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William Stewart Halsted

Our Surgical Heritage

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There is perhaps no story in medical science over the past 100 years more fascinating than the life of Dr. William Stewart Halsted, generally regarded as the most innovative and influential surgeon the United States has produced. The number and magnitude of Dr. Halsted's contributions to surgery are staggering.[1] They range from the development of an operation to cure breast cancer to the introduction of rubber gloves in the operating room. They include some of the earliest operations on the biliary tract, the introduction of the plate and buried screw technique for the management of long bone fractures, and some of the earliest and most innovative approaches to the treatment of aneurysms of the great vessels. Halsted developed the submucosal intestinal suture, which allowed the development of the broad field of alimentary tract surgery. He made many contributions in the area of parathyroid and thyroid physiology and surgery, and his monograph on thyroid goiter became a classic. Halsted developed an operation to cure inguinal hernias, in an era in which they virtually were incurable. One of his most notable contributions was the introduction of local and regional anesthesia. He was the first in this country to promulgate the philosophy of "safe" surgery. He advocated the gentle handling of tissues, careful hemostasis, the avoidance of dead space, and a meticulous surgical technique at a time when speed, inattention to hemostasis, and rough handling of tissues were the rule.

Perhaps his most important contribution to surgery, however, was the introduction of a system to train young surgeons. Up until the opening of The Johns Hopkins Hospital in 1889, there was no formal system to train surgeons in the United States. All surgeons were self-trained or learned by way of an apprenticeship, and few spent more than 1 or 2 years in a hospital setting. Halsted introduced a system in which medical school graduates entered a university-sponsored, hospital-based surgical training program that, over a several-year period of increasing responsibility slowly led to the training of young surgeons who were well versed in anatomy, pathology, bacteriology, and physiology. The training program culminated in a final period of near-total independence and autonomous activity.[2] This system of training surgeons spread slowly to other hospitals in Baltimore and eventually throughout the entire country. It is this method for training surgeons introduced by Halsted that probably is more responsible than any other single factor for the incredible productivity that has placed the United States in the forefront of surgical science throughout the world. This contribution is in large part responsible for the magnificent surgical heritage of our country. The story of William Stewart Halsted and his many contributions remains one of the most interesting stories in modern science.

EARLY LIFE (1852–1874)

Halsted was born in 1852 in New York City, the oldest of four children born to Mary Louisa Haines and William Mills Halsted, Jr. Halsted's father was the head of a family import business entitled Halsted, Haines, and Company. The firm was successful, and Halsted was raised in privileged circumstances. The family had a magnificent home

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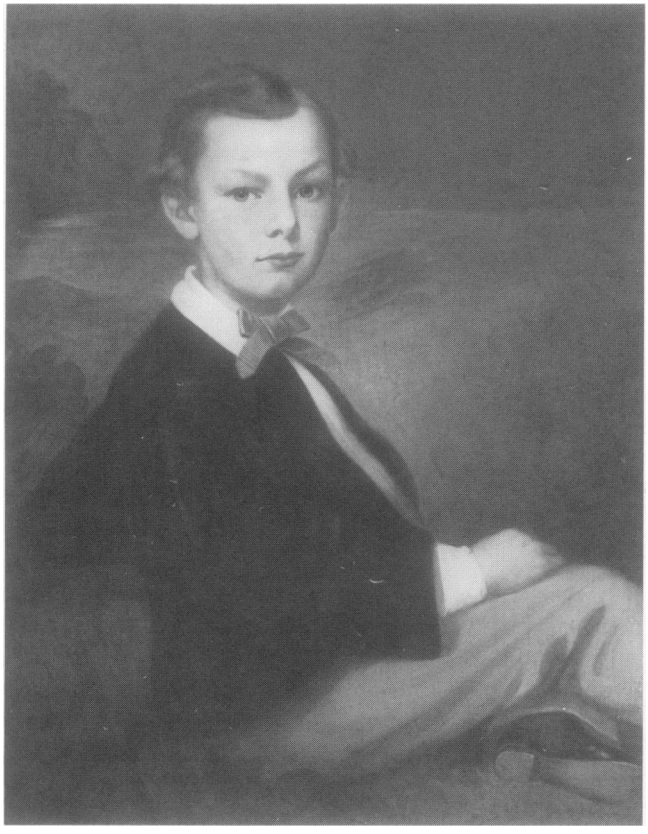

Figure 1. William Stewart Halsted as a young boy of 8 years. This is a photograph of Halsted taken from a larger oil painting of his mother, brother, and oldest sister (reproduced with permission of The Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions).

on Fifth Avenue, with a summer home in Irvington on Hudson. Halsted's father was not only a successful businessman, but was on the Board of Governors of the New York Hospital and Bloomingdale Asylum and a member of the Board of Trustees of the College of the City of New York and of the College of Physicians and Surgeons. Most of Halsted's early schooling was at home by tutors (Fig. 1) until age 10, when he was sent to a private school in Monson, Massachusetts. That year proved to be a rather unpleasant experience for Halsted, and he ran briefly away from school. The next year, he entered Andover and after 6 years, graduated in 1869 (Fig. 2). At that point, he was not thought ready for college, so he spent another year studying at home in New York City before entering Yale College in 1870.

In college, Halsted spent most of his time in athletics and social activities. He spent little time with his studies and was an average to poor student. There apparently is no record of him ever taking a book out of the Yale library during his 4 years in New Haven! He was a standout in sports, was shortstop on the baseball team, rowed for the crew, and was a rather good football player and captain of the Yale team his senior year. The first football game ever played during football's formative years with 11 men on each team was a game in which Yale played the Eton Graduates (Fig. 3). Halsted was the captain and scored the winning goal. This game marked the beginning of football as we know it today.[3] At Yale, Halsted belonged to a great number of social clubs and societies, was popular with his classmates, and forged a friendship with his roommate of his last 3 years, Samuel Clarke Bushnell, that would last throughout his life. Friendships and close associations during this part of Halsted's life apparently were common. He was outgoing, popular, and socially very active and at ease.[1]

MEDICAL EDUCATION (1874–1880)

During his last few months at Yale, Halsted read texts in anatomy and physiology, became interested in medicine, and attended lectures and clinics at the Yale Medical School. After graduation from Yale in 1874, Halsted entered the College of Physicians and Surgeons in New York City. At the College of Physicians and Surgeons, Halsted excelled. Unlike in college where he was uninterested in academic studies, he took up the study of medi-

Figure 2. Photograph taken of Halsted in 1868, 1 year before his graduation from Andover. His clothes suggest his privileged upbringing (reproduced with permission of The Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions).

