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"A Thrill of Extreme Magnety": Robert E. Gross and the Beginnings of Cardiac Surgery

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Glossary of Abbreviations

PDA: Patent ductus arteriosus

Abstract:

In 1938 a landmark surgical procedure was performed at Boston Children's Hospital. Lorraine Sweeney, a seven-year-old girl, underwent a ligation of a patent ductus arteriosus (PDA), the first successful surgery of its kind ever performed.[1,2] The procedure transformed her health and was a crucial step in opening up the fields of vascular and cardiac surgery. The procedure was performed by Dr. Robert Gross, a pupil of Dr. William Ladd, both among the most notable contributors to the development of pediatric surgery. In addition to playing a critical role in the progression of surgical innovation, this procedure took place in the fascinating context of the Boston medical community and its rich history of medical development, and among those involved were physicians whose legacies have a special place in the history of the field. This study reviewed the available primary and secondary sources to compile a narrative account of this landmark procedure and its place in the history of medical innovation.

Introduction:

In 1938 Lorraine Sweeney, a seven-year-old girl, underwent a ligation of a patent ductus arteriosus (PDA), essentially the first successful surgery of its kind ever performed. The procedure transformed her health and was revolutionary in the domain of surgical procedure that it entailed. The procedure was performed by Dr. Robert Gross at Boston Children's Hospital, who went on to be a leader in the field of pediatric surgery and was responsible for many of its important early developments. The procedure was done in defiance of the instructions of his mentor, Dr. William Ladd, another impressive figure in the development of pediatric surgery. How the procedure came to be done, despite the risks and its lack of official sanction, is an important tale of the American academic medical centers of the time and the fascinating personalities involved.

Furthermore the history of surgical innovation has had a distinct trajectory within the history of medicine, owing to the necessity of different methods for research and the introduction of new therapies than is possible in a field where treatment strategies are typically pharmaceutical.[3] Surgical history, particularly prior to the second half of the 20th century, has often been pushed forward by a handful of determined innovators who took the risk, wisely or not, of attempting an entirely new surgery for the first time. As such it is a history that has been particularly shaped by the personalities and circumstances of the surgeons responsible for major innovations, and the cultures of the hospitals and support staff that assisted them. Furthermore the city of Boston and its numerous historical hospitals have a particular role in this history as they do in much of American medicine's legacy.[4] It was within the context of Boston's teaching hospitals in the 1920s and 30s that an instrumental move forward in the development of cardiac and vascular surgery was made, culminating in the first successful repair of a patent ductus arteriosus (PDA) in a 7-year-old child in 1938.

In researching the story of how this surgery was developed, this account sheds light on the early history of surgical innovation, highlighting both the methods of innovation and the medical culture that served as the context for this important step forward. Furthermore it will highlight a unique era in the field of anesthesia, a discipline which at the time was not performed by physicians, and which also deeply shaped the surgical possibilities of the time.

The complete story of this important surgical event has not yet been recounted in full detail. Several partial accounts have been written, but only a handful of these have been published in volumes dedicated to medical history.[5-7] Instead the source material for this research is drawn largely from unpublished personal accounts, including personal letters and unpublished chapters. In addition, much of the information comes from internal memos, newsletters and publications of Boston Children's Hospital which are not widely available or seen by the public. In fact, the sources for this project came largely from Boston Children's archival program, one of the most comprehensive such programs in the country. This also allowed for review of primary materials such as patient and OR notes from the historical time of interest. In addition to drawing from a unique set of sources and providing the first detailed narrative account of the event, this study highlights much of the cultural and historical context in which this innovation took place. Important details of medical history and the history of Boston's hospitals are explored as they relate to this event.

Finally, this account provides the unique opportunity to hear directly from the patient involved in the landmark surgery, who is still alive at the time of this research. In addition to two direct interviews conducted with this patient, interviews were also conducted with faculty who knew the physicians involved, and with the nurse anesthetist who provided anesthesia for the procedure.

Methods:

With the assistance of the archivist, the Boston Children's Hospital archives were searched for any materials from the time period in question, which were reviewed by the study authors for materials relevant to the procedure being researched or which could give additional contextual and historical details of the time period. The surgical report was reviewed at Countway Medical Library. Other books on medical history relevant to the period in question from these libraries were reviewed. Transcripts of previous interviews with Lorraine Sweeney-Nicoli and Betty Lank were provided by Dr. Mark Rockoff who had been an interviewer in both cases. Finally, a second interview was performed by the study authors with Lorraine Sweeney-Nicoli.

Results

The following is an abbreviated account of the study results which was published in the Journal of Pediatric Surgery, Volume 48, Issue 8, August 2013. Addended to this report will be the fuller-length account.

Abstract

Seventy-five years ago, a 7-year-old girl underwent the first successful ligation of a patent ductus arteriosus. This procedure transformed her health and was a milestone in the development of cardiac surgery. The operation was performed by Dr. Robert E. Gross, then the surgical chief resident at Boston Children's Hospital, who went on to have a distinguished career in pediatric surgery. The patient is now a great-grandmother and the oldest known survivor of cardiac surgery.

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Seventy-five years ago, a landmark surgical procedure was performed and subsequently reported in the Journal of the American Medical Association [1]. Seven-year-old Lorraine Sweeney underwent ligation of a patent ductus arteriosus (PDA), the first successful surgery for congenital heart disease. The procedure transformed her health and was a milestone in the development of cardiac surgery.

Lorraine grew up in Boston in the 1930s, the youngest of eight children born to Irish immigrants. As a child she was weak and tired easily, and her parents noticed a constant "buzzing" that seemed to come from her chest [1], [2] and [3]. Though doctors suspected she had congenital heart disease, no effective treatments were available. In response to her daughter's increasing debilitation, Lorraine's mother brought her to Boston Children's Hospital, where they met a young surgeon, Robert E. Gross. After examining Lorraine, Gross concluded that she had a PDA, and that he could repair it.

Gross worked under Dr. William E. Ladd, the Surgeon-in-Chief at Boston Children's Hospital, and a man considered by many to be among the world's most distinguished pediatric surgeons. Ladd had established the nation's first training program in the field and developed several innovative surgical procedures for infants, particularly those with gastrointestinal malformations [4], [5], [6], [7] and [8].

