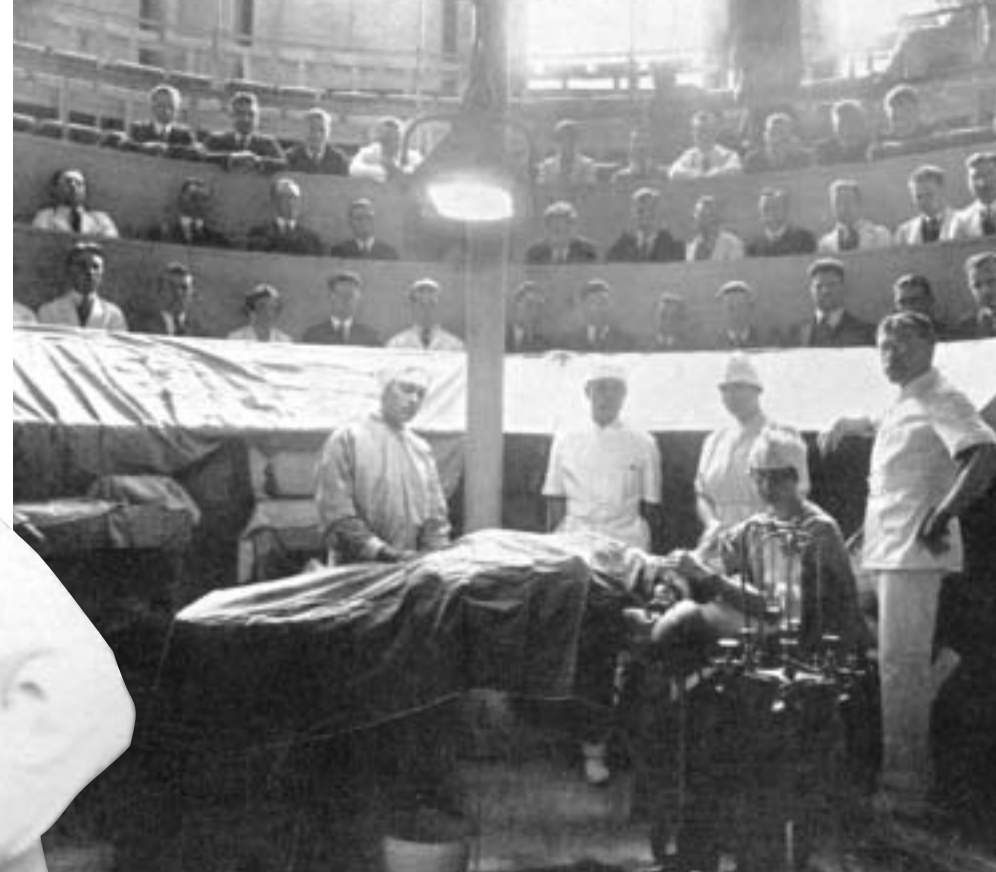
Frazier trainees somewhat feared, and most certainly revered their demanding mentor whom they affectionately called "Pop Frazier." In his "Memoirs of Charles H. Frazier," Pendleton Tompkins, MD, an intern in 1931, recalled, "Pop had insomnia and if he couldn't sleep would call up at two or three in the morning and say, 'I can't sleep. Get that man with the cerebellar tumor ready for operation in one hour.'" Tompkins and numerous other trainees not only survived their years under Frazier's ardent tutelage, but also went out into the world to develop prestigious neurosurgical training programs and practices elsewhere.

"There was an informal organization within the hospital known as the 'Frazier Club,' consisting of house officers whom Dr. Frazier had peremptorily (though temporarily) dismissed from the operating room. Nearly all of the more seasoned house officers were members."