Figure 3. Photograph of the Yale football team taken in 1873. Halsted, third from the left in the row standing, was captain. Halsted had to endure the misspelling of his name his entire life, including under this picture of the first football team to play the game with 11 men on each side (reproduced with permission of Yale University Archives, Manuscripts and Archives, Yale University Library).

cine with total dedication. In medical school, he became friends with an internist several years older, Dr. Thomas A. McBride, with whom Halsted was later to live. After 2 years of intensive activity and study at medical school, Halsted found himself run down, fatigued, and unable to study properly. He decided to take the summer off to recuperate on Block Island. There he studied in the mornings and the evenings, but in the afternoon, he sailed and fished. Halsted returned to New York City in the fall well tanned and rested and decided to take an examination for an internship at Bellevue Hospital, even though a new regulation made only graduates of medical school eligible. He entered a room full of young doctors pale and tired from cramming for examinations all summer in New York City. Halsted did so well that he was given an internship, despite the fact that he was still 1 year from graduating (medical school at the College of Physicians and Surgeons at that time was 3 years in length). Halsted described the event as follows: "As I have said I had little expectation of being admitted to Bellevue for I was ineligible, not having a medical degree, nor had I taken the cram quiz. I recall contrasting my physical condition with that of the other fellows who presented themselves for this examination. Most of them were pale and nervous having remained in town all summer for the cram quizzes. Some of them told me they had been bracing up on strychnine and quinine during the hot weather. I had a fine coat of tan and was in perfect health. I cannot recall being nervous for I was taking the examination as something of a lark, knowing that I could try again in the Spring."[1]

Most of Halsted's intern year at Bellevue was spent on the medical wards, although he did assist at some surgical operations, primarily those involving trauma (Fig. 4). It was about this time that Lister visited the United States and described the technique of antisepsis. Some of the Bellevue surgeons accepted the theory, but most did not. Halsted was impressed by the superior results obtained by those surgeons who practiced antisepsis. Near the end of his internship in 1877, Halsted took the examination for his medical degree and ended up among the top 10 in his class. These top 10 were invited to enter an essay competition, the winner of which was announced at Commencement. Halsted won the prize, thus placing him at the top of his class.

On graduating from medical school in 1877, Halsted was awarded the position of house physician to the New York Hospital. Halsted had an active experience in both medicine and surgery during that year and made his first contribution to medicine.[1] He devised the hospital chart, which traces temperature, pulse, and respirations, a contribution that is used today in virtually every hospital in the world. During the end of his year as house physician at New York Hospital, he met Dr. William H. Welch, at that time a pathologist at Bellevue Hospital. Welch was to become a lifelong friend, advisor, and mentor.

Having spent 1 year during medical school as an intern at Bellevue and 1 year after medical school as a house physician at New York Hospital, Halsted had acquired all of the formal training available in the United States. There were, of course, no programs in any hospital to prepare young medical graduates for careers in medicine, surgery, or any other specialty. At this point, Halsted did what many young American graduates of medical school did who could afford it: he went to Europe for a period

Figure 4. Halsted as an intern at the Bellevue Hospital. He is standing in the middle, just under the arch. Photograph was taken in 1877 (reproduced with permission of The Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions).

of observation and study. Most of the first year was spent in Vienna studying pathology with Chiari, anatomy with Zuckerkandl, embryology with Schenck, and attending the operative clinics of Billroth and Braun. Probably the most valuable experience of his first year abroad was becoming friends with Billroth's brilliant assistants, Wöelfler and Mikulicz. These friendships were to last the rest of his life. He left Vienna in the Spring of 1879 to go to Würzburg to study embryology with Kölliker and histology with Stoehr and attended the operative clinics of vonBergmann. Halsted also spent time in Halle attending the clinics of Volkmann. He spent brief periods in Hamburg, where he observed the surgeon Schede, and in Kiel, where he observed Esmarch.[1] Halsted returned to New York City early in the Fall of 1880, his opportunities for training in this country and abroad exhausted, and prepared to begin his career as a surgeon.

THE NEW YORK PERIOD (1880–1886)

It was an opportune time for Halsted to begin his career as a surgeon in New York City. The fields of bacteriology, embryology, and histology were blossoming. The studies of anatomy and pathology were well established. The importance of physiology to surgery was about to be appreciated. General anesthesia had been introduced some 3 decades earlier, but the full significance of its benefits had not been appreciated. Lister had introduced the concept of antisepsis, and the German surgeons had developed instruments to achieve hemostasis, neither of which generally were accepted or in use in America at that time. Therefore, the foundation on which modern surgery in this country was to be built—anesthesia to control pain, instruments to stop bleeding, and antisepsis to prevent infection—was there, awaiting an energetic, innovative, dedicated individual to carry surgery to a new plane. Many had the opportunity, but only Halsted seized it.

The 6 years that Halsted spent in New York City between 1880 and 1886 were the most vigorous and energetic of his career. He joined the staff of Roosevelt Hospital, where he organized and started an outpatient dispensary that met seven mornings a week. The clinic was so successful that the Trustees of Roosevelt Hospital 1 year later erected a new building specifically to house the outpatient department. In addition, Halsted joined the faculty of the College of Physicians and Surgeons as an Assistant Demonstrator of Anatomy. Halsted also had an appointment as a visiting physician at the Charity Hospital on Blackwell's Island and was appointed the Surgeon-in-Chief to the Emigrant Hospital on Ward's Island. Because he was so overcommitted, Halsted's surgery at Charity Hospital generally was performed at night. Halsted also had a major commitment as a visiting physician to Bellevue Hospital. Because of his concern that it was impossible to carry out antiseptic technique at Bellevue Hospital, Halsted convinced the Commissioners of Charities and Correction to erect an operating room for his sole use. This turned out to be a tent-like structure on the grounds of the hospital that cost $10,000 to erect. Part of the cost was supported by members of Halsted's family. This structure allowed Halsted to practice the technique of antisepsis at a time when most surgeons in the United States and Europe failed to endorse it. Halsted also was on the visiting staff of the Presbyterian Hospital. In addition to these appointments, during several summers, he had an appointment at the Chambers Street Hospital caring for trauma patients. It was at this hospital that he was the first to perform autotransfusions. Individuals in whom carbon monoxide poisoning developed from handling illuminating gas were treated by Halsted by bleeding, shaking the blood with air to free it of carbon monoxide, and then infusing it back into the patient.[1]

In addition to his hospital activities, Halsted organized a private "quiz." At that time in New York City at the College of Physicians and Surgeons, the usual courses of instruction did not prepare students adequately to pass final examinations and graduate. Therefore, medical school instruction was supplemented by quizzes that were organized by faculty members. Halsted's quiz consisted of approximately 65 students. The students were taken on ward rounds, given lectures, as well as anatomic and pathologic demonstrations by Halsted and several other faculty members that he recruited into the quiz. Dr. Welch was responsible for pathology. Apparently Halsted's quiz was the most popular of all the quizzes in New York City. His students consistently ranked the highest in the class.[1] At this point in his career, Halsted was thought by his students to be an inspiring and charismatic teacher. His work as a surgeon in New York City spread quickly. He was known as a bold, daring, and original surgeon. As his workload suggests, he was described as indefatigable with great energy.