Surgery on the heart, however, was not yet practical in 1938, though many suspected that operating on the great vessels could be the path for opening up this possibility. Surgical correction of a PDA was suggested as early as 1907 by Dr. John Munro of Boston, who demonstrated an approach via sternal incision in infant cadavers [9]. If feasible, ligation of a PDA could save many children from progressive heart failure and/or endocarditis. Life expectancy for this condition did not typically exceed late adolescence [10]. Dr. Elliott Cutler, Surgeon-in-Chief at the Peter Bent Brigham Hospital (now the Brigham and Women's Hospital) in Boston, was also examining the potential for surgery on the great vessels and predicted that the first procedure might be correction of a PDA [11]. However, surgical ligation was not attempted until 1937, when an emergency procedure was performed by Dr. John Strieder on a 22-year-old woman with endocarditis at Massachusetts Memorial Hospital. The patient survived the operation, but died several days later [12] and [13]. Gross had begun his surgical training under Cutler, meanwhile collaborating with pediatrician John Hubbard to work out a surgical approach to ligate a PDA [11]. When he met Lorraine in 1938, he was ready to make the attempt.

Gross was the son of a Baltimore piano-maker. He was born with a congenital cataract, and as a boy his father would give him smaller and smaller clocks to take apart and reassemble, training his depth perception and turning him into a finely-skilled mechanic [4] and [14]. After graduating from Harvard Medical School, he trained in pathology, where his work in the laboratory and autopsy studies exposed him to many of the congenital heart malformations that were fatal at the time [10] and [11]. He then completed a residency in general surgery at the Brigham and was the surgical chief resident for Ladd when Lorraine came to see him [11] and [14]. Ladd was not about to let his young trainee attempt such a dangerous and groundbreaking procedure. But when Ladd left for vacation that August, Gross proceeded anyway [10].

It was a bold move! In the history of medicine few physicians had "dared violate the sanctity of the human heart", as one article later put it [15]. The only comparable attempt had just failed, and his own chief and the leader of American pediatric surgery had declared Gross's ambitions premature, putting his entire career in jeopardy if he continued. Yet Gross was not the only one facing a great risk. Lorraine's mother had lost her husband only a few months earlier. He was killed by a car as they crossed the street together near their home. Now her remaining years with her youngest child might be abruptly cut short if the procedure failed [2].

The operation took place on August 26th, 1938. An incision was made in the 3rd intercostal space on the left side, and the 3rd rib was retracted upward. The left lung collapsed, revealing a PDA that was 7–8 mm in diameter and 5–6 mm in length. Resting his finger on Lorraine's heart, Gross described "a thrill of extreme magnety1" felt over the pulmonary artery but disappearing over the aorta [1] and [16]. "When the [sterile] stethoscope was placed on the pulmonary artery, there was an almost deafening, continuous roar, sounding much like a large volume of steam escaping in a closed room" [1].

Anesthesia at this time was still in its early stages. Lorraine received cyclopropane by mask while lying on her side, breathing spontaneously during the surgery [1], [16], [17] and [18]. Betty Lank, the hospital's chief nurse anesthetist, provided the anesthesia. It was not until the end of WWII that physicians with field experience in anesthesia filled this role at Boston Children's Hospital and many other institutions. Lank was also an impressive innovator. After seeing cyclopropane demonstrated as an alternative to ether in adults, she developed its use in pediatric patients [19]. In addition, she devised masks and blood pressure cuffs that were appropriately sized for infants and children at a time when these were not readily available [17] and [18].

After examining the cardiac anatomy thoroughly, Gross wrapped a silk tie around the PDA and waited. Lorraine's blood pressure rose from 110/35 to 125/90. The ductus seemed too short to resect, so Gross performed a simple ligation [1] and [16]. When the thread was tightened, the thrill over her heart disappeared, and the continual "buzz" from her chest was silent. Gross wrote in his operative note that the room seemed suddenly to become still [16].

The procedure was a success. It had taken little over an hour, and within a few days, Lorraine was feeling energetic and healthy. Nevertheless, she remained hospitalized for nearly two weeks due in large part to the intense interest in the case [1], [2] and [3].The relationship between Ladd and Gross was never the same [10].

Gross became Surgeon-in-Chief at Boston Children's Hospital and the first William E. Ladd Professor of Child Surgery at Harvard Medical School in 1947, two years after Ladd's retirement [11]. He continued to develop techniques for repairing anomalies of the great vessels, including coarctation of the aorta and several other procedures that were foundational to the fields of cardiac and vascular surgery [10] and [20]. Despite his impressive career as a leader in pediatric surgery, Gross once found himself in the same position as Ladd when he refused to take a chance on a daring innovation. Dr. Helen Taussig, a pediatric cardiologist from Johns Hopkins Hospital, reached out to him with an unusual idea, which was to create an artificial ductus for "blue babies" with defects such as Tetralogy of Fallot, in which not enough blood reached their lungs [2] and [14]. Gross responded that he got rid of ductuses, and that he did not make new ones [2]. In 1944, Dr. Alfred Blalock and his technical assistant, Vivien Thomas, performed this landmark procedure in Baltimore to great acclaim.

Gross is also remembered for his meticulousness in all things — from the perfect silence of his operating rooms to his starched white coat and bow tie [20], [21] and [22]. He was beloved by his patients, and along with Ladd created an enormous legacy of innovation in the field of pediatric surgery. The greater part of the first generation of pediatric surgeons trained with Ladd or Gross, and as one student recalled, "There is a long golden cord that stretches from Ladd to the present, binding all of us together, as in no other surgical speciality" [6].

Lorraine was reunited with Gross in 1950 when she was expecting her first child, and her physician was concerned about the effect this might have on her heart. Gross was confident there would be no cardiac problem. He also told Lorraine how grateful he had always felt towards her mother whose courageous decision "gave me my chance" [3]. Gross had indeed bet his entire career on that operation and joked with Lorraine that if she had died, he would have "become a chicken farmer in Vermont." "Well Doctor," she replied, "Thank God I come from good Irish stock" [2]! Lorraine thereafter sent Gross a card each year on Valentine's Day signed "your wee

heart girl", and the two remained in contact until Gross died in 1988 at the age of 83 [2]. Lorraine is now a great-grandmother, and her 75-year follow-up makes her the world's longest known survivor of cardiac surgery [23] (Fig. 1, Fig. 2 and Fig. 3).

Fig. 1. Lorraine in 1938.

Fig. 2.

Lorraine with Gross in 1963 (the 25th anniversary of her PDA ligation) in the operating room where her surgery took place at Boston Children's Hospital.