—Drs. Jonathan E. Rhoads and Thomas W. Langfitt, 1977

(Surg Neurol 1977;7:253-4)

"Pop Frazier," the elder neurosurgeon. *Library of the College of Physicians of Philadelphia*



Frazier's Neurosurgical Clinic, 1921. *University of Pennsylvania Archives*



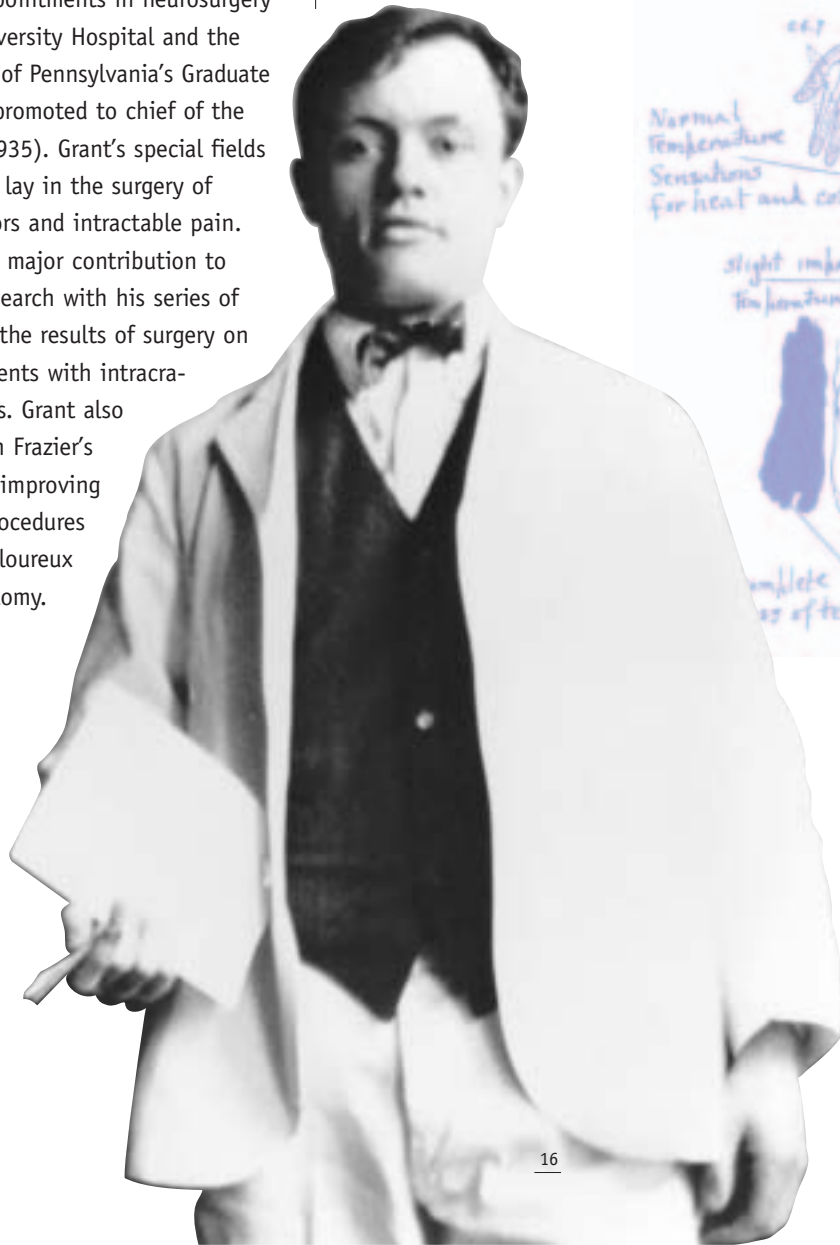
Edward B. Martin, MD, 1917. *University of Pennsylvania Archives*