In addition to all of his professional obligations, Halsted maintained an active social life and lived on East 25th Street between Madison and Fourth Avenue with his friend, Dr. Thomas McBride. McBride was apparently "a handsome, attractive fellow" who "made a great deal of money and spent it lavishly."[1] Several nights a week, they hosted and entertained stockbrokers, architects, and other young professionals in the city with dinners, musical productions, or discussion groups. Halsted's reputation as a surgeon grew steadily. His boldness is shown amply by the fact that in 1882, he was called to see his mother who was deathly ill. He found on examination that she was slightly jaundiced with tenderness in her right upper quadrant. At 2 o'clock in the morning, in his mother's home, he operated on her and performed a cholecystostomy, removing seven gallstones from her pus-filled gall blad-

der. Halsted stated that he thought this was one of the earliest operations for gallstones performed in this country (personal communication, August 3, 1922, William S. Halsted to William H. Welch. Box 28, Folder 32, The William Stewart Halsted Papers; Alan Mason Chesney Medical Archives of The Johns Hopkins Medical Institutions, Baltimore, MD). During the first several years back in New York, Halsted wrote several papers and attended and presented papers at the New York Surgical Society regularly.

Halsted's career changed dramatically on October 11, 1884, when he read in the *Medical Record* a report of the Ophthalmological Congress in Heidelberg.[4] Dr. Henry D. Noyes, who had attended the conference, reported that the most notable event at the Congress was a demonstration of the extraordinary anesthetic power that a 2% solution of muriate of cocaine had on the cornea and conjunctiva when it was dropped into the eye. Later in his report, he was prophetic in his summary that "it remains, however, to investigate all the characteristics of this substance, and we may yet find that there is a shadow side as well as a brilliant side in the discovery."[4] After reading this report, Halsted quickly obtained cocaine and began a series of experiments on himself, colleagues, and medical students that led to the development of local and regional anesthesia. Through a series of brilliant experiments, Halsted showed that virtually every peripheral nerve in the body could be injected with cocaine so that its peripheral distribution was anesthetized entirely and thus rendered insensitive to surgical interventions. This, of course, was of particular interest to dentists, and in 1922, shortly before his death, his priority in being the first to show the anesthetic properties possible with local infiltration of nerves was established by the National Dental Association. Unfortunately, during the process of these experiments, Halsted and several of his colleagues became addicted to cocaine. Only Halsted and Dr. Richard Hall, who moved subsequently to Santa Barbara, California, for his rehabilitation, survived. The rest died of their addiction. Halsted's only publication on local and regional anesthesia appeared in the *New York Medical Journal* in 1885.[5] This article is a rambling, incoherent paper that is a testament to the addicted debilitated state that Halsted had reached. The first sentence of that article reads as follows: "Neither indifferent as to which of how many possibilities may best explain, nor yet at a loss to comprehend, why surgeons have, and that so many, quite without discredit, could have exhibited scarcely any interest in what, as a local anesthetic, had been supposed, if not declared, by most so very sure to prove, especially to them, attractive, still I do not think that this circumstance, or some sense of obligation to rescue fragmentary reputation for surgeons rather than the belief that an opportunity existed for assisting others to an appreciable extent, induced me, several months ago, to write on the subject in hand the greater part of a somewhat comprehensible paper, which poor health disinclined me to complete."[5] In an apparent attempt to cure himself of his addiction, Halsted took a trip on a sailboat to the Windward Islands in February and March of 1886 and took only half of the amount of cocaine he would need to sustain himself on the trip. He hoped to decrease the amount of cocaine gradually and rid himself of his addiction before his return to New York. It is possible that Dr. Welch accompanied him on this trip. It has been written that his efforts were unsuccessful and that he broke into the Captain's stores to obtain cocaine or morphine to sustain him on the trip back. Finally after his professional activities had almost ceased completely, and on the urging of his father, younger brother Richard, and Dr. Welch, Halsted entered the Butler Hospital in Providence, Rhode Island, in May 1986.

REHABILITATION (1886–1889)

At the Butler Hospital, Halsted's addiction apparently was treated by switching it from cocaine to morphine. During this same difficult period, Halsted's close friend and roommate, Thomas McBride, died of chronic renal failure. In November 1886, after a 7-month hospitalization, Halsted was discharged from the Butler Hospital and accepted an invitation from Welch to move to Baltimore. Welch had been named the first Chief of Pathology at The Johns Hopkins Hospital, which was to open in 1889, and subsequently was appointed the first Dean of The Johns Hopkins University School of Medicine when it opened in 1893. Halsted arrived in Baltimore in December 1886 and lived with Welch in his rooming house. Welch was to become Halsted's closest friend and confidante after the death of Thomas McBride earlier that year.

Halsted began working in Welch's experimental laboratory and collaborated with other young scientists, most notably the anatomist Franklin Mall. It probably was Mall who gave Halsted the idea that the intestinal suture should be anchored in the submucosal layer and not the muscular layer of the intestine, as surgeons up to then had thought. In a series of brilliant experiments that took only 3 or 4 months to complete, Halsted showed that the strength of the wall of the intestine resided in the submucosal layer and that any attempt at anastomosis of intestine should be carried out with the sutures passing through the submucosal layer. His first formal presentation of this work took place at the Harvard Medical School on April 5, 1887. Apparently to demonstrate his point, Halsted would use fresh canine intestine. He would first suture it together with stitches that passed only though the muscular layer and would demonstrate that the intestines pulled apart with only a little pressure. He then would suture the intes-

Figure 5. The Johns Hopkins Hospital as it appeared in 1889, the year of its opening (reproduced with permission of The Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions).

tine together with his submucosal suture and demonstrate that the loops of intestine would stay fast together. This contribution, the Halsted submucosal intestinal suture, was necessary for the development of the broad field of gastrointestinal surgery.[6] Several months after he began his work with Welch and only 1 month after his presentation in Boston in March of 1887, Halsted was readmitted to the Butler Hospital for further therapy. He remained there for 9 months and was discharged in December 1887. Halsted returned to Baltimore in 1888, continuing his laboratory experiments, and also began seeing patients and performing operations. Many of his experimental studies during this time were devoted to the thyroid gland.

THE BALTIMORE PERIOD (1889–1922)

The Johns Hopkins Hospital opened in 1889 (Fig. 5). The elaborate plan for the hospital was devised, and its construction was supervised by Dr. John Shaw Billings, a Lieutenant Colonel in the Medical Corps of the United States Army.[7] Billings was an eminent authority on hygiene and sanitation and was considered one of the foremost experts on hospital construction and management. Billings also planned and oversaw construction of the New York Public Library, was founder of the Surgeon General's Library, and served as its librarian and is given credit for devising the *Index Catalog* that evolved subsequently into the *Index Medicus*. Billings had strong feelings on medical education and, along with Dr. William H. Welch, played a major role in selecting the initial faculty and staff of The Johns Hopkins Hospital. The Johns Hopkins University itself had opened 13 years earlier in 1876, and its first President was Dr. Daniel Coit Gilman (Fig. 6).[7] Dr. Gilman, after an outstanding career as an educator and administrator at Yale University, had been named President of the University of California in 1872. The Board of Trustees of The Johns Hopkins University convinced Gilman to take on the presidency of The Johns Hopkins University. He was given full authority to develop the university according to his philosophy. Gilman modeled The Johns Hopkins University after the great graduate universities of Europe.