Fig. 3.

Lorraine in 2011.

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Discussion

The history of medicine is ultimately the history of the individuals that worked to develop it, and it can be instructive to remember how these individual stories contribute to the culture and technology that we work with today. This study reviewed the history of the first successful patent ductus arteriosus ligation procedure, and found that its development was interwoven with the personal histories of the physicians and patient involved. In reviewing the fuller context of this innovation, it becomes evident that numerous factors of the location, time period, and personages involved played crucial roles in bringing the medical field closer to the present-day.

Limitations of this study include the limited historical resources available and the subsequent limited opportunities for extensive fact-checking of historical details, though this was done across sources wherever possible. Furthermore the distant time period of events leads to limitations in recall for sources that detail the events from memory after a significant period of time.

Though this study focused primarily on the individuals involved and their personal histories, areas of further research may focus more on the context of medical innovation and technology in the time period, examining the origins of the medical and surgical knowledge available at the time and further characterizing its strengths and limitations. Similarly further research into the medical context of the Boston and other academic hospitals at the time could provide further information. Finally a more detailed examination of how the innovations described in this study contributed to later medical innovations could be explored.

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Addendum: Full narrative account with references

When Lorraine Sweeney was a child you could hear her heart from across the room.[1] She grew up in Boston in the 1930s, the youngest of eight children born to Irish immigrants. As a little girl, Lorraine remembers watching from the window as her friends played hopscotch, but she always felt too weak and tired to join in. There seemed to be something wrong with her heart, but no one could say what it was.[1] Mary Ellen Sweeney, her mother, prayed that some doctor would appear with the power to fix her daughter's heart, but in those days no such doctor existed.[1-2]

Mr. Sweeney came from County Donegal, and like many of the Irish immigrants worked for the Boston Elevator Company where he drove a streetcar between Brighton and Cambridge. His children remember him as gentle, quiet, and unfailingly cheerful, and that he was always whistling or singing. "Music came on with the kettle in the morning," is how Lorraine described her household, where her mother also played accordion and sang. Mrs. Sweeney was from County Mayo, and spoke Irish Gaelic. When Lorraine was seven years old her father was killed by a car as he crossed the street with their mother in front of St. Columbkille's, the Irish parish.

Mrs. Sweeney had brought Lorraine to see many doctors throughout her life, and after her husband's death she tried again at the Floating Hospital, so-called because it had begun in 1894 as a large boat where sick children could rest in the summer in the fresher air of Boston Harbor.[3] The doctors at Floating sent her to Boston Children's Hospital, where she met a young doctor named Robert Gross.[4]

Dr. Gross told Mrs. Sweeney that he could operate on her daughter, but it would be an entirely new procedure. He had never performed this operation before; only one other surgeon had ever tried and the patient had died. It is not clear how he might have described the procedure and its potential risks in an era before informed consent, but Mrs. Sweeney told him that she would think it over.

Mary Ellen Sweeney had just been devastated by the loss of her husband. Dr. Gross offered a surgery whose risks were entirely unknown – would it save her youngest daughter or just take away the handful of years that might remain for her? Not knowing how to decide, she went to St. Columbkille's and asked Monsignor Tracy what he thought she should do. "Well, Mrs.

Sweeney," he told her. "If God wants her, he'll take her either way. You let her have the operation, and God be good to her."[1]

The origins of pediatric surgery in the United States are legendary, in that a certain tale is always told to mark its beginnings. On December 6th, 1917, in the harbor of Halifax, Nova Scotia, a Norwegian freighter called the SS Imo was carrying relief supplies to Belgium, when it collided with a French ship, the SS Mont Blanc, which was carrying a full load of TNT and aviation fuel bound for the war in Europe.[4-6] The Mont Blanc caught fire, lighting up the sky and the Halifax pier and drawing the families of the city to their windows to see what had happened.[6] Then the TNT exploded, destroying the entire harbor district and killing nearly 2,000 people in an instant.[5-6] Many of the casualties were children who had come to their windows to watch the fire, and those who were not killed had devastating facial and eye injuries from the implosion of glass. From around Canada and America came an influx of disaster relief, but a large portion of the relief effort came from Boston, which provided physicians. Nova Scotia still sends a Christmas tree to Boston each year in gratitude.[6-7] Among the Boston physicians who volunteered was a young surgeon named William Edwards Ladd.

Ladd was born in 1880, the son of an old Massachusetts family.[3] He used to joke that he owned all the land from Boston to Newburyport by right of the original land grant made by the King of England to his forbears.[4] Ladd was a Harvard man, graduating from the college in 1902 and the medical school in 1906.[5]

He was also on the surgical staff at Boston Children's Hospital when he went to Halifax to help the wounded.[5] He had been appointed to the visiting staff in 1910 but maintained a growing adult practice outside the hospital, as was customary at the time.[5,8] The Children's Hospital was then located on Huntington Avenue near Boston's Symphony Hall. Since its founding in 1869 it had been a charitable organization supported by philanthropy and volunteers in contrast to the model of hospitals serving adult patients. It was established in an era when immigration and industrialization were creating a growing class of urban poor, and many of the early patients were children of the city's new influx of Irish immigrants.[9] Traumatic injuries and infectious disease – particularly tuberculosis – were among the main illnesses treated, although in the early years the treatment might consist primarily of comfort, hygiene, and nutrition.[3,9-10] The hospital

later moved to its current location on Longwood Avenue adjacent to Harvard Medical School. Away from the city where "the air was purer and the noise and jar less", the hospital now had enough space for a pasture to graze dairy cows to provide tuberculosis-free milk for its young patients.[3,9] There the inpatients could be housed in spacious, sunlit wards behind the hospital, since early "research" into hospital design had determined that sunlight and fresh air were curative.[9] The physicians were "visiting staff", because their main offices, and remuneration, were outside of the hospital and they literally visited the building to see their patients.[3] As Ladd later recalled, "It meant that there was no one on the staff who was not on it for the love of the game, and this gave the staff an *esprit de corps* which proved a potent factor in the later success and development of the hospital."[8]

The story goes that Ladd was so moved by the injuries of the surviving children of Halifax who had been watching the fire from their windows that he determined to dedicate his surgical career to pediatric patients.[5] Thus he became one of the first surgeons to devote his practice entirely to young patients, which proved to be a foundational step in developing pediatric surgery as an independent field.