The Case for Cordotomy

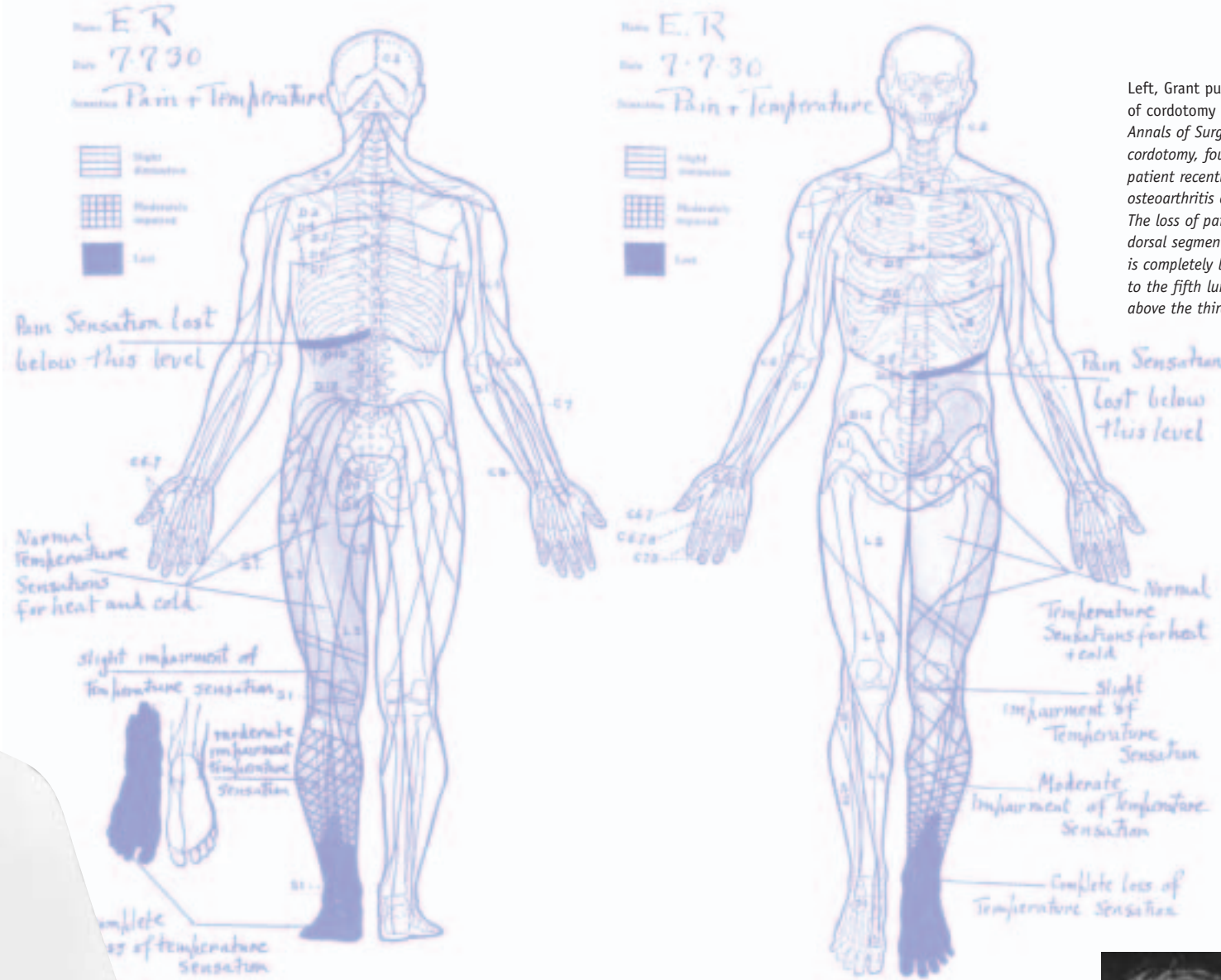
While Frazier clearly dominated the early years of Penn Neurosurgery, Edward B. Martin, MD (M1883) made a landmark contribution to the specialty. In 1911 this John Rhea Barton Professor of Surgery performed the first human cordotomy, an operation suggested by neurologist William Spiller. Spiller's idea was to relieve intractable pain in the lower part of the body by division of the anterolateral column of the spinal cord. Martin performed the operation after Frazier declined to try it. Spiller and Martin reported the successful procedure in the *Journal of the American Medical Association* in 1912. Frazier subsequently performed and improved this operation.

Frazier Trainee and Successor

After an internship at the University Hospital, Francis Clark Grant, MD (M1919) served as a general surgery resident under Frazier, whom he eventually succeeded as Penn's chairman of Neurosurgery. Grant also spent a year in Boston with Harvey Cushing, MD, then returned to Philadelphia for faculty appointments in neurosurgery at the University Hospital and the University of Pennsylvania's Graduate Hospital (promoted to chief of the latter in 1935). Grant's special fields of interest lay in the surgery of brain tumors and intractable pain. He made a major contribution to clinical research with his series of papers on the results of surgery on 2,326 patients with intracranial tumors. Grant also followed in Frazier's footsteps, improving surgical procedures for tic douloureux and cordotomy.