When The Johns Hopkins University opened in 1876, it was the first American University that had its emphasis primarily on graduate education and research. Dr. John Shaw Billings concurred with this philosophy. When 13 years later in 1889 The Johns Hopkins Hospital opened, and then 4 years later in 1893 The Johns Hopkins University School of Medicine opened, they both evolved in an atmosphere that promulgated graduate education and research. The appointment of Dr. William H. Welch as

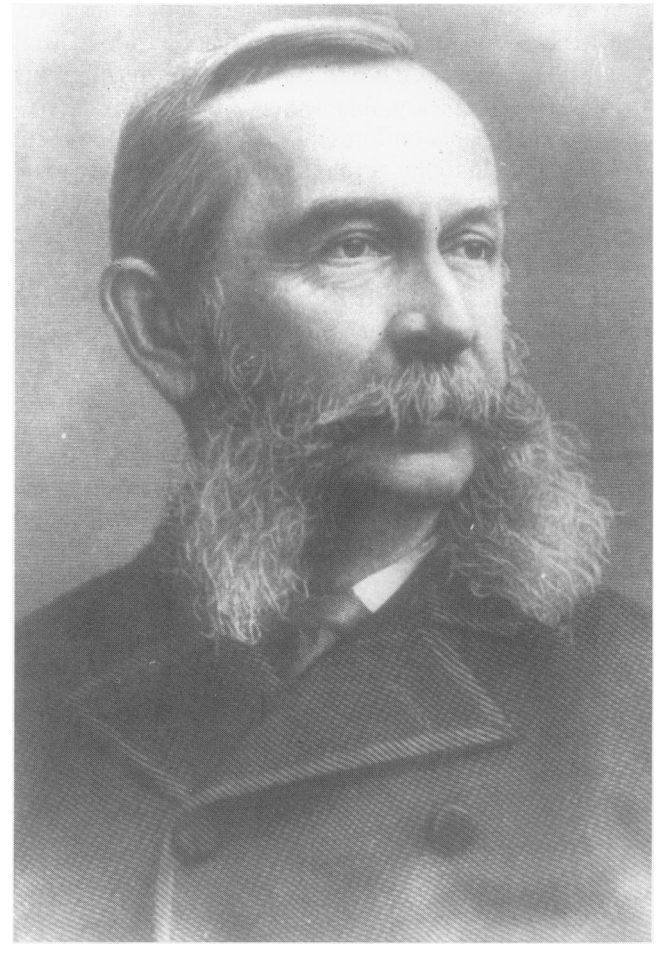

Figure 6. Photograph of Daniel Coit Gilman, first President of The Johns Hopkins University. Gilman patterned The Johns Hopkins University after the great graduate universities of Europe and made Hopkins the first research-oriented institution in this country (reproduced with permission of The Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions).

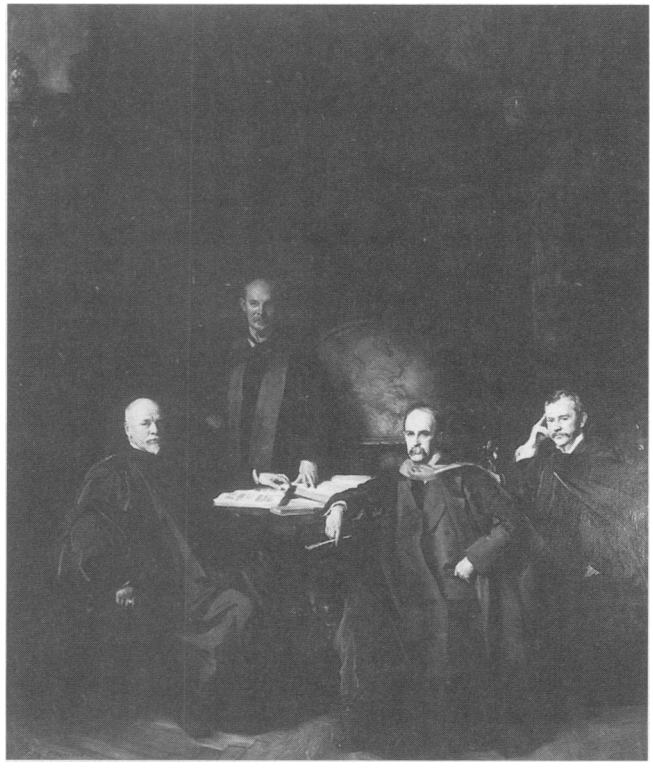

Figure 7. Photograph of the magnificent oil portrait by John Singer Sargent of the original four great doctors of The Johns Hopkins Hospital. William Welch, William Osler, and Howard Kelly are seated in front, with William Halsted standing in the rear. It is said that Sargent did not like Halsted's cynical wit and painted his face with colors that would fade (reproduced with permission of The Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions).

Chief of Pathology was made in 1884. In 1889, Dr. William Osler was chosen by Welch and Billings to be the first Chief of Medicine. It was Osler who convinced Welch that Howard Kelly would be appropriate as the first Chief of Gynecology. The first choice for Chief of Surgery was Sir William Macewen,[7] who was Professor of Surgery at Glasgow. He made impossible demands on the Board of Trustees, and later Dr. Welch and Dr. Billings recommended Halsted (Fig. 7). When The Johns Hopkins Hospital first opened, Dr. Halsted was appointed Associate Professor of Surgery, Surgeon-in-Chief to the Dispensary, and Acting Surgeon to the Hospital (Fig. 8). Apparently these lesser appointments were made because the Trustees still were concerned that his addiction was not cured. Halsted's brilliant contributions to the management of inguinal hernia and breast cancer that followed were such that his addiction to drugs certainly was thought to have been overcome. Osler wrote a letter to President Gilman in support of Halsted's appointment stating, "Halsted is doing remarkable work in surgery, and I feel his appointment to the University and Hospital would be quite safe."[8] In 1890, he was appointed Surgeon-in-Chief to the Hospital, and in 1892, he was appointed Professor of Surgery.

For the next 30 years until he died in 1922, he remained Chief of Surgery at The Johns Hopkins Hospital and Professor and Chairman of the Department of Surgery in The Johns Hopkins University. The monumental productivity of Halsted during this period likely never again will be duplicated in American surgery. In addition to his pioneering work in developing an operation to cure inguinal hernia and an operation to prevent the local recurrence of and cure breast cancer, he performed the first choledochotomies in the country (personal communication, August 3, 1922, William S. Halsted to William H. Welch, Box 28, Folder 32, The William Stewart Halsted Papers; Alan Mason Chesney Medical Archives of The Johns Hopkins Medical Institutions, Baltimore, MD), was the first surgeon in the world to resect successfully a periampullary cancer in 1898,[9] and, along with Opie, made significant contributions to understanding the pathogenesis of gallstone pancreatitis in 1901.[10] His contributions in

Figure 8. Photograph of Halsted taken in Baltimore in 1889, the year The Johns Hopkins Hospital opened (reproduced with permission of The Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions).