At that time the surgical management of a child was essentially seen as an adult case in miniature. Ladd felt that most surgeons knew little about treating children and even less about infants, and he set about to improve pediatric care and establish it as a separate field of specialization rather than the task of the least experienced member of the surgical staff.[4-5] He began to spend more and more of his time at Children's, where his interest in pediatric surgery began to attract the attention of the Harvard faculty.[4-5] In 1927 he was named chief surgeon at Children's, and by the 1930s pediatric surgical training was an established curriculum in Boston.[3] It consisted of a one-year appointment as a "house officer" at Children's Hospital, divided into six clinical rotations of two months each.[4] The most junior resident was called a "pup", and the "pupship" included working in the research laboratories that were the lifeblood of a field that was only just inventing itself.[4]

The next step was to change pediatric care from part-time *pro bono* work to a full-time career. It was not until 1936 that a significant portion of the surgical staff gave up their outside appointments and dedicated their work full-time to the Children's Hospital, and not until 1938 that Harvard created the first professorship of pediatric surgery.[11] Both changes were made possible by grants from Harvard Medical School, as well as the "willingness of the surgeons to

accept financial loss."[11] Ladd felt that there was no doubt that this step had improved patient care and teaching, and "accelerated progress in the field of Children's Surgery".[11] Financial difficulties were still a major concern for the hospital, where the average cost of a day of surgical care in 1938 was $6.66.[11] Ladd insisted that no necessary treatment would be omitted for financial reasons. For example, having recently discovered the value of having certain patients breathe "high concentrations of oxygen", he was determined to have this technology available at his hospital despite the cost, and contracted with engineers at MIT to "construct some sort of apparatus that will be more efficient and so lessen the almost prohibitive cost that at present places this valuable aid in treatment out of the reach of many."[11]

The volunteer ethic of the hospital was the heart of its culture. Though modern health care providers may look back with nostalgia for a more caring era of medicine, even in those days there was a sense that an increasingly impersonal and technical attitude was creeping into the field. Ladd wrote in 1939, "One hears much of the 'scientific medicine' and the cold impersonal attitude of 'scientific doctors.' This need not be and is not the case particularly at The Children's Hospital. Our Service was proud that a patient came to us from Texas rather than going to another nationally known clinic as had been advised…The mother wrote to us saying among other things, that she now knew that here her child was not 'just another ward patient' but that the kindly, personal care given by nurses, house staff, and visiting surgeons, was something she could not have believed had she not experienced it."[11]

Though he was largely responsible for the specialization of pediatric surgery at that time, Ladd did more than restructure surgical training. He was himself a tireless innovator and was responsible for a number of important new procedures. Whenever there was a death on the service he would examine the autopsy findings in the pathology department.[5] Particularly struck by the high incidence and mortality of abdominal malformations, he spent hours in the autopsy lab investigating the mesenteries and intestines of children who had died from gut volvulus, a twisting of the intestines. He developed a procedure to repair the malrotation, a method which still bears his name.[5] Later he was among the first physicians to repair esophageal atresia, a condition in which the child's esophagus and stomach do not connect. His first procedure was done by folding a patient's skin into a tube that ran along the surface of her chest: she would massage the food down herself.[12] "One does not obtain success without many trials, errors, and disappointments," he wrote in 1939. "But time, effort, and money are not wasted thereby,

because this constant and earnest effort has placed, and will continue to hold The Children's Hospital in the first rank of accomplishment."[11]

Ladd was a tall and imposing man, whose "very dark eyes were most impressive and tended to rivet your attention to what he was talking about," as one of his students recalled.[4] He was pleasant and easy to work with, and had enormous hands that must have displayed a magnificent dexterity given the diminutive size of many of his patients.[2] He was the Surgeon-in-Chief at Children's Hospital until 1945, and so was still in charge when Mrs. Sweeney brought her daughter to see Dr. Robert Gross, his young assistant resident who was not yet even a full associate on the surgical staff.[3-5,10]

While William Ladd came from an old Boston family, Robert Gross was the son of a Baltimore piano-maker. He was born in 1905, a year before Dr. Ladd graduated medical school. His father, perhaps hoping that he would join him in the musical instrument business, sent him to work with watchmaker, turning Gross into a finely-skilled mechanic.[5] As a boy he was described as a "sensitive, somewhat shy tinkerer, an avid reader, a keen observer, and an enjoyer of the outdoors."[13] In his book The Work of Human Hands, G. Wayne Miller described him as "a shy child, a reader, a scholar, one of eight children, an outdoorsman, and tinkerer who loved to take things apart and put them back together. Bob could break down and rebuild an automobile engine. He could mend clothes. He loved hammers, screwdrivers, motors, pumps, and knives. He was good with his hands, very good. His father encouraged him to take clocks apart and then put them together again."[15] As a boy he spent his summer holidays working on a farm in central Minnesota where he made the journey by train and boat, and later by "jalopy".[13] Deciding to remain in Minnesota, he attended Carleton College and was considering a career in chemistry when a friend gave him Harvey Williams Cushing's biography of Sir William Osler as a Christmas gift.[13,16] Gross was completely enraptured, and later said he nearly dropped out of his classes to find time to read it.[13] Osler had died in 1919, but Cushing was then on the staff of Harvard Medical School and chief of surgery at the Peter Bent Brigham Hospital where he was pioneering the field of neurosurgery. So Gross decided to go to Harvard Medical School.[13]

Gross would later recall the story of when he finally met Cushing in a surgical theater at the Peter Bent Brigham Hospital. He went up to the visitor's gallery to watch as Cushing did an operation, only to be thrown out by Cushing for his presumption – he was told not to return until

he had finished medical school. Gross said he never wanted his own students to feel such embarrassment.[14]

He graduated with honors in 1931 but was unable to secure a training position in surgery.[13,16] His letter of recommendation as a 4th year medical student may not have been the most compelling: "Mr. Gross is an interested, eager and accurate student, somewhat above the average, has a pleasant personality and a good appearance. He should make a satisfactory House Officer," wrote his professor of pediatrics to Dr. Ladd.[3] Unsuccessful, Gross instead began training in the department of pathology.[13,16] His time was largely spent studying specimens in the autopsy lab, an especially critical place of education for surgeons at a time when many procedural techniques were at an early stage of development. The pathology lab could essentially serve as an encyclopedia of unsolved physiological problems to investigate, and provided plenty of inspiration to a physician interested in surgical solutions.[17] He was eventually able to begin a surgical training program at the Brigham under Dr. Elliott Cutler.[17] Cutler's attention at that time was on the potential for surgery on the heart or the great vessels - that is, the large arteries and veins that bring blood to and from the heart.[13] He had published a review of early attempts at cardiac surgery and predicted that one of the first feasible surgeries might be correction of patent ductus arteriosus (PDA).