Francis Clark Grant, MD as an intern at the Hospital of the University of Pennsylvania, 1919. *University of Pennsylvania Archives*



Left, Grant published a study on the value of cordotomy for the relief of pain in the *Annals of Surgery* in 1930. Left unilateral cordotomy, fourth thoracic segment. Shows patient recently operated upon for painful osteoarthritis of the left sacro-iliac region. The loss of pain sensation up to the tenth dorsal segment is shown. Temperature sense is completely lost only from the first sacral to the fifth lumbar segments and is normal above the third lumbar segment.



Above, Grant (upper right) as a general surgery resident, looking on as Frazier operates on a neurosurgical patient, 1923. *Archives of the School of Nursing of the Hospital of the University of Pennsylvania*

Right, Grant's interest in the treatment of tic douloureux included anatomical studies on the injection of local anesthesia into the second and third divisions of the trigeminal nerve. Injecting the third division of the fifth nerve from 2 centimeter mark; method of measuring angle (110 degrees) in vertical plane with protractor. (*JAMA*, 18 March 1922)



Frazier Trainees



Max Peet, MD. A 1910 graduate of the University of Michigan Medical School, Peet undertook his postgraduate training in surgery at Penn. His work with Frazier inspired him to pursue a career in neurosurgery. Upon his return to Michigan, Peet introduced neurosurgical procedures to the institution and eventually headed its Division of Neurosurgery. He became known for the tic douloureux operation, which he had learned from Frazier, and for splanchnectomy for hypertension, a procedure he devised.

Library of the College of Physicians of Philadelphia



Alfred Washington Adson, MD (M1914). After medical school, this Penn graduate spent his next few years training with Frazier. In 1917 the Mayo Clinic recruited him to establish its Section of Neurosurgery, where he pioneered work on glossopharyngeal neuralgia and surgical treatment of the cervical rib. Adson served as president of the Society of Neurological Surgeons in 1932-33. *The Society of Neurological Surgeons*



Donald Munro, MD. A graduate of Harvard Medical School, Munro became Frazier's assistant in 1916. After serving in the US Army Medical Corps during World War I, he accepted an appointment at the Boston City Hospital (BCH), part of the Harvard Surgical Service. In 1929 he headed up the neurosurgical service at BCH and made important strides in reducing the mortality from subdural hematomas and extradural clots. Munro became a pioneer in understanding spinal cord injury (SCI) and one of the primary leaders in the development of specialized units dedicated to the treatment and rehabilitation of patients with SCI. *The Society of Neurological Surgeons*



Temple Fay, MD (M1921). Following medical school, Fay undertook assistantships with Spiller and Frazier, and taught at Penn. In 1923 he published the first of his important papers on the reduction of intracranial pressure by hypertonic solutions. Interested in trigeminal and glossopharyngeal neuralgia, Fay devised the first intracranial approach to the problem by sectioning the glossopharyngeal nerve within the vault, along with the upper cervical posterior roots and the trigeminal root. In 1927 he devised the first lighted retractor, which facilitated operative exposure beneath structural shelves and in deep recesses. Fay left Penn in 1929 to establish the Department of Neurosurgery at Temple University. *Urban Archives, Temple University, Philadelphia, PA*



W. James Gardner, MD (M1924) operating on a patient in the Gardner Chair. While a Frazier trainee (1926-1929), Gardner studied the effect of various substances on intracranial pressure and co-authored (with Frazier) the first report of hereditary deafness resulting from bilateral acoustic neuromas. Gardner, who also shared Frazier's interest in trigeminal neuralgia, published results on "decompression" of the sensory root in a series of 200 patients followed for six years. Gardner left Penn in 1929 to head the neurosurgery program at the Cleveland Clinic, where he remained for three decades. Following Frazier's advocacy for the sitting position for patients undergoing cranial surgery, in 1938 Gardner invented the surgical chair that bears his name. Gardner's legacy also includes his cervical traction tongs and theories on congenital hindbrain abnormalities and hydromyelia. *Cleveland Clinic Archives*



James Watts, MD. Watts received his medical degree from the University of Virginia, then did his internship at the Hospital of the University of Pennsylvania. He stayed on at Penn to undertake a fellowship in neurosurgery under Frazier's tutelage from 1933 to 1935. After this training, Watts moved on to George Washington University, where he established the Department of Neurosurgery. There, he and William Freeman, MD, a 1920 Penn medical graduate, pioneered surgery for prefrontal lobotomy. *National Library of Medicine*