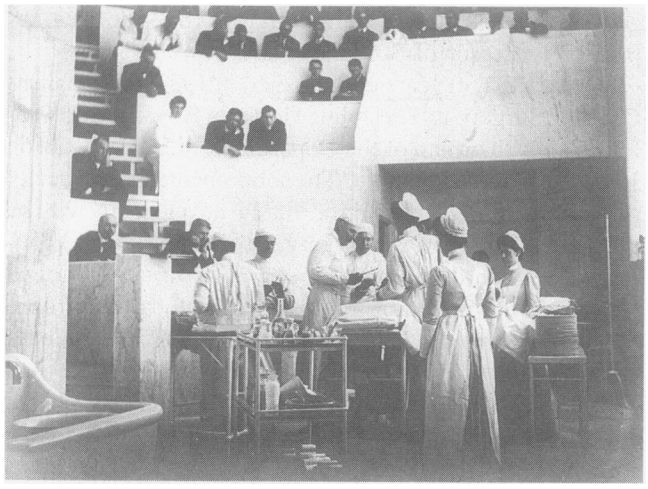

Figure 9. Halsted operating in his amphitheater, probably in 1904. It is doubtful that visitors could see much, and Halsted was not very expressive. One can see rubber gloves in use, but no one was wearing a surgical mask, and the visitors are in street clothes (reproduced with permission of The Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions).

the fields of biliary tract surgery, periampullary cancer, and pancreatitis, along with his introduction of the first safe intestinal suture, support easily his candidacy for the father of alimentary tract surgery in this country (Fig. 9). Similarly, his feats in vascular surgery, being the first to ligate and excise a subclavian aneurysm, his pioneering attempts to manage abdominal aortic aneurysms by proximal banding, and his interest and work in arteriovenous fistulas clearly establish him as one of the early pioneers in vascular surgery.[6] In addition, although rarely given credit, he was the first surgeon to use the plate and screw technique, with buried screws, in the management of long bone fractures.[8] He made many important contributions, along with Professor Albert Kocher of Bern, Switzerland, in the management of thyroid goiter. He also conducted experiments in dogs in which successful parathyroid autografts were performed.

One of Dr. Halsted's most important and lasting contributions was that of promulgating the philosophy of "safe" surgery. With general anesthesia, surgeons for the first time could operate carefully and meticulously, maintain careful hemostasis, handle tissues carefully and gently, and reapproximate tissue planes as they had been before surgery, all to promulgate the healing and health of the patient. The introduction of rubber gloves, initially to protect the hands of his scrub nurse, Ms. Caroline Hampton, who later became his wife, was a substantial aid in preventing surgical infection.[1] Halsted also was the first surgeon in the United States to favor the use of fine silk as a suture material, in contradistinction to the heavy catgut that was in general use. For many years, his department at The Johns Hopkins Hospital was the only major clinic in the United States to support its use. These tenets all seem eminently obvious and intuitive today. In 1889, when Halsted's career at The Johns Hopkins Hospital began, they were not. They were the antithesis of current practice. Even though general anesthesia had been introduced over 4 decades earlier, most surgeons still operated rapidly and with little concern for hemostasis, as if the patient were awake and screaming, being held down by assistants. By the time of his death in 1922, the surgical community in the United States had accepted his philosophy of safe surgery, and surgery in the United States had advanced more rapidly under his lead than it was ever to advance again. In his quiet understated fashion, Dr. Halsted, by example, was responsible for changing the direction and philosophy of surgery in this country (Fig. 10).

Surgical Residency Training

Among all of Halsted's marvelous contributions, I would rate his most important the introduction of a system to train young surgeons. In the latter part of the 19th century and the early part of this century, many chairs in surgery went unfilled. There were few qualified individuals, and those qualified often were more interested in private practice than being encumbered with an administrative and teaching post. Because there were no formal training programs in surgery, most surgeons were self taught. Among many busy practitioners in a large city, there was a good deal of competition, and some were totally uninterested in teaching surgery to others. One of the first accomplishments of Halsted at The Johns Hopkins Hospital was to devise a training program for surgeons based primarily on what he had observed in Europe. This eventually evolved into the surgical residency training programs as we know them today.

Halsted published only one paper on the topic of surgi-

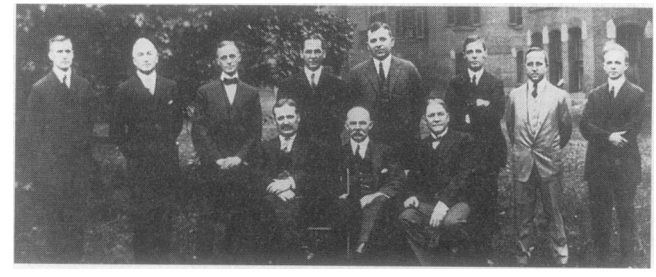

Figure 10. Photograph taken in 1914 at the 25th anniversary of the opening of The Johns Hopkins Hospital. These were some of the men from "Halsted's school," that spread the concepts of "safe surgery" and residency training through the country. Seated—Finney, Halsted, and Bloodgood. Standing—McClure, Young, Cushing, Mitchell, Follis, Miller, Churchman, and Heuer (reproduced with permission of The Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions).

cal training from an address delivered at Yale University in 1904.[2] The Yale Class of 1874 was holding its 30th reunion, and Dr. Halsted was asked to give a medical address. In this address, he described the training program developed during his first 15 years at Hopkins. The average term of service for the intern who succeeded to the chief residency position in the hospital was 8 years, 6 years as assistant and 2 years of service as the house surgeon. Halsted described the purpose of his residency program as follows: "We need a system, and we shall surely have it, which will produce not only surgeons, but surgeons of the highest type, men who will stimulate the first youths of our country to study surgery and to devote their energy and their lives to raising the standard of surgical science."[2] Thus, Halsted was not only interested in devising a system to train surgeons, but he wished to develop teachers and role models, academicians. He went on further to state that his residents ". . .are expected in addition to their ward and operating room duties, to prosecute original investigations and to keep in close touch with the work in surgical pathology, bacteriology and, as far as possible, physiology."[2] This describes the "clinician–scientist," and Halsted certainly was the first surgeon in this country to promote that concept. Halsted himself had been self trained, as all surgeons were in the United States up until his era. He spent 1 year as an intern at Bellevue, 1 year as a house physician at New York Hospital, and then 2 years abroad as an observer. The rest of his art and science was self taught. Only through the development of a Residency Training Program as devised by Halsted could the marvelous advances being made in surgery be passed on efficiently and effectively to others. This process, in turn, would produce more young surgeons interested in "raising the standards of surgical science." Up until 1889, with no organized training programs, apprenticeships served the purpose of training. This was inefficient and ineffective in producing a cadre of surgeons who were tutored in the most advanced surgical care available. No matter how great the magnitude of advances by Halsted and his peers during the evolution of the modern era of surgery in this country, without a mechanism for passing them on to others and a mechanism for educating young clinicians–scientists, such as is provided by the Halsted surgical residency training system, their continuation could not be assured, nor their promulgation and extension promoted.