In 1937 Gross was awarded the George Gorham Peters Traveling Fellowship, allowing him to spend nine months visiting the most active surgical centers of Britain and the continent.[13] When he returned to Boston he was appointed Chief Resident in surgery at Children's Hospital under Ladd. He continued to work in the laboratory and autopsy room, collaborating closely with a pediatrician named John Hubbard.[13] Together they were working out a surgical approach to correct a PDA, the same heart defect that Gross would later recognize as he examined Mrs. Sweeney's seven-year-old daughter.

A fetus does not breathe. It has little for its lungs, whose function is replaced by the placenta. Oxygenated blood returns from the placenta to the fetus in the umbilical vein, which eventually feeds into the right heart. After birth, the right heart will send blood to the lungs, but before birth its anatomy is slightly altered since there is little need to perfuse lungs that are not used for gas exchange. Instead there is a hole in the wall of the right atrium, called the foramen ovale, and the returning blood flows straight into the left heart, bypassing the lungs, for its

journey to the rest of the body. Not all of the blood is diverted through this hole, however. Some does flow from the right atrium to the right ventricle, where it is pumped into the pulmonary artery leading to the lungs. Here a second bypass point exists. The ductus arteriosus is a passageway between the pulmonary artery and the aorta. Oxygenated blood that ends up in the pulmonary artery has a second chance to rejoin the circulation that is going to the body instead of the lungs, once again ensuring that the body is perfused first with the most oxygen-enriched blood.

At birth, as the infant takes its first breaths, the resistance of the vasculature in the lungs drops. Now the lungs represent a much lower resistance pathway for blood to flow into, and the greater return of blood from the lungs to the left atrium makes its pressure relatively higher than in the right. This shuts the flaps of the foramen ovale, and in most people the hole eventually fuses shut. In about a third of people, however, it remains slightly open.

Closure of the ductus arteriosus can be more complicated. As flow begins to the lungs, now a lower-resistance pathway, pressures in the pulmonary artery fall below the pressures in the aorta. Mediated by a decrease in hormone-like compounds called prostaglandins, the ductus constricts at birth but may remain partially open in the first days and weeks of life. In some infants, especially those born prematurely, it does not fully close, but remains "patent", meaning "open."

The first person who suggested a surgical correction of a PDA was Dr. John C. Munro of Boston. He wrote an article in 1907 suggesting that an approach via a sternal incision would be possible and demonstrated the technique on infant cadavers. He never attempted the surgery on a living patient, in part because accurate diagnosis was not possible at the time.[18] The next serious attempt was not until the 1930s. The year before Lorraine came to Dr. Gross, an emergency ligation was performed by Dr. John William Strieder at Massachusetts Memorial Hospital. The patient was a 22-year-old woman, and though she survived the initial surgery she died several days later of bacterial endocarditis.[18]

What did it mean to live with a patent ductus arteriosus? "Everybody in the hospital had spent their lives seeing children die with patent ductuses," recalled Dr. Robert Bartlett, a leader in the field of surgery from the generation after Ladd. "It must have been just awful because these kids had progressive pulmonary hypertension and would live to be about seven or eight."[16] The children might be relatively fine for the first years of life, but would gradually find

themselves fatigued and breathless, coughing up blood.[16] Their hearts were failing. Much of the oxygenated blood that the heart tried to pump to the body would end up passing through the ductus and back into the lungs. The heart had to work overtime to compensate while the lungs were overwhelmed with fluid. Furthermore, the ductus was a perfect site for bacterial colonization, and many children died from infected vessels. If they were particularly lucky, patients with a PDA might live to their early twenties.

"This offensive open channel cried out for a mechanical solution," wrote Dr. Judson Randolph, who trained in pediatric surgery at Children's.[5] Dr. Gross, the piano-maker's son who took apart clocks and put them back together as a child, excelled in seeing the mechanical solutions to physiological problems.[5] Having carefully worked out the technique in the lab using animal experiments and human cadavers, he was ready to try a ligation in a child. There was one problem, however: Dr. Ladd had not given his permission.

Mrs. Sweeney, however, had made up her mind. With the blessing of Monsignor Tracy, she would send Lorraine to Dr. Gross for the surgery. Years later Lorraine would recall that Dr. Gross "loved my mother and he thought it was wonderful for her to have the courage to let him do it."[1]

Lorraine was admitted one week before the surgery was performed. Her mother could not bear to go with her to drop her off at the hospital, afraid she might be parting with her daughter forever.[1] Instead, one of Lorraine's older sisters told her that they were going to visit her niece who was staying in the hospital, and Lorraine was excited that her big sister would choose her for such an important errand. They took the streetcar in from Brighton, and then Lorraine was left by herself at Children's.

In those days parents were not allowed to stay at the hospital when their children were admitted, and visiting hours were extremely limited. Most parents dropped off their children and did not return until the day of discharge, and some doctors forbade visits altogether.[1] Lorraine's memories of her days in the hospital give a sense of how frightening it all must have been for a child left among strangers: she recalls sitting on long wooden benches in the clinic waiting for her number (ninety-nine) to be called, and lying alone in a crib while nurses came occasionally to take blood. Once she was so frightened when Dr. Hubbard tried to give her an injection that

she ran between his legs, down the stairs, out the door of the hospital, up Longwood Avenue, and hid behind a billboard until she was discovered.[1] Nowadays a child staying at Boston Children's Hospital would have toys, books, television, computers, iPads, and plenty of visitors. "Child-life specialists" work full-time to promote as comfortable and emotionally smooth a stay as possible for patients, as well as for their families, who can often stay in the hospital itself. But as for Lorraine - "I mostly thought about my mother and going home and just being lonesome," she recalled. There was one cheerful point, however – she loved seeing Dr. Gross because she associated him with her mother who had first brought her to see him. Gross would push her around the hospital in a wooden wheelchair, and gave her a little doll dressed in a Spanish costume that she is seen holding in photographs from that time.[1] A cousin of her father also came to the hospital – he had volunteered to donate blood for her before the surgery. He was a particularly tall man, and as she received the transfusion Lorraine worried that this meant she would grow up to be a giant.[1]