Halsted was influenced greatly by European surgery. During his first 2 years abroad from 1878 to 1880, he was impressed by the Germans, Austrians, and Swiss. Their affiliation with large university hospitals, their academic and scholarly approach to clinical problems, and their interest in training young surgeons all had a significant impact on Halsted's thinking and philosophy. Throughout his career, Halsted spent time most summers visiting his friends abroad. It would appear as if he had more close friends in Europe than he had in the United States. In a letter to a colleague in 1915, he listed Kocher, von Eiselsberg, Korte, Bier, Küttner, and Payr as friends whom he "knew quite intimately" and Schede, von Mikulicz, and Wölfer as "particular friends" (personal communication, January 18, 1915, William S. Halsted to H. G. Beyer, Box 2, Folder 18, The William Stewart Halsted Papers, Alan Mason Chesney Medical Archives of The Johns Hopkins Medical Institutions, Baltimore, MD). In the United States, there were few surgeons outside of Rudolph Matas of New Orleans whom Halsted considered as a close friend. The Germanic system of training young surgeons consisted of assistants spending many years in a university surgical clinic and eventually achieving the position of first assistant to the professor. They stayed in this position often for years, until a chair was offered to them in a lesser university or until they dropped out into private practice. One of the great contributions that Halsted made above and beyond the German system was to make the student, or chief resident, and not the teacher, or professor, the focus of attention. In the early days of The Johns Hopkins Hospital, only Halsted's chief resident and Halsted himself had operating privileges. The chief resident was responsible for all of the patients and performed the majority of operations. Halsted chose only a few particular patients on whom he wished to operate. Halsted insisted on great knowledge of bacteriology and pathology and stimulated an interest in physiology. He also required original research as an important part of the surgical training. But unlike the German system in which the professor was the center of attention around which all activities revolved, the residency system that Halsted developed and promulgated in the United States focused on the resident. Although many years of long days were required to complete such a training program, it was a kinder system, in which the focus was on the student rather than on the teacher.

Halsted's residency training concept spread first to other hospitals in Baltimore and then slowly throughout the United States. Prominent surgeons and surgical leaders such as Harvey Cushing, Stephen Watts, J. M. T. Finney, George Heuer, Mont Reid, Emil Goetsche, Willis Gatch, Roy McClure, Emil Holman, Joseph Bloodgood, Adrian Taylor, Walter Dandy, Samuel Crowe, Hugh Hampton Young, and many others were produced or influenced by Halsted's method of training. Dr. Halsted had 17 chief residents during his years at Hopkins, and 7 became Professors of Surgery at Harvard, Yale, Stanford, Cornell, Virginia, Pittsburgh, and Cincinnati.[11] One became Chief of Surgery at the Henry Ford Hospital. Most of the remaining had academic appointments at universities. Only four went into private practice. In addition, Dr. Halsted had 55 assistant residents who spent 1 or more

years with him but who did not become his chief resident. Twenty went on to become professors, 5 became associate professors, and 8 became assistant professors. Fourteen went into private practice. Eleven of Halsted's 17 chief residents set up residency training programs. These men took the concept of a surgical residency training program and disseminated it throughout the country. This produced a system that guaranteed the knowledge that was accumulating rapidly during the development of the modern era of surgery, and could be preserved and taught to each succeeding generation of surgeons. It also produced a group of outstanding trainees interested in continuing to advance the field of surgical science. Virtually all surgeons in the United States can trace their roots back to William Stewart Halsted and The Johns Hopkins Hospital.[11] Had not such a system for training young surgeons evolved at the same time that the modern era of surgery was dawning, the promulgation and extension of such information would have been hampered severely. It is thus that one of Halsted's first acts on the opening of The Johns Hopkins Hospital in 1889, the creation of a system for training surgeons, turned out to be his greatest contribution to our surgical heritage.

Private Life

During Dr. Halsted's years in Baltimore, outside of the hospital, he led a quiet and private life. His closest friend in Baltimore was Dr. William H. Welch, and before Dr. Halsted's marriage, they dined together frequently, often at the Maryland Club. A small group of prominent lawyers and businessmen from Baltimore occasionally were asked to join them. He had many professional colleagues in Baltimore, but few close friends. Even Dr. William G. MacCallum, his long-time friend and biographer, stated that he had only been in Halsted's home on one or two occasions and had only met Mrs. Halsted once. Dr. Halsted was single when he first arrived in Baltimore, but married Miss Caroline Hampton, his scrub nurse, in 1890 (Fig. 11). Miss Hampton was born into a prominent family in South Carolina that lost most of its wealth during the Civil War. Against her family wishes, she decided to become a nurse, moved to New York City, and graduated from The New York Hospital in 1888. She came to Baltimore in 1889 to be in charge of surgical nursing at The Johns Hopkins Hospital and ended up as Dr. Halsted's scrub nurse. In 1890, they married in South Carolina, with Dr. Welch serving as the best man. The Halsteds spent their honeymoon at the Hampton family hunting lodge and estate at Cashiers, North Carolina. The estate subsequently was purchased by the Halsteds and named High Hampton (Fig. 12). Mrs. Halsted was to spend 4 or 5 months each year at High Hampton, managing the property, overseeing the farming of the land, and taking care of the garden. She was an excellent horse person and apparently was a graceful rider (Fig. 13). She also was fond of dogs. Dr. Halsted would leave Baltimore in May, often spend 2 or 3 months in Europe, and then join Mrs. Halsted at High Hampton (Fig. 14). The Halsteds had no children, but had a warm relationship that is recorded in many of Mrs. Halsted's letters to him. Dr. Halsted had two hobbies, growing dahlias and astronomy. In