During her stay Lorraine underwent a meticulous physical examination. Ever the mechanical thinker, Dr. Gross noted in exquisite detail every visible, audible, and sensible sign of what Lorraine's heart might be doing. He was still trying to figure out with absolute certainty the physiology of her case. Pages of notes relay details such as: "Over the entire precordium there was a prominent coarse thrill which was most intense in the third interspace to the left of the sternum. This thrill was continuous but was accentuated during systole. There was a rough "machinery" murmur heard with maximal intensity over pulmonic area to the left of the sternum in second and particularly in the third interspace. It was continuous throughout the cardiac cycle but… greatly accentuated during systole."[19] The descriptions go on and on, far exceeding what would likely be noted in a chart today. Notably, her diastolic blood pressure averaged a remarkably low 38 mmHg. And she had a murmur of such extreme "magnety", in Dr. Gross's words, that it could be heard without a stethoscope.[1]

In the days before many modern diagnostic technologies were available, observation was an even more critical tool. Meticulous and time-intensive attention to physical signs was often the best tool a doctor had, and simple observations could be the principle means of unraveling the causes and treatment of a disease. Dr. Thomas Lanman was a surgeon at Children's Hospital beginning in 1919. In a 1954 reflection on the changes his field had seen in the prior decades, he noted that in the new era of antibiotics and advanced anesthesia it was easy to forget how

advances were made in a generation that lacked these tools.[20] "I think it is a great pity not to call attention to what he did," he wrote, referring to Dr. Ladd, "and to point out that much of what he did he developed not so much as the result of improvement and advances in technique as by the painstaking application of age-old basic principles of good surgery."[20] For example, appendicitis frequently led to death in the 1920s and 30s, but a case series by Dr. Ladd reported 95 consecutive cases of perforated appendix – a much more serious situation – with no deaths.[20] All of these cases were just prior to the advent of the new sulfonamide antibiotics. Lanman credited the surgical proficiency and speed of Children's Hospital surgeons, but also their scrupulous attention to small details which told them the exact moment to act – their "painstaking attention to detail."[20] In the words of Sir William Osler, the man whose story sent Gross down the path of a medical career, "We miss more by not seeing than we do by not knowing."

To perform surgery on the heart was still nearly unimaginable in the 1930s. "For more than twenty centuries, few physicians dared violate the sanctity of the human heart," was how the situation was summed up in a Children's Hospital retrospective on the surgery some decades later.[2] If Dr. Gross could surgically repair Lorraine Sweeney's PDA, it would be the first step towards making heart operations a possibility. Though the surgery was not truly on the heart but on the vessels just outside of it, it would represent a radical innovation in what was surgically possible, and had the potential to usher in an era when cardiac surgery could become a reality. Thus Dr. Ladd, himself a bold innovator who was not afraid of carefully weighed risks, was not about to allow his 33-year-old chief resident to perform the first procedure of its kind, and did not give his permission to Gross to proceed.[16] Ladd, however, had decided to go on vacation that August. When Ladd was safely on a ship to Europe, Dr. Gross operated on Lorraine Sweeney.[16]

The surgery took place on August 26th, 1938. Lorraine received cyclopropane anesthesia by mask and was turned onto her side.[2] Decades later she still remembered that moment of looking up and seeing the faces of the surgeons looking back down at her as she lost consciousness.[1]

An incision was made between her third and fourth ribs on the left side of her body, and the 3rd rib was retracted upward. As its surrounding airtight sac was perforated, the left lung collapsed, leaving the heart visible. Gross discovered a large PDA, 7-8mm in diameter and 5-6mm in length.[4,19] After months of experimenting on animals and cadavers, he could finally see

the ductus *in vivo*, as the heart just below it pumped liters and liters of blood through the vessel. As ever, his method for understanding was to make a meticulous physical examination. He felt with his fingers along the actual vessels, looking for clues to understand where the blood was going, not taking for granted even then that he understood its physiology until the evidence was clear. Gross placed his finger onto Lorraine's heart – "a very vibrant thrill" was felt over the entire organ, with greater intensity as he approached the pulmonary artery and disappearing over the aorta. He took a sterile stethoscope and placed it directly onto her heart. "When the stethoscope was placed on the pulmonary artery there was an almost deafening, continuous roar, sounding much like a large volume of steam escaping in a closed room." He could feel the blood jetting against his finger as he touched it to the pulmonary artery. He placed a braided silk tie around the vessel that linked the pulmonary artery and the aorta. Then they waited.[19]

Lorraine's blood pressure began to rise, from 110/35 to 125/90, as her left heart was finally able to direct its flow entirely to the body. Gross felt that the ductus was too short to cut and sew up on each end, so he decided to ligate it, or constrict it completely. When the thread was drawn tight, the thrill that shook her heart completely disappeared.[19] Gross wrote in his operative note that it seemed as if the entire operating room had suddenly become still.[21]

Anesthesia was administered by a woman named Betty Lank. Lank was born in 1904 on Campobello Island off the coast of New Brunswick, the same island where Franklin Delano Roosevelt vacationed and where he contracted polio in 1921. (Lank's uncle had taught the young FDR how to sail.)[22] She was one of nine children, the daughter of a fisherman. As a teenager during the First World War, she decided she would eventually leave the island and train to be a nurse.

Lank ended up near Boston, where she graduated from nursing school. She then took a 3-month course in anesthesiology, which was sufficient to impart everything that was then known about the field. After joining the staff at Children's Hospital she quickly became the chief nurse anesthetist.[22-23] In those days anesthesia was still at an early stage. The role of anesthetist originally fell to the least experienced person in the room, often a medical student. Eventually nurses took over, and it remained this way until an influx of doctors returned from World War II with anesthesia experience from the war (Lank trained one such doctor, Robert Smith, who is credited for helping to develop pediatric anesthesiology as a specialty.[23] Lank herself had

wished to work as a nurse in the war, becoming a United States citizen to do so, only to be declared "essential" by the hospital management which could not lose their chief anesthetist in such a scarce time.[1]

"Terrifying" and "awful" are words that Lank would later use to describe the crude methods of anesthesia that were used in the first half of the last century. Patients rarely had their trachea intubated, nor was their breathing controlled.[22] They were simply put to sleep by covering their face with a metal mask wrapped in gauze and slowly pouring liquid anesthetic, usually ether, drop by drop onto the mask.[22-23] Intravenous catheters (IVs) were rarely used. Lank remembers using ether with a homemade cone for encephalograms, sitting the child up and hoping he would stay under long enough to finish a spinal tap. Cleft lips were repaired with the child sitting in the nurse's lap, using just a mouth hook to deliver the anesthesia, and it was difficult to keep the children adequately anesthetized. She often worried that the patient was not totally unconscious. She recalled another prone craniotomy where sat under the drapes and attempted to keep the mask on tight while the patient occasionally vomited.[22] The only methods of monitoring vital signs were to feel the child's pulse, count respirations, and watch. Later she made her own small blood pressure cuffs.