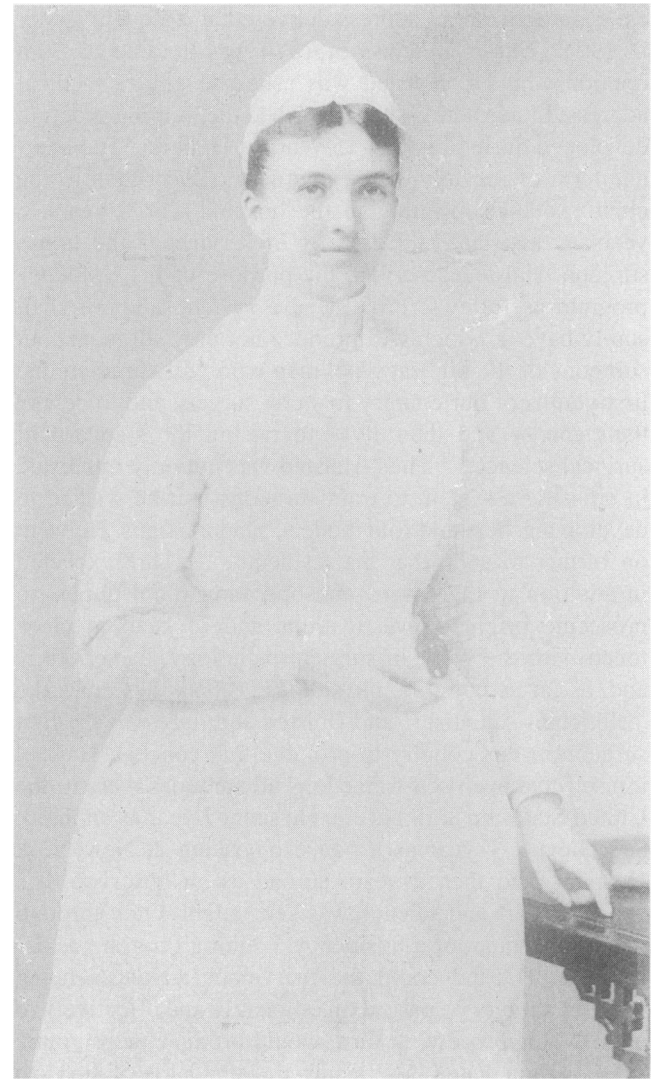

Figure 11. Photograph of Miss Caroline Hampton, probably taken in 1889 when she was appointed in charge of nursing in the surgical division of the newly opened Johns Hopkins Hospital. Miss Hampton was the niece of General Wade Hampton, the Civil War hero who later became a senator from South Carolina. She became Dr. Halsted's scrub nurse and when a dermatitis developed from the carbolic solution used to sterilize instruments, Halsted had two pairs of rubber gloves made by the Goodyear Company to protect her skin. This eventually led to the entire surgical team wearing gloves and the introduction throughout the world of the use of sterilized rubber gloves for all surgical procedures (reproduced with permission of The Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions).

Figure 12. The Halsteds owned 2000 acres of land in the mountains of western North Carolina. Mrs. Halsted spent several months there each summer, with Dr. Halsted joining her after his annual trip to Europe. Dr. Halsted pursued his two hobbies here: dahlia growing and astronomy (reproduced with permission of The Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions).

High Hampton, he had one of the great collections of dahlias in the country and corresponded frequently with other growers throughout the United States and the world. In addition, he was interested in astronomy, had a telescope in High Hampton, and spent clear summer evenings in this activity.

In Baltimore, the Halsteds lived in Bolton Hill at 1201 Eutaw Place in an elegant townhouse. They entertained with dinner parties early in their marriage, with Dr. Halsted playing an active role in the elaborate preparations. He often picked out the wood for the fire, personally oversaw the purchasing of food for the dinner, including the selection of the coffee beans, and insisted on having the tablecloth ironed after it was placed on the table, so

Figure 13. Mrs. Halsted was an excellent horsewoman from her southern upbringing and loved dogs. The date of this photograph is unknown (reproduced with permission of The Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions).

Figure 14. Dr. Halsted with his dogs at High Hampton. This shows Dr. Halsted, who did not like to be photographed, in a rare relaxed and casual pose (reproduced with permission of The Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions).

that there would be no creases. Dr. Halsted was interested in antique furniture and rugs, and his and his wife's home was furnished elegantly. Some of their furniture now is on permanent display at the Baltimore Museum of Art as outstanding examples of period antique furniture. Later in their marriage, the Halsted's entertaining at their home on Eutaw Place became less frequent. Mrs. Halsted apparently had attacks of migraine, which made entertaining difficult.

Dr. Halsted's closest friend and colleague outside of Baltimore was Dr. Rudolph Matas of New Orleans. A warm and extensive correspondence between the two survives. Matas, at one time, apparently had a testicular tumor develop and was operated on by Dr. Halsted in 1903 in Halsted's home on Eutaw Place.[12] The operation obviously was successful because Dr. Matas lived until 1957, when he died at the age of 97 years. Dr. Halsted had many friendships with surgical colleagues in Europe, with that of Dr. Theodor Kocher of Bern, Switzerland, being the closest (Fig. 15).

Halsted was an exquisite dresser and often wore a silk

Figure 15. Photograph of Dr. Halsted operating with Dr. Theodor Kocher in Bern, Switzerland. Kocher is sitting and is on the right side of the patient. Halsted is standing on the patient's left side, and only the top of his head can be seen. This operation can be dated by a passage in MacCallum's biography stating that Halsted visited Kocher in 1911, accompanied by Fisher, Follis, and Sowers, all of whom can be identified in the audience. Apparently during this operation, Halsted was applying one of his metal bands proximal to an abdominal aortic aneurysm. Some weeks later, Kocher's son Albert, the tallest man standing to Halsted's right, wrote Halsted that the band had eroded subsequently into the aorta, and the patient bled to death (reproduced with permission of The Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions).

top hat or a derby. His suits were tailored in London, and his shoes were made in Paris. His shirts also were made in Paris, and for many years, he had them sent back to Paris for laundering, stating that he was unable to find a suitable laundry in Baltimore. He was a heavy smoker of cigarettes. He did not like to be photographed, and little is known of the intimate details of his life in Baltimore, because he remained private except to a privileged few.

Recognition

The obituary of Halsted that appeared in the *Baltimore Sun* on September 8, 1922, accurately described his career. "Because Dr. William S. Halsted lived, the world is a better, a safer, a happier place in which to be. In his death not only Baltimore, but civilization as a whole, has sustained a heavy loss. He was one of the few men who really count. Quiet, simple, unostentatious except in the medical world, where he towered, a great and dominating figure, the full scope of his genius and the tremendous extent and value of his services to mankind were neither generally known nor generally appreciated."

Dr. Halsted received relatively little professional recognition during his career, compared to the magnitude of his contributions.[1] He was elected Vice President of the American Surgical Association in 1913, and President of the Maryland Medical and Chirurgical faculty in 1918, the only two offices, to my knowledge, that he held in American surgery. It has been customary in the United States to honor those who have contributed greatly to surgery by electing them to office in a variety of surgical associations and societies. It is remarkable that this did not happen to Dr. Halsted. He was given honorary degrees by his alma mater, Yale, and by Columbia. In 1917, he was inducted into the National Academy of Sciences, perhaps his highest honor. He was given a gold medal by the National Dental Association in 1922 to commemorate his introduction of local anesthesia. At one point, apparently, he was under strong consideration to receive the Bigelow Medal in Boston. Harvey Cushing wrote him of the strong likelihood, and Halsted was delighted and excited concerning the possibility and even started thinking of the talk he would deliver for his acceptance. In a letter to Cushing, he wrote, "You can fancy what pleasure your letter bearing the glad tidings gave me. I greatly appreciate the honor and shall of course do my best to prepare an address"(personal communication, May 22, 1922, William S. Halsted to Harvey Cushing, Box 4, Folder 6, The William Stewart Halsted Papers, Alan Mason Chesney Medical Archives of The Johns Hopkins Medical Institutions, Baltimore, MD). Unfortunately, Dr. Cushing then went abroad, and when he returned, the committee had decided against Halsted as the recipient, and Cushing had the unpleasant task of writing Halsted concerning the decision. He probably was esteemed more highly, and his work known more widely in Europe than in the United States. In 1914, he was made an honorary member of the German Surgical Association, the first American so honored. He was made an honorary fellow of the Royal College of Surgeons of England and of Edinburgh. Apparently because of his reticent and reclusive personality during his most productive days in Baltimore, many of the accolades and honors that one of his stature would have been expected to receive were not offered to Halsted.