In the late 1930s cyclopropane came into use. After seeing it demonstrated at a workshop at Yale, Lank wanted to develop its use for infants, who presented particular challenges to the anesthetist and strongly resisted the pungent odor of ether. Compared to ether, Lank found cyclopropane to be a "beautiful anesthetic", easier to use and less prone to causing nausea. The babies would wake up more easily afterwards, and their "breathing was beautiful, very even, [and] strong."[22] Still, the process was perilous. Ether and cyclopropane are flammable, and they were administered onto masks rather than down endotracheal tubes. Lank remembers seeing Dr. Ladd coming into the operating room for a quick look wrapped up in a sheet - he was wearing wool, which along with nylon had to be strictly forbidden around the flammable gases. In the back of their minds was the terror of a cyclopropane explosion at the nearby Deaconess Hospital.[22] The operating room had to be kept humid to minimize static electricity. The anesthetist was often seated for hours under drapes beside the patient's head with drops of water smearing the anesthesia notes and bloody rags from the surgery falling beside her while she simply held the mask and perhaps an oral airway against the patient. Special post-operative care was not standard, and even if anesthesia went well the shock after surgery could be severe.[2]

Temperature control was also a problem: no warming beds existed for the tiny babies, and Lank would wrap them up in sheets to keep them warm and put hot water bottles around their bodies, or leave ice bags around their necks in the summer. To calm the infants before the surgery she would sterilize a nipple and give them ten parts glucose and one part brandy.[2]

Working with this stage of technology required a near-daily necessity for innovation. Lank was instrumental in customizing the tools and methods of anesthesia for pediatric cases. When she decided to monitor infant blood pressure, she had no cuff small enough and made one herself with a piece of rubber tubing.[2] When there were no masks made for babies, Lank figured out a way to shrink celluloid masks in 70% alcohol. She asked the hospital engineer to make a carbon dioxide-absorbent canister small enough to use for an infant. Much of her equipment was homemade – she would cut the tips off of catheters of various sizes and tape them into an oral airway tube.[22] It was so often simple things – masks that fit properly, a pediatric-sized blood pressure cuff – that represented steps towards modern medicine. She later said that the greatest innovations in anesthesiology and surgical care that she saw in her career were the monitoring of blood gases, intubation, and post-operative intensive care.[2]

Nowadays children needing surgery can have their parents beside them holding their hands as they are put under anesthesia. With no parents in the hospital, providing comfort was also a critical part of the nurse's role. Lank noticed that the children sitting by themselves in the waiting room used to stare up at the ceiling, so she had it painted with stars and would sometimes sit beside the children and show them the constellations.[2] She found that children loved holding a balloon or having a music box playing when they were going under anesthesia.[2] Lank would also sing to them. From her childhood well into her 90s Lank was a member of her church choir, and she would hum Brahms' lullabies to the children as they were put under anesthesia. "We loved those little babies especially, and somebody called me once a hypnotist," she later recalled. "Because you know, [the] children [were] scared and I would hum to them and tell them what to do and they were great. So I hope that isn't lost," she said, speaking of the modern era of medicine. "All the little things! I don't suppose anybody ever hums to them, I'm sure!"[22]

The surgery was a success, and Dr. Gross was fired as soon as Dr. Ladd returned.[16] But the immensity of what he had done allowed cooler heads to prevail, as much of the staff of

Children's Hospital approached Dr. Ladd about taking less drastic measures. The feeling among his colleagues was that Dr. Gross had done something truly revolutionary, opening up the next horizon for surgery, namely the heart.

The entire procedure had taken a little over an hour.[1] Lorraine felt only a "mild discomfort" on the afternoon of the surgery. The next morning she was sitting up in a chair. By the third day, she was walking around the ward.[1] The transformation was nearly immediate: within a few days she was as energetic as any child. Nevertheless she was kept in the hospital for nearly two weeks, largely due to the interest shown in her case and Dr. Gross's desire to show off his winning gamble.

After her stay at Children's, Lorraine was moved to the Children's Convalescent Home in Wellesley, Massachusetts.[1] There she rested and played under the care of the nurses, and remembers receiving such treats as a daily glass of orange juice served in cold tin cups. It was during her stay that the famous hurricane of 1938 struck Boston. Lorraine recalled: "It was quite a hurricane. All the nurses were all running around closing up windows and doors. Their little white hats were blowing off and all. I was in the crib and seeing all of this was like in a movie, not knowing the seriousness of it being a hurricane." As the winds grew more and more fierce, she remembers that her only thought was of the sandcastle she had made outside that afternoon – it would be blown over.

Dr. Gross came to visit her during her stay, and then about 10 days later she went home to lead a normal life, eventually having 2 children and 3 grandchildren.[1] In fact, one granddaughter went on to become a Child Life Specialist in a Boston hospital – trained to help children adjust well to their time in the hospital.[1]

Some felt that Dr. Ladd never forgave Dr. Gross.[16] They both stayed at Boston Children's Hospital for the remainder of their careers, which extended for decades and included many more innovations in pediatric surgery. The men did come together to write one of the first major textbooks of pediatric surgery in 1941 - Abdominal Surgery of Infancy and Childhood – which essentially catalogued Ladd's extensive work in understanding congenital malformations of the abdomen.[5,10,13,16] The book further extended the already impressive reach of Ladd's teaching – surgeons around the country now had a guide if they "found themselves in front of a tiny patient."[5] Another founder of the field, Dr. Willis Potts, largely responsible for establishing the

specialty in Chicago, remembers reading this textbook over and over when he was stationed in the South Pacific with the Medical Corps in WWII.[5]