Halsted's achievements in Baltimore were carried out with a totally different demeanor and behavior than his activities during his 6 years as a surgeon in New York City. When reading descriptions of Halsted during his time in New York, statements such as "model of muscular strength and vigor," "full of enthusiasm and the joy of life," "brilliant, bold and daring surgeon," and "an inspiring teacher" are read.[1] He was active socially and was perceived as being charismatic and a leader. A friend described him as "having a gay and cheerful disposition, kind heart and agreeable and cultivated manners. . ."[1] His radically changed demeanor in Baltimore probably is best described by Harvey Cushing[13] in a tribute that appeared after Halsted's death in *SCIENCE* in 1922. "A man of unique personality, shy, something of a recluse, fastidious in his tastes and in his friendships, an aristocrat

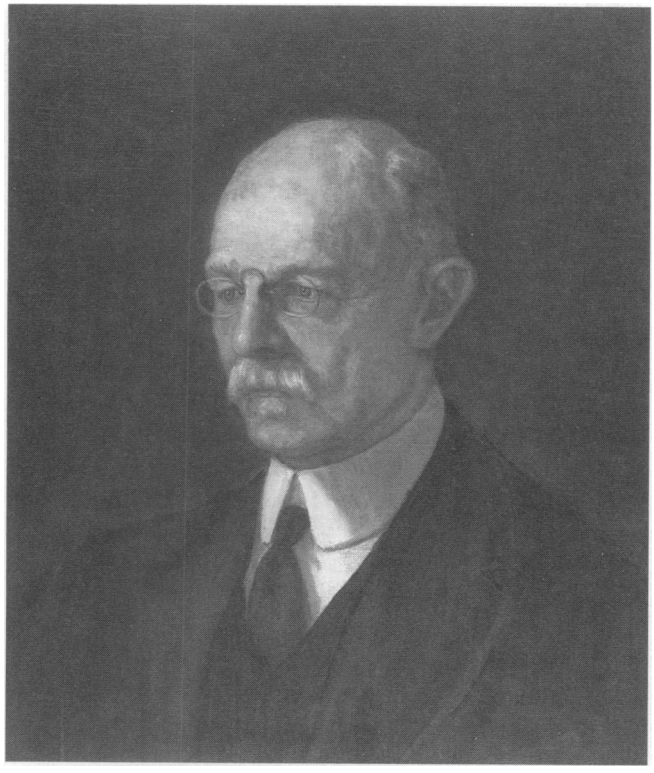

Figure 16. Photograph of an oil painting of Halsted that belongs to the Johns Hopkins Hospital and hangs in the office of the Chief of Surgery. The artist is unknown. It probably was painted from one of Halsted's last photographs taken by John Stocksdale, just before Halsted's death.

in his breeding, scholarly in his habits, the victim for many years of indifferent health. . . Overmodest about his work, indifferent to matters of priority, caring little for the gregarious gatherings of medical men, unassuming, having little interest in private practice, he spent his medical life avoiding patients—even students, when this was possible—and, when health permitted, working in clinic and laboratory at the solution of a succession of problems which aroused his interest."

Halsted's personality and demeanor clearly were markedly different during his Baltimore days compared to his New York period and before. Even though it was assumed that his addiction to cocaine had been cured during his two hospitalizations in Rhode Island, evidence supplied by private notes in a diary kept by Sir William Osler, the first Chief of Medicine at The Johns Hopkins Hospital and Halsted's physician, clearly document that he remained addicted to drugs. Osler wrote, "About six months after the full position had been given I saw him in a severe chill, and this was the first intimation I had that he was still taking morphia. Subsequently I had many talks about it and gained his full confidence. He had never been able to reduce the amount to less than 3 grains daily, on this he could do his work comfortably and maintain his excellent physical vigor. . . I do not think anyone suspected him—not even Welch."[14] This entry in his diary was probably made within 1 year of having written President Gilman that Halsted's addiction was cured and his appointment "safe." It appears that Halsted continued to take substantial amounts of morphine at least through 1898. A later entry in the diary that is difficult to date states, "Subsequently he got the amount down to 1 ½ grains, and of late years (1912) has possibly got on without it."[14] Because of the shame and disgrace that Halsted must have felt because of his inability to rid himself of his addiction, he perhaps reacted by developing a more reclusive retiring existence, having few close friends and acquaintances, so that his secret might be protected. His excessive compulsiveness, his dedication to study and experimentation, which he could carry out by himself, his total devotion and emergence into the study of surgical problems, and his avoidance of time-consuming social activities all probably resulted from his reaction to his addiction (personal communication, 1996, Dr. Paul R. McHugh, Psychiatrist-in-Chief, The Johns Hopkins Hospital, Baltimore, MD). In Osler's own words, "The proneness to seclusion, the slight peculiarities, amounting to eccentricities at times, (which to old friends in New York seemed more strange than to us) were the only outward traces of the daily battle through which the brave fellow lived for years."[14]

It is interesting to speculate on what course Halsted's career might have taken had he not become addicted to cocaine. He undoubtedly would have remained in New York City, his home, where he was considered the brightest and most innovative of surgeons. Socially, he was prominent and enjoyed an active and rewarding life. He later described those years in New York as the happiest of his life.[8] There would have been little reason to leave. Addiction to cocaine, however, changed that. Presumably physically shattered and humiliated by this addiction he was unable to control, he left his birthplace and home, New York City, to move to Baltimore for his rehabilitation. Leading a quiet and scholarly life working in a research laboratory allowed him to rebuild his life and image in such a way that he could be productive but, at the same time, develop a lifestyle and demeanor that would allow him to hide his secret from all but two or three of his closest colleagues and friends. Gradually, as he became more confident and secure in his new role, he resumed his clinical activities, but at a much reduced pace. His new lifestyle was private and reserved. This allowed him more time for his creative and innovative energies, resulting in a productivity almost certainly greater than had he remained in New York City, with his more clinically oriented, gregarious social behavior. It, therefore, could be argued that Halsted's immense academic and scholarly productivity was not despite his addiction, but

in part because of it. Had he not developed his disability, it is unlikely he would have followed Welch to Baltimore and Hopkins. The chance to work with brilliant colleagues in a new hospital associated with the first research and graduate university in this country, with all the opportunity for innovative and scholarly academic contributions, would have been lost. An unusual set of circumstances led Halsted to Baltimore and The Johns Hopkins Hospital, and the result was an amazing productivity that led to the creation of our surgical heritage (Fig. 16).

When Halsted died, he was buried in Greenwood Cemetery in Brooklyn, New York. There had been a small, private funeral ceremony presided over by his old friend and roommate, the Reverend Samuel C. Bushnell. The interment of the ashes at Greenwood Cemetery was attended only by his brother and two sisters, their families, and by Welch. Mrs. Halsted, ill and grieving, did not attend. A quiet, private ending to the most productive and influential surgical career witnessed in this country. It is perhaps as Halsted would have wished.

Acknowledgments

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