Dr. Gross was named Surgeon-in-Chief at Children's Hospital in 1947, two years after Dr. Ladd retired.[10,16] His professorship was, in fact, the William E. Ladd Chair in Surgery at Harvard.[10,16] He went on to develop a number of other techniques for repairing congenital anomalies of the great vessels, helping usher in the era of cardiovascular surgery.[10,16] He was among the first to develop a technique to repair coarctation of the aorta, which he was called upon to perform for the son of King Leopold III of Belgium.[2,16] Though coarctation is uncommon, his technique became a model for early repairs of aortic aneurysm.[13] He developed a technique to create cadaveric aortic grafts, freeze-dried and sterilized for use in the repair – a foundational step in the field of vascular surgery.[5,10,17] He continued to perform PDA repairs throughout his career, but after Lorraine's surgery he was required to alter his technique fundamentally. He wrote in 1987, "Eleven children were operated upon satisfactorily for ductus closure by ligation. The twelfth was a fourteen-year-old girl also treated by ligation. She was well at the time of hospital discharge. Two weeks after that, there was a party for her at her home. While dancing with friends, she suddenly collapsed on the floor and was instantly dead! The family permitted an autopsy examination, which showed that the ductus ligature had cut through, permitting massive hemorrhage. I never again ligated a ductus." The defect was thereafter transected and each end was sutured shut.[13]

Gross continued to be a lifelong tinkerer and inventor. His students remember that he was always fixing an overhead light or a squeaking door.[14] His motto in everything was to keep it simple, and he hung a sign in his operating room which read, "If an Operation is Difficult You Are Not Doing It Properly". His laboratory in the Children's Hospital included a machine shop and a full-time mechanic, and there he became occupied with working out his own version of the pump oxygenators that were ushering in an era of open-heart surgery in the 1950s.[14] Gross would perform consecutive open-heart surgeries on children with similar blood types so that the second child could be hooked up to his machine without emptying it.[4,13]

He is invariably remembered as a meticulous man, as much in appearance and behavior as in the operating room. He was typically seen wearing a bow tie and a starched white coat. Those who remember him always remark on his immaculate appearance and his expectation that those around him attain the same personal standards.[10] "What a figure Gross cut," Miller wrote in his

book on surgery at Children's, "with his red bow tie and starched white lab coat and spit-polished shoes and perfectly slicked hair. How he spoke – eloquent, educated, totally in command of his audience. This bunch of Harvardians. A true giant in their midst."[16] Gross was short and compact of stature, fiercely energetic but rarely losing his temper.[4] He is also remembered as caring towards his students and beloved by his patients, who might find him making an evening house-call.[14] The rewards of a field that intervenes so early in life can be particularly moving. Gross remembers a baby girl that he had operated on as an infant, who at the age of 17 decided to come by the hospital for a visit before she left for college. Astonished and moved by seeing her grown-up, he wrote, "This all made me thank the Lord for what could be accomplished by surgery."[13]

Gross seems also to have been a deeply shy and reserved man, avoiding to the point of embarrassment any attention or praise.[14,17] He refused any publicity when, in 1963, the premature infant of John F. Kennedy was referred to his care in the hyperbaric chamber used for some of his cardiac procedures.[14] Some accounts of his fastidiousness were darker. For some his shyness was pride and aloofness, and his strictness and rigidity represented a man who struggled to stay in control in a field where the stakes were high and the threats of competitors, were they perceived as such, were constant. Later in his career he was said to sometimes disappear, even for weeks, when a child died on his operating table.[10,16]

The legacy of Drs. Ladd and Gross was enormous. The first generation of pediatric surgeons came largely from their tutelage, and as one student recalls, "There is a long golden cord that stretches from Ladd to the present, binding all of us together, as in no other surgical speciality."[4] One student wrote in 1989 that at hospitals across the country one could find surgeons imitating not only Gross's operative style but his immaculate starched white coat and hushed operating room.[14] These physicians were of course all men, with one exception. Dr. Benjy Brooks of Houston "was accepted into the residency by Dr. Gross, sight unseen, on the assumption that the name Benjy was masculine; it was not and she was not," recalled another surgeon who trained under Gross. "To his credit, Dr. Gross accepted his own confusion, and finished Benjy in her two year assignment as senior surgical resident."[4] Gross continued to work until 1972 performing his last and 1,610th PDA ligation in March of that year.[13-14,17]

Dr. Gross also experienced what Dr. Ladd must have felt when his chance to be part of a historical innovation slipped away. Dr. Helen Taussig came to Boston from Johns Hopkins

Hospital to talk to Dr. Gross about a peculiar idea she had: to actually create a new ductus for "blue babies", children with heart defects such as Tetralogy of Fallot where not *enough* blood flows to the lungs for oxygenation.[14,17] He told her, "I get rid of ductuses; I don't make them."[1] She returned to Johns Hopkins, where Dr. Alfred Blalock and his remarkable teaching assistant Vivien Thomas performed this landmark procedure in 1944 to great fame.[1,14]

Years later, towards the end of his career, Dr. Gross revealed that he had from childhood been partially blind in one eye. He had been born with a cataract.[16] His entire career, spent developing surgeries on the smallest of people, was done with only partial vision and impaired depth perception. This may have been why his father encouraged him to learn to disassemble and assemble watches, starting with larger and working towards smaller and smaller ones. If you watched him in the operating room you might see him move his hand just a little bit, creating a sort of artificial depth perception.[1] No one knew until a fellow surgeon was diagnosed with melanoma in one eye which required surgical removal. Dr. Gross contacted him to say that he need not quit on account of that.

Lorraine Sweeney was reunited with Dr. Gross in 1950 when she was expecting her first child. Her doctor wanted to contact him to be sure that there were no potential complications for Lorraine as she entered pregnancy. Dr. Gross assured him that it was quite alright – Lorraine's heart was as healthy as any other patient's. He and Lorraine remained in touch for the rest of his life, and he always called her "My Lorraine".[1] She would sometimes send him a valentine on St. Valentine's day, signing it "your wee-heart girl". At his funeral she read an Irish blessing.[1]

Before Dr. Gross died, Lorraine went once to visit him at the farm in Vermont where he had retired.[17] As they spoke he recalled her mother, the young woman from County Mayo who came to him as a newly widowed mother of 8, and told Lorraine, "I loved your mother – she gave me my chance." Lorraine asked him what he would have done if her surgery had not been successful. Knowing what that would have meant for his career after he had gone against Dr. Ladd's wishes, Gross laughed and said, "Lorraine, you know, if you didn't survive, I'd have ended up as a chicken farmer in Vermont!" "Well Doctor," she replied, "thank God I come from good Irish stock!"

